

INVESTIGATING ECONOMIC GROWTH,
TRADE ISSUES AND ENERGY STRATEGIES
FOR CENTRAL ASIAN COUNTRIES

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Abstract

Central Asian economies enjoyed impressive economic growth after the long recession following the dissolution of the Soviet Union in 1991. This study examines the economic and energy development policies and strategies of these countries from various perspectives. We use statistical data analysis techniques and mathematical modelling methodologies focusing upon regression modeling analysis in order to deal with the economic and energy related data during the period 1990-2014, investigating the relationships among economic growth, energy production, and the trade of energy resources. Findings show that energy production growth had a statistically significant positive impact on GDP growth in fossil-fuel rich Kazakhstan, Uzbekistan, and Turkmenistan while the study also established negative impact of GDP growth on the trade balance of Central Asian countries, except for Turkmenistan. Another findings follow that foreign direct investment had a significant influence on balance of trade in the cases of Uzbekistan and Turkmenistan, which instituted import substitution policies right from their initial years of independence. Quantitative measurement of oil and natural gas prices' impact on trade demonstrated that in most countries, except Turkmenistan, oil price increase brings rather negative impacts on the trade balance, while natural gas price increase brings positive impacts in all countries except Turkmenistan. Based on these quantitative investigation on economy, energy, and trades we propose future energy strategies for Central Asian countries targeting for 2030, stressing the importance of diversification of economies.

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Chapter 1. Introduction

1.1 Central Asia in Brief

Central Asia (CA), located in the heart of the Eurasian continent, consists of five landlocked countries: Kazakhstan (KAZ), Uzbekistan (UZB), Turkmenistan (TUR), Kyrgyz Republic (KYR) and Tajikistan (TAJ), and has borders with Europe, Russia, China, Pakistan, Afghanistan, and the Middle East. The region has an area of about 4 million square kilometers, comparable in size to the European Union (Figure 1.1). Sixty-nine percent of CA territory belongs to KAZ, while the remaining thirty-one percent is divided unequally among the other four countries, with the smallest parts belonging to KYR and TAJ. Since the region is located in the heart of Eurasia, connecting the four main parts of this continent (Europe, Asia, the Middle East and Russia), it has been of geopolitical interest to major powers for many centuries. Moreover, in the last two decades CA has emerged on the world map as a region rich in natural resources, notably fossil fuels. Massive foreign investment in the energy sector of these countries has enabled extensive exploration and development of oil and natural gas fields; this substantially increased the region's proven hydrocarbon reserves and as a result the region became more attractive to the fuel hungry regions of the world.

The dissolution of the Soviet Union in 1991 and the ensuing disruption of networks caused deep recessions with sharp declines in all sectors, including the energy sector. The disintegration of the Soviet Union forced these new countries to face realities and challenges of domestic and foreign issues independently and to build their own strategies for overcoming those challenges. KAZ and KYR introduced open market economies—with large-scale

privatization of previously state-owned enterprises and properties—and immediate trade liberalization, which gave rise to shock, confusion, and chaos during the initial stages of development, while UZB and TUR avoided drastic changes, by opting for gradual change towards a market economy with a strong state presence (Agzamov et al.(1995), (Pomfret(2010, 2012))). The second decade of development of the Central Asian countries (CAC) was largely dependent on two factors: external (exogenous) and internal (endogenous). The lack of access to potential markets and alternative transportation networks and international commodity prices impacted these economies externally, while specialization of respective economies, endowment of natural and human resources, and domestic policies had internal influence. Both internal and external factors played significant roles in determining the course, performance, and success of each country in the following years.

A country's geographic location is of great importance to the development of that country's economy. In most cases, depending on its location, each country is blessed with natural resources. The CAC have different natural settings and different endowments of natural resources. The northern CAC—KAZ, UZB and TUR—are located mostly in vast steppe and deserts and are enormously rich in natural resources. Their local economies depend on extensive exports of minerals and energy resources, which enable them to some degree of capability to respond to economic crises and recessions in the world market. On the other hand, KYR and TAJ are located in predominantly mountainous areas, and as a result possess limited natural resources.



Figure 1.1: Political map of the CAC.

Data source: University of Texas Libraries: <http://www.lib.utexas.edu/maps/asia.html>

Population, including its size and growth, also plays a key role in a country's economic development. The population of CA is one-eighth that of the European Union and is unequally distributed over the region (Figure 1.2). The main concentration, of 68.6 million, resides in two countries: KAZ and UZB, 17.5 million and 31.3 million, respectively, with the remaining 19.8 million distributed in TUR, KYR, and TAJ. KAZ has had the highest urbanization rate in the region since the end of Soviet era, due to its extensive industrialization during the soviet period. The population of the other three countries is a small portion of the total: approximately five million people in each of TUR and KYR, and more than eight million in TAJ, which has the highest population growth rate in the region, 2.2% annually.

Despite the fact that KAZ's territory is the largest, its population accounts for only 25.6% of the regional total. The CA region had a population of only 51 million when it separated from the USSR. At that time, the largest populations belonged to KAZ and UZB, with a slight variance in the size of their populations (16.4 million and 20.9 million). Today the difference between them has stretched significantly with a drastic change in the UZB population, which reached more than 32 million in 2017 and is forecasted to grow during next several decades. These figures indicate that there has been an increase of 11 million in UZB's population in the last 25 years.

The next significant change in population size occurred in TAJ, which has an average growth rate of population of 2.2% annually. Its population, as of 2014, was more than 8 million or 12.4% of the total regional population. KYR and TUR have equivalent populations, which are equivalent to 16.5% of the regional population if taken together (Figure 1.2).

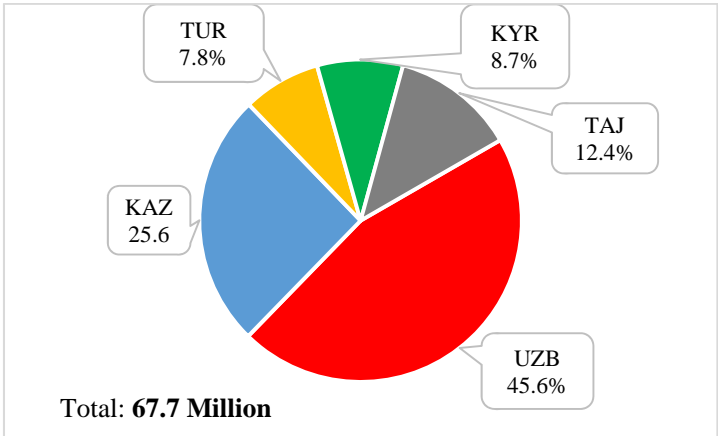


Figure 1.2: Distribution of population in CAC.

Data source: World Development Indicators, The World Bank

<https://data.worldbank.org/data-catalog/world-development-indicators>

As a distinct region, CA comprises five states with a shared history and similarities in culture, tradition, customs, and language. The region has had different names in different periods such as Turkestan, Mawarannahr, Baqtria, and Transoxiana. It was home to nomads and sedentary cultures. In the second half of the 19th century, the region was occupied by the Russian Empire, which was overturned by the soviet socialist movement. After the soviet socialists came to power, they divided the region into five republics, controlled by Moscow using the “divide and rule” strategy (Spechler(2000)). Although the region was separated, it was considered by soviet communists as a single unit, and a shared regional infrastructure was developed to connect the region and other parts of the USSR. The region was a single economic subdivision within the “unified economic complex of the USSR” (Spechler(2000)). After the dissolution of the USSR in 1991 these five CAC emerged as successors to the Soviet Socialistic Republics of USSR. The lack of an accord or mutual understanding among the newly declared independent states, along with local ambitions, rendered important key infrastructure useless, making transition process even harder, complicated, and arduous for the CAC.

Since becoming independent, the CAC economies have experienced significant economic transformation from agriculture-based economies towards industrialized economies. During their first decade of independence, all five countries struggled with transitional recession, which had a dissimilar impact on each economy, depending on the local policy. The least affected by the transitional shock was UZB, thanks to its gradual transition policy, while KAZ and KYR suffered drastic declines in GDP due to their policy

of rapid change. However, a sharp increase in the world commodity prices (particularly the price of energy fuels and minerals) from the 2000's onward significantly benefited all economies of the region, particularly those well-endowed with energy resources, KAZ and TUR. That economic upsurge lasted more than 15 years, with a more than sevenfold GDP increase in KAZ and TUR. However, a number of world financial crises, followed by a sharp drop in commodity prices, particularly for oil and gas, disrupted the stable growth of these young and still weak economies.

1.2 Research Problems and Objectives

Over the last century the world economy has experienced unprecedented growth. Among many other factors, energy has been considered one of the main drivers of this growth. To investigate the linkage between energy and economic growth, existing empirical studies have explored three sets of relationships: a) the abundance of energy resources and its impact on economic growth (Antonakakis et al.(2017), Auty(1993, 1999, 2001, 2007), Barry(2009), Franke et al(2009), Sachs & Warner(2001)); b) the relationship between energy consumption and economic growth (Ahmed & Azam(2016), Apergis & Payne(2009, 2010a, 2010b), Asafu-Adjaye(2000), Bildirici & Kayıkçı(2012), Chiou-Wei et al.(2008), Chontanawat et al.(2008), Chuanhe et al.(2015), Dogan(2014), Ebohon(1996), Eggoh et al.(2011), Lee(2005), Mudarrisov & Lee(2014), Sentürk & Sataf(2015), Sharma(2010), Soares et al.(2014), Soytas & Sari(2003), Tsani(2010), Tugcu et al.(2012), Yuan et al.(2008), Yu & Hwang(1984)); and c) the relationship between energy production and economic growth (Wada(2017), Klueh et

al.(2009), Liu(2013), Umit(2015), Lee & Chang(2008), Ahmad & Du(2017), Ozkan et al.(2012), Reynolds & Kolodziej(2008), Peach & Starbuck(2011)).

The first group of studies examined the theory of energy (natural) resource curse or paradox of plenty in resource rich countries, and has argued that economies with abundant natural resources perform relatively poorly and, therefore, resource abundance has a negative effect on economic growth. The second group of studies examined the relationship between energy consumption and economic growth. The empirical focus of these studies is concentrated on whether economic growth boosts energy consumption or whether energy consumption takes precedence over economic growth (Tsani(2010)). This relationship is well studied for many regions by many scholars, including for the CAC. The third group of studies examined the relationship between energy production and economic growth for specific countries and examined energy production as the main driver of economic growth.

The findings of all of the above studies are mixed, with different results for different countries. Every country and region has unique conditions, so it is impossible to generalize results to other countries. Unfortunately, until now no research examined the impact of energy production on economic growth in energy rich CA, aside from studies focusing on energy consumption and resource abundance. CA is a new and little studied region, which is rich in hydrocarbon resources. The CAC do not have much experience managing their own resources, because they were in the Soviet Union. A large amount of fossil fuel reserves have been discovered in the region recently, which attracted massive foreign investment. Energy resource exporting started to play an important role in the economies of the CAC, leaving

them vulnerable to external and unpredictable risks, such as volatilities of commodities prices in international markets. In such a situation, the region needs extensive policy and strategy formation on energy resource management, which has not been explored in the literature at this time. This kind of policy and strategy work requires fundamental, extensive, and detailed information, which is also not well presented in the current literature. A better understanding of the impact of energy production on an economy can help government analysts and policymakers to formulate comprehensive policies for the sustainable growth of their economies. Therefore, for the policy and development strategy work in the region, studies focusing on energy and economic growth are indispensable.

This study aims at investigating the relationship between energy production and economic growth in five CAC, and examining the current role of energy in boosting trade there. By doing so, this dissertation presents the fundamental information needed in a complex and detailed way.

Foremost, we investigate the relationship between energy production and economic growth by using a mathematical model to understand the correlation of energy production and GDP in the CAC. We use two periods of growth in the CAC economies: “before” and “after” the Lehman shock year 2008, as “1998-2009” and “2009 -2014”.

Next, we investigate the impact of energy production on trade using data on Gross Domestic Product (*GDP*), energy production (*EPR*), foreign direct investment (*FDI*), oil price (*OLP*), and natural gas price (*NGP*) as independent variables, and trade balance (*E-I*), export potential (*E*), trade (*E+I*) data as the main dependent variables. In this study we cover

the time period of 23 years starting from 1992 (following the collapse of the Former Soviet Union (FSU)) up to 2014.

We forecast for the year 2030 based on the findings of our regression models, current hydrocarbon reserves and hydro energy potential of the CAC, including forecasts of international institutions, and present future policy recommendations.

This dissertation is organized as follows: Chapter 1 provides brief overview of the geography, people, and history of CA, and presents the main similarities and differences among the CAC. Chapter 2 presents the past and current economic situation in the CAC, including aspects of energy production. This chapter also examines the relationship between energy production and economic growth in the CAC. An econometric model is used to estimate the impact of the CAC's energy production on the economic growth of these countries and to evaluate the degree of the CAC's dependency on energy resources. Chapter 3 reports the analysis of energy production's impact on trade in the CAC. A mathematical model is used to estimate this impact, using five independent variables: Gross Domestic Product (*GDP*), energy production (*EPR*), Foreign Direct Investment (*FDI*), oil price (*OLP*) and natural gas price (*NGP*). Chapter 4 investigates the current energy and trade policies of the CAC in light of future targets set by the CAC governments. Chapter 5 discusses the empirical results of mathematical modeling described in Chapters 2 and 3, focusing on future strategies for the CAC. The last Chapter draws conclusions and policy recommendations.

Chapter 2. Economic Growth and Energy Situation in the CAC

2.1 Historical Trends of GDP and GDP per Capita

The size of the CA region's economy is quite small and accounts for only 0.41 % of the world economy (World Bank(2016). KAZ's share in the regional economy is the largest among the CAC with 60.9 % of the regional total and its GDP is 184.3 billion USD (in current 2015 prices), which experienced a seven fold increase in the last 15 years. While there are many reasons behind this strong growth, the key factor is the country's vast endowment of fossil fuels: its energy production growth and energy export expansion, coupled with a significant increase in price for energy fuels in the world market. Introduction of favorable investment policy by KAZ government in the late 1990s resulted in an extensive inflow of foreign direct investment in the gas and energy sectors of its economy with further increases in production volumes. UZB is the second largest economy in the CA region with a GDP over 66.7 billion USD (in current 2015 prices). The UZB economy consumes an large proportion of the energy resources produced due to inefficiency in its energy usage and outdated energy infrastructure. Due to its state-led and gradualism approaches, UZB failed to attract extensive foreign direct investment, which resulted in linear but stable increases in the size of its GDP over the years. TUR followed its counterpart KAZ in modernizing its energy sector through extensive direct foreign investment and expanding its energy export markets through building alternative export routes. The energy price upsurge in addition to this policy enabled an 11 fold increase in its GDP over a 20-year period. KYR's and TAJ's GDP sizes are very small and have experienced very minor changes over the last 25 years.

Table 2.1 shows GDP and GDP per capita (GDPC) in years 1998 and 2015 and average annual increase of GDP per capita (GDPCG) during the period from 1998 to 2015. From Table 2.1, we find that these five CAC are divided into 2 groups: “Group I” consisting of KAZ, UZB, and TUR, which show much larger GDP values, and “Group II,” corresponding to KYR and TAJ, which show smaller GDP values. We see that Group I countries have more than 4 times larger GDPs compared with Group II countries. Regarding the GDPCG corresponding to the unit increase of GDP, we find that TUR shows the largest average annual increase of 182.99 US\$ corresponding to 1 million US\$ increase for GDP. TUR’s average annual increase is more than 6 times larger than UZB with the smallest one being 29.16. KAZ, with the largest GDP among the CAC, shows average annual increase 55.72, one third of TUR—the country with the largest average growth. We also find that Group II countries, with much smaller GDP compared with the others, shows rather large average annual increases such as 153.90 and 108.12 US\$ for KYR and TAJ, respectively.

Table 2.1: GDP, GDP per Capita and Average Growth of GDP per Capita

Country	GDP		GDPC		GDPCG
	1998	2015	1998	2015	1998-2015
KAZ	22,135.2	184,360.6	1,468.7	10,508.4	55.72
UZB	14,988.9	66,732.8	623.2	2,132.0	29.16
TUR	2,605.6	37,334.2	592.8	6,947.8	183.0
KYR	1,645.9	6,571.8	345.1	1,103.2	153.9
TAJ	1,320.1	7,853.4	219.5	925.9	108.102

GDP: Gross domestic product (current Billion US\$); GDPC: GDP per capita (US\$); GDPCG: Average GDPC growth (US\$/Million US\$)

Data source: World Development Indicators, The World Bank (2016)

<https://data.worldbank.org/data-catalog/world-development-indicators>

Figures 2.1a and 2.1b show the trend of GDP and GDP per capita for the CAC during the period from 1993 to 2015.

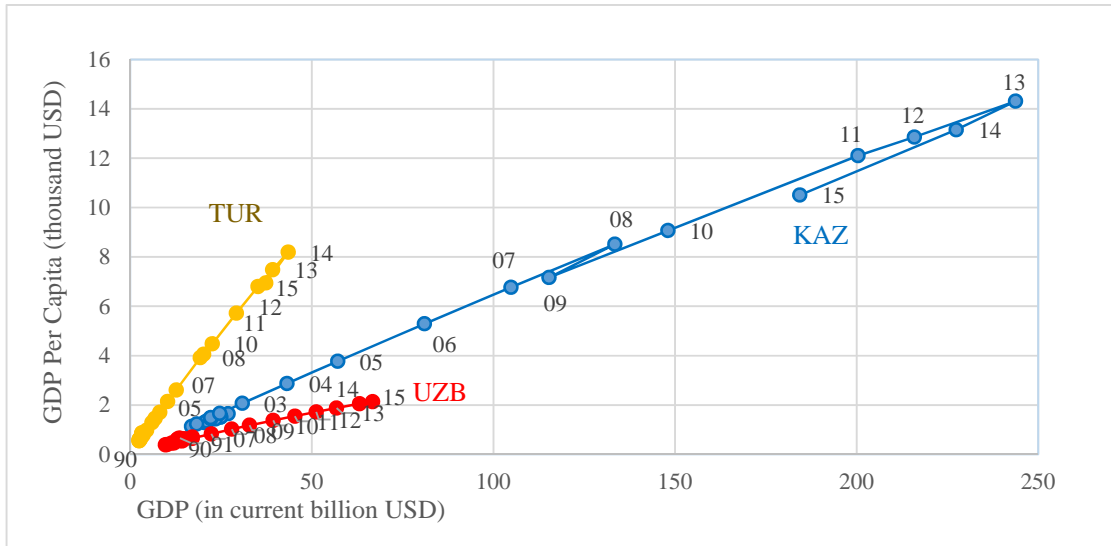


Figure 2.1a: GDP and GDP per capita for the Group I countries.

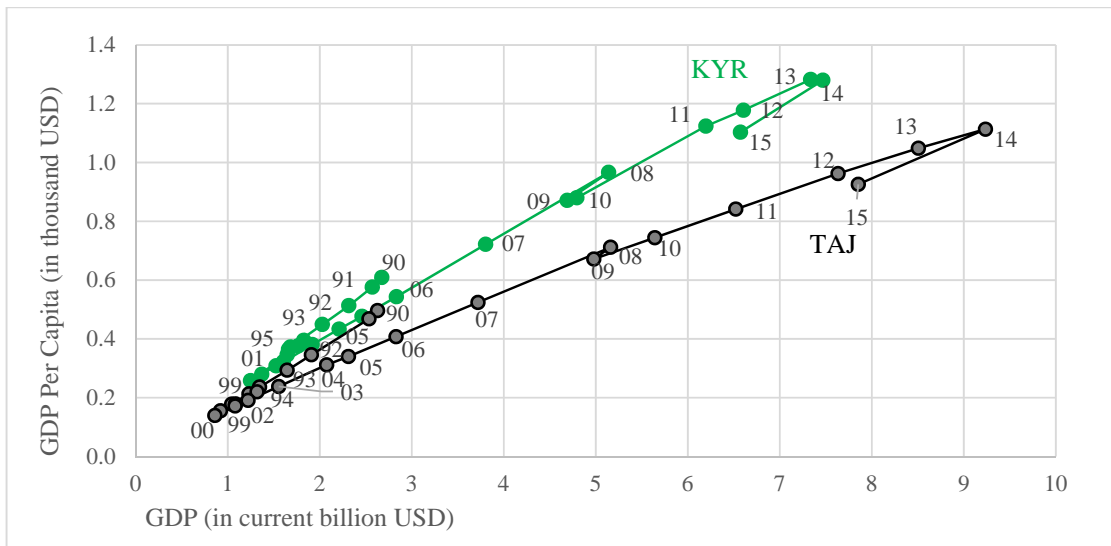


Figure 2.1b: GDP and GDP per capita for Group II countries.

Data source: World Development Indicators, The World Bank (2016)

<https://data.worldbank.org/data-catalog/world-development-indicators>

The sharp increase in GDP enabled significant increases in GDPC in both KAZ and TUR, moving these countries from the low-income category to the upper-middle income category. After years of foreign investment into hydrocarbon resource extraction development, an increasing export of oil and natural gas transformed both KAZ and TUR into fast-growing economies. KAZ became Central Asia's economic leader, with a gross domestic product greater than those of its four neighbors combined (ADB(2010)). The lack of population growth in KAZ and TUR enabled significant growth in GDPC indicators in these countries, while in UZB, a big rise in population (1.6% annual growth) prevented clear illustration of GDP growth.

2.2 Energy Production in the CAC

The CA region's share of World energy production is very small at only 2.2% (303.218 Ktoe out of 13.594.108 Ktoe), while CAC's share of the world economy is only 0.4%. These figures support the assumption that the CAC export significant amounts of energy to the world market. Figure 2.2 illustrates the large and growing discrepancy between energy production and consumption (TPES) volumes in the region, which supports claims of large energy exports in the region.

Both energy production and consumption declined during the recession. The turning point in energy production recovery was 1998, after seven years of decline. However, energy consumption did not reflect this growth. After 14 years of growth in the economy, the level

of energy consumption is almost at the same level (only 5.0% difference), while energy production level increased 46.5%.

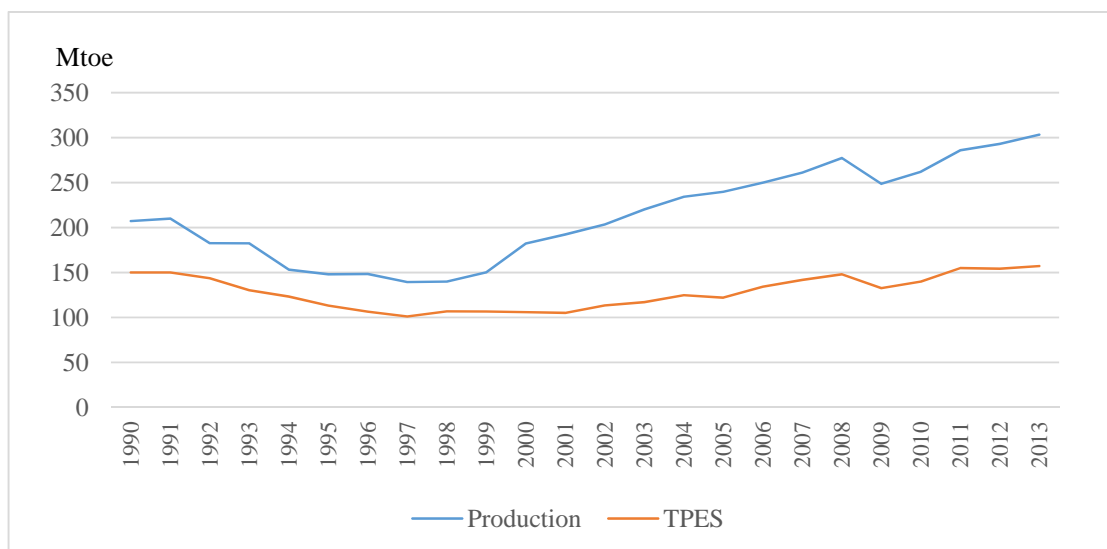


Figure 2.2: Total production and TPES in CA over 24 years (1990-2013).

Data source: The IEA, <https://www.iea.org/statistics/>

If the reason for significant decline in energy production and consumption in 1990s was a transition period, the growth was determined by an upsurge in energy resources' price in international markets and significant investment in the energy sphere. The new discoveries of oil and gas fields in the region, aided by the development of favorable legal frameworks for investors, attracted massive foreign investments in the energy industries of KAZ, TUR, and UZB. Despite the significant growth in energy production, we have observed negligible growth in domestic energy consumption, which could be explained by slow development in manufacturing and other industries of the region.

Figures 2.3 and 2.4 show the comparative trend of energy production and consumption of the CAC in 1990, 2000, and 2013. KAZ accounted for 43.9% and 43.1% of regional energy production in 1990 and 2000, respectively. After more than a decade of development in 2013 this share increased to 55.8%, which shows a large increase in KAZ's energy production in the region. KAZ's share of total energy consumption in the region dropped from 48.9% in 1990 to 33.7% in 2000 and could recover again after a decade in 2013 to 51.9%. UZB's share in the regional energy production and consumption followed a declining trend from 30.2% and 48.0% in 2000 to 17.9% and 27.3%, respectively, in 2013. TUR's energy production has also declined from 35.2% in 1990 to 25.2% in 2013, but its energy consumption share increased from 11.7% in 1990 to 16.7% in 2013. These fluctuations in regional energy production and consumption shares are mostly due to large increases in KAZ's share in both energy production and consumption.

Further, Figures 2.5 and 2.6 demonstrate the share of countries in production of coal and crude oil. In coal production KAZ holds the dominating position with a 96.0% share in the region. KAZ's share also prevails in crude oil production with a 84.2% share of regional total. UZB's share in coal and crude oil is minor. TUR holds 12.5% share in regional crude oil production; however, it does not have reserves and production of coal. KYR has significant reserves of coal (31.0 billion tons), though it does not produce significant volume of coal due to its weak production infrastructure. It imports cheaper coal from KAZ instead of developing its own coal extracting. Crude oil production in UZB had a sharp upsurge in 1993 after discovering and developing several oilfields, which significantly improved UZB's self-

sufficiency on oil products, decreasing its dependence on oil imports as a result (Figure 2.7). However this oil self-sufficiency lasted only a decade, until 2004 when the sharp drop in crude oil production volume occurred due to depletion of oil reserves and insufficient investment of exploration and extraction.

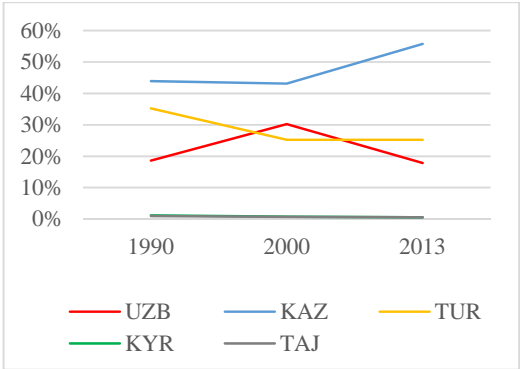


Figure 2.3: EPR in the CAC in 1990, 2000, 2013.

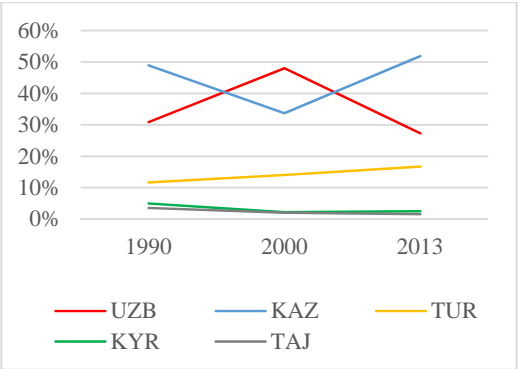


Figure 2.4: TPES in the CAC in 1990, 2000, 2013.

Data source: The IEA, <https://www.iea.org/statistics/>

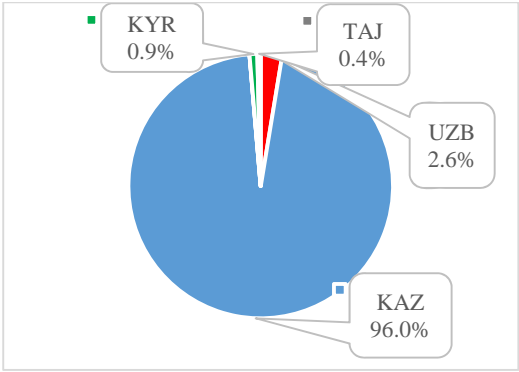


Figure 2.5: Coal production share among the CAC (2013).

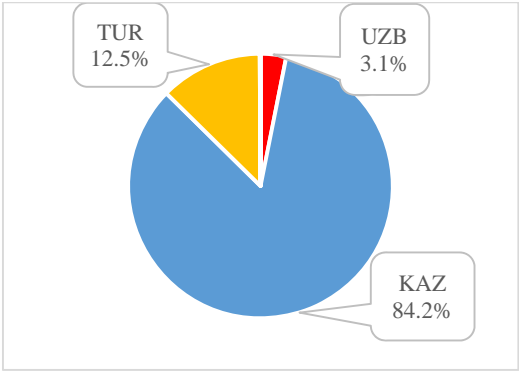


Figure 2.6: Crude oil production share among the CAC (2013).

Data source: The IEA, <https://www.iea.org/statistics/>

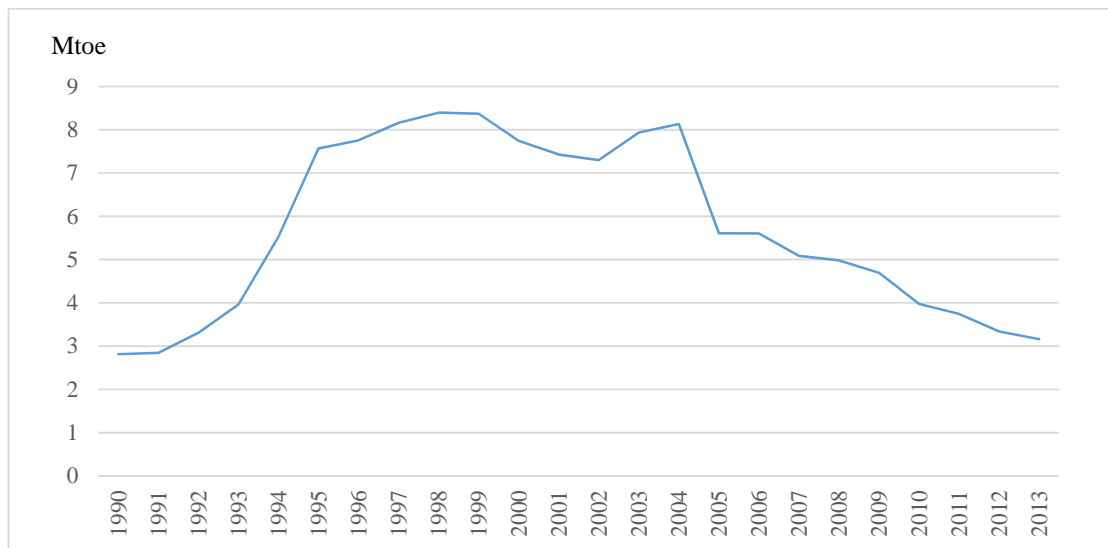


Figure 2.7: Crude oil production in UZB over 24 years.

Data source: The IEA, <https://www.iea.org/statistics/>

UZB and TUR dominate in natural gas production in the region, holding 33.9% and 44.6% of the regional total, respectively (Figure 2.8). TUR and UZB are the second and third largest natural gas producers in Eurasia, following Russia.

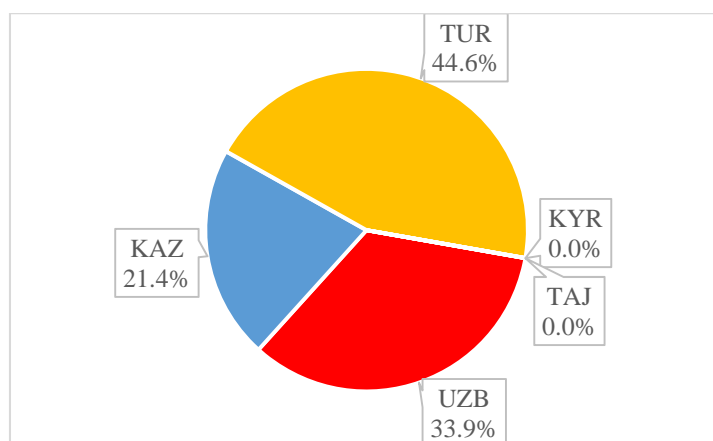


Figure 2.8: Natural gas production share among the CAC (2013).

Data source: The IEA, <https://www.iea.org/statistics/>

In the hydro energy production segment, KYR and TAJ hold the dominant positions with more than 60.0% of the regional total of hydro energy production (Figure 2.9). This is due to the geographic locations of these countries in upper streams of two main rivers of the region—Amudarya and Syrdarya. As noted earlier, these countries have a high potential for power supply and can supply the whole region with electricity, covering 90.0% of local demand. Hydro energy infrastructure in these countries were built during the Soviet Union era and most of them require rehabilitation, and this requires substantial investment. KAZ and UZB dominate in electric power production, holding 45.9% and 28.4% of the CA total, respectively (Figure 2.10). KAZ heavily relies on coal in electric power generation (82.5%), while UZB heavily relies on natural gas (88.2%). KYR and TAJ totally rely on their hydro power plants in generation of electric power.

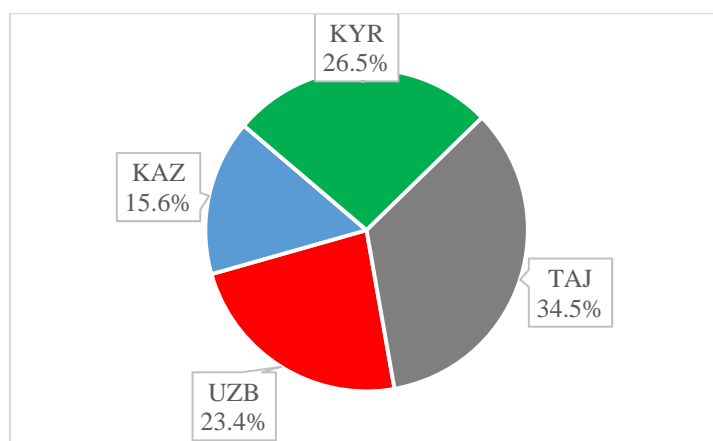


Figure 2.9: Hydro energy production share among the CAC (2013).

Data source: The IEA, <https://www.iea.org/statistics/>

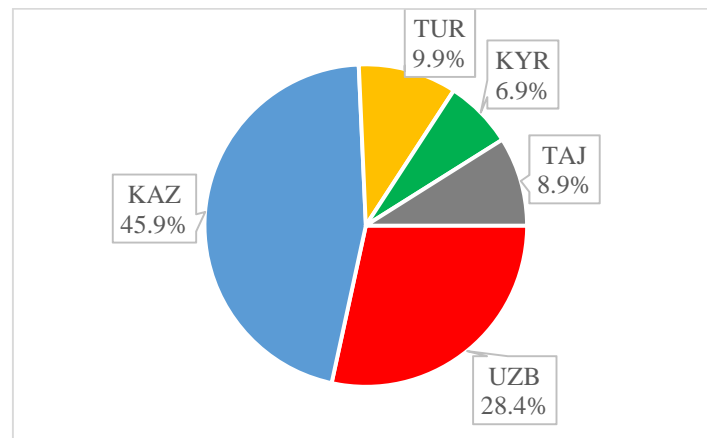


Figure 2.10: Electric Power production share among the CAC (2013).

Data source: The IEA <https://www.iea.org/statistics/>

Figures 2.11a and 2.11b show the relationship between GDP and energy production (EPR) in the period 1990-2013 for the Group I and II countries, respectively. From these figures, we find that all CAC have similar trends with respect to the relation between GDP and EPR such that both of these two components have a downward trend from 1990 until around 1995, then they change to an upward trend from around 1995 to 2013. First, from Figure 2.11a, we find that for major countries in Group I such as KAZ, UZB, and TUR the whole period from 1998 to 2014 can be divided into two periods: the first 1998-2008 and the second 2009-2014, corresponding to “before” and “after” the “Lehman shock” year 2008. Furthermore, these major countries show particularly and clearly the typical and remarkable difference before and after the economic crisis. We try to apply modeling techniques in order to measure the difference quantitatively. As seen in Figure 2.11b, Group II countries KYR and TAJ show very similar trends while they have much smaller values for both EPR and

GDP compared with Group I countries. In addition we find that for these two countries in Group II their trends for the relationship between EPR and GDP are almost linear for both periods before and after the economic crisis.

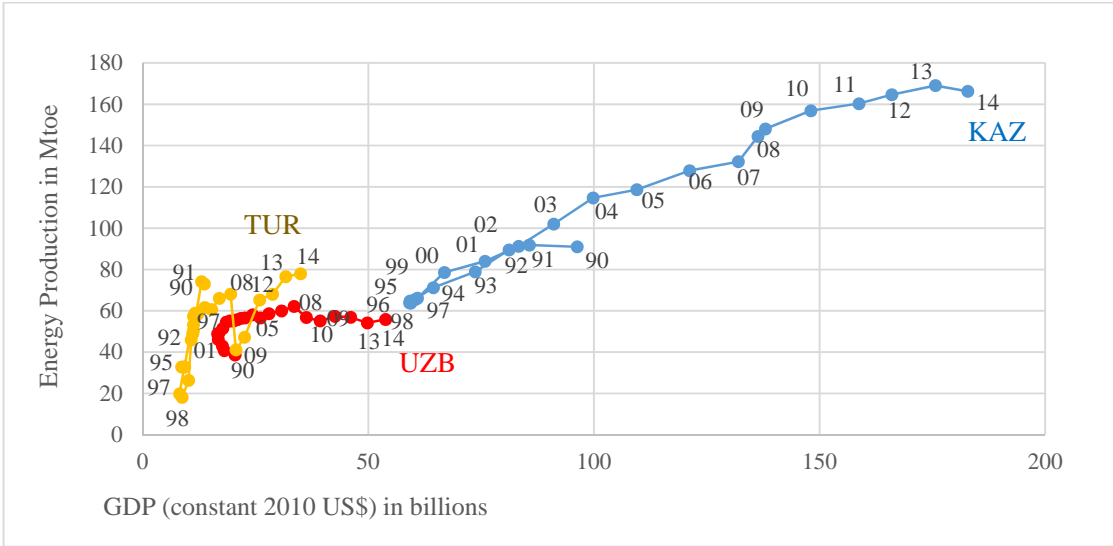


Figure 2.11a: GDP and EPR during 1990-2014 for the Group I countries.

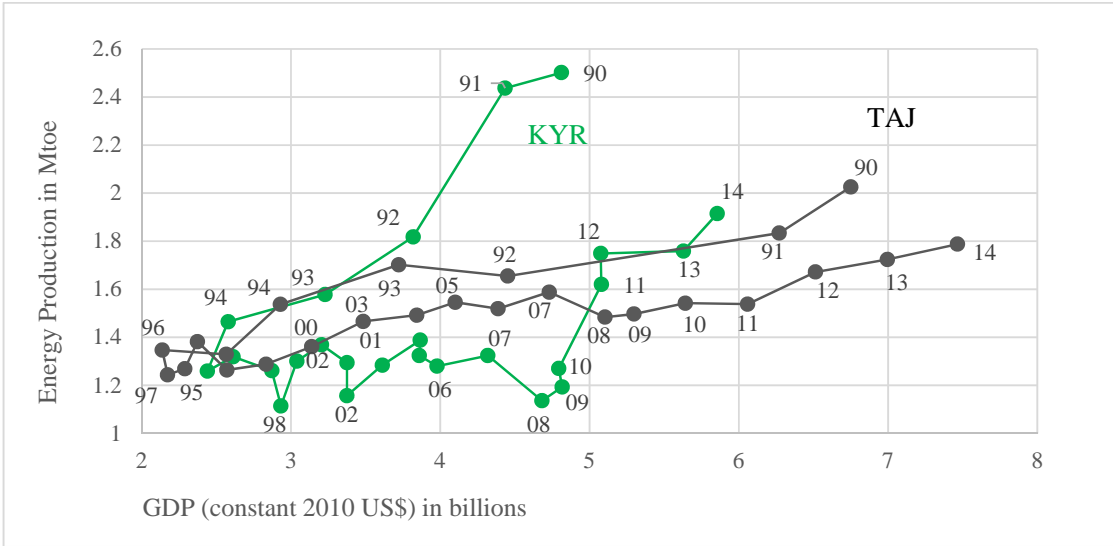


Figure 2.11b: GDP and EPR during 1990-2013 for the Group II countries.

Data source: The IEA, World Development Indicators, The World Bank (2016)

<https://www.iea.org/statistics/>

<https://data.worldbank.org/data-catalog/world-development-indicators>

2.3 Relationship between Economic Growth and Energy Production in the CAC

We try to investigate the upward trend quantitatively in more detail by applying the following mathematical model to these individual CAC.

$$y = a(x - x_0)^b + y_0 \quad (1)$$

where x and y indicate *GDP* and *EPR*, respectively, and x_0 and y_0 are initial values for *GDP* and *EPR*, respectively, in each corresponding period. a and b are parameters. The above model can be applied to the data with non-decreasing trend for both variables x and y .

Regression results for estimating parameters a and b , and coordinates x_0 and y_0 corresponding to the initial points are given in Tables 2.2a and 2.2b, in which Period I indicates the period starting from the corresponding year given by x_0 and y_0 in I up to the next corresponding year in Period II, while Period II indicates the period starting from the corresponding year given by x_0 and y_0 in II up to the latest year 2014. As the above mathematical model can be applied to the cases such that the historical trend of both variables x and y is non-decreasing, we delete two cases of period II for UZB and period I for KYR among all combinations of CAC and time periods. Thus, numerical regression results are shown in Tables 3a and 3b. We find that all these results show very high goodness of fit for the above model with R^2 higher than 0.55 up to 0.97. We know that parameter b in (1) indicates the *GDP* elasticity with respect to the energy production *EPR*. Regarding the

estimates for parameter b for the major countries—KAZ, UZB, and TUR, we find that KAZ's estimate 0.993 is very close to 1 and the largest among these three countries. Thus it implies that in KAZ energy production (EPR) grows almost proportionally to the GDP growth, i.e., EPR grows almost 1% corresponding to the unit % growth of the GDP . UZB shows the smallest elasticity at 0.353 increase of EPR corresponding to the unit % growth of the GDP , while TUR shows intermediate elasticity at 0.598 before the economic crisis. After the economic crisis, we find that in two major countries, KAZ and UZB, estimates for the parameter b show a decrease compared with those for Period I before the economic crisis, while in TUR, estimates for the parameter b show an increase. Parameter estimate for b in KAZ shows a decrease from 0.993 to 0.463, while UZB also shows a decrease from positive 0.353 to negative -0.264. This is due to slowing down of energy resources production in both countries without significant impact on their GDP growth. If in KAZ this decrease was smaller, in UZB's case the decrease of energy production was observed on a gradual base for several years. Differently than both other countries in group I TUR shows an increase from 0.598 to 1.259 in the Period II, as the increase of energy production during the second period is higher than the first period as seen in Figure 2.11a. UZB and TUR have similarity in that their major energy production is natural gas, yet their elasticities show different trends between Period I and Period II, and this difference could be explained by the fact that UZB consumes almost all of its produced natural gas, while TUR enjoys revenues from exports of produced natural gas's sizable share. As we can see the trend of elasticity of TUR looks different from those of KAZ and UZB and this difference can be explained by strong growth

of natural gas production and export in the Period II as a result of Chinese investment into TUR's energy sector and newly built gas pipeline, which started export of TUR's gas to China.

KYR's parameter estimate for b shows a very large elasticity value 4.0 as it attains a rapid increase of energy production corresponding to the GDP increase while on the other hand TAJ shows a slow increase for the energy production during both period I and II.

Table 2.2a: Regressions Results for Group I Countries

Country	KAZ		UZB	TUR	
Period	I	II	I	I	II
x_0	59.28	137.98	18.52	8.75	20.68
y_0	64.80	148.05	54.54	18.11	41.11
$\log a$	0.0550	1.0539	0.6302	1.1856	0.0429
(t -value)	(0.6023)	(7.3410)	(17.9640)	(9.8293)	(0.1942)
(P -value)	(0.5636)	(0.0018)	(0.0000)	(0.0000)	(0.8554)
b	0.9933	0.4626	0.3533	0.5980	1.2589
(t -value)	(16.1874)	(6.4632)	(8.4688)	(3.1306)	(7.1884)
(P -value)	(0.0000)	(0.0029)	(0.0000)	(0.0140)	(0.0019)
R^2	0.9703	0.9126	0.8885	0.5505	0.9281

Table 2.2b: Regressions Results for Group II Countries

Country	KYR	TAJ	
Period	II	I	II
x_0	4.82	2.17	5.29
y_0	1.19	1.24	1.49
$\log a$	-1.8627	-0.8706	-0.0030
(t -value)	(-3.4211)	(-9.9199)	(-0.1104)
P -value	(0.0267)	(0.0000)	(0.9173)

<i>b</i>	4.0331	0.7574	0.3491
(<i>t</i> -value)	(2.6548)	(3.8693)	(7.6937)
(<i>P</i> -value)	(0.0566)	(0.0037)	(0.0015)
<i>R</i> ²	0.6379	0.6245	0.9367

Tables 2.3a and 2.3b show the situation of energy production and consumption by energy resource type in 2014 for five CAC. From Table 2.3a and 2.3b we see that in energy production, Group I major countries KAZ, UZB, and TUR depend upon one of the major fossil energy resources such as oil, natural gas, or coal, while other minor countries KYR and TAJ depend mostly on hydro power, as they are poor in hydrocarbon resources. Regarding the energy consumption for these CAC, we see that natural gas accounts for almost 60.0-70.0% of total energy consumed in UZB and TUR while KAZ depends on a variety of energy resources such as oil, coal, and electricity. We also find that Group II countries KYR and TAJ consume imported oil and coal and domestically produced electricity.

Table 2.3a: Energy Production in the CAC (2014)

Production					
	Total	Oil	NG	Coal	Hyd.
KAZ	166,284 (100)	84,346 (50.7)	32,264 (18.8)	49,940 (30.0)	711 (0.4)
UZB	55,845 (100)	2,975 (5.3)	50,271 (90.0)	1,577 (2.8)	1,017 (1.8)
TUR	77,976 (100)	12,797 (16.4)	65,179 (83.6)	0,00 (0.0)	0,00 (0.0)
KYR	1,915 (100)	82 (4.3)	27 (1.4)	659 (34.4)	1,144 (59.7)
TAJ	1,788 (100)	25 (1.4)	3 (0.2)	384 (21.5)	1,376 (77.0)

(): % for each country

Data source: The IEA, <https://www.iea.org/statistics/>

Table 2.3b: Energy Consumption in the CAC (2014)

Consumption						
	Total	Oil	NG	Coal	Elec.	Hyd.
KAZ	36,598 (100)	10,404 (29.0)	2,823 (8.0)	10,621 (29.0)	5,925 (16.0)	6,803 (19.0)
UZB	30,810 (100)	2,605 (8.0)	21,323 (69.0)	562 (2.0)	3,944 (13.0)	2,354 (8.0)
TUR	17,827 (100)	6,187 (35.0)	10,444 (59.0)	0,00 (0.0)	954 (5.0)	235 (1.0)
KYR	3,106 (100)	1,193 (38.0)	150 (5.0)	583 (19.0)	945 (30.0)	232 (7.0)
TAJ	2,533 (100)	875 (35.0)	188 (7.0)	390 (15.0)	1,055 (42.0)	25 (1.0)

(): % for each country

Data source: The IEA, <https://www.iea.org/statistics/>

Regarding the energy production given in Table 2.3a, we find that Group I countries consisting of KAZ, UZB, and TUR dominate almost 98.8% of the total, while they occupy almost 88.7% of the total *GDP* in 2015. Thus we know that among all the CAC, Group I countries dominate almost completely the energy resource production and consumption situation. As for energy production amongst Group I countries, KAZ's share is the largest at 54.7% of the total, while UZB and TUR show 18.4% and 25.7%, respectively. KAZ's energy production by fossil energy resources demonstrates oil as the largest (50.7%), then coal (30.0%) and natural gas (18.8%), while UZB and TUR depend upon only natural gas at 90.0% and 83.6%, respectively. This implies that energy resources in KAZ are the most diversified with three types of fossil energies: oil, natural gas, and coal.

The current situation of the energy consumption in the CAC in Table 2.3b shows that KAZ's share is the largest (40.3%), while UZB and TUR have 33.9% and 19.6% shares,

respectively. We see KAZ's share is larger for energy production than consumption. We find that the share of production is larger than the share of consumption in KAZ and TUR, while UZB's case is the opposite. This means that KAZ and TUR are countries with energy production dominance, while UZB is, on the other hand, a country with energy consumption dominance. This can be identified by comparing production/consumption ratio, which in KAZ and TUR are 4.54 and 4.37, respectively, much larger than UZB at 1.81. Looking at the structure of energy consumption in Group I countries, we determine that KAZ, which has a diversified structure, shows a small share (8.0%) for natural gas. This implies that KAZ intends to produce and export natural gas strategically rather than consuming it domestically.

Chapter 3. Trade Issues of Energy Resources in the CAC

3.1 The CAC's Energy Trade

The CAC are located in the heart of the Eurasian continent, which is considered as a great advantage in geopolitical matters. However, from an economic perspective, this advantage turns to a disadvantage because this location distances the CAC from main consumer markets in Europe and Asia due to the lack of direct transportation routes. Further, the lack of access to the sea significantly hampers these CAC from utilizing the opportunities of promoting trade with world markets on a full scale. The only available route leading to European markets through Russia restricts opportunities for the CAC to develop their trade relations with the main consumer markets, due to Russia's price dictation and using this lever as an instrument of political influence. However, countries with extensive export potential such as KAZ and TUR could build alternative routes for the export of their main export items—oil and gas. In 2009, the gas pipeline connecting TUR and China, through KAZ and UZB, was constructed and put into operation successfully, which significantly increased export potential of all three CAC. The oil pipeline, which was built between KAZ and China in 2009, made possible export of KAZ oil to alternative destination with alternative route (Movkebaeva(2013)). TUR built gas pipeline to Iran, enabling alternative route to its gas export (Atai & Azizi(2012), Roy(2011)). These new pipelines transformed the CAC, making them less dependent on Russian pipelines, and increasing their revenues. Consequently, Russia lost its position as the main trading partner of CAC in 2014, plunging to a lower level

in the list of top 5 partners of the CAC. Figure 3.1 shows the exporting destinations of the CAC in 2014.

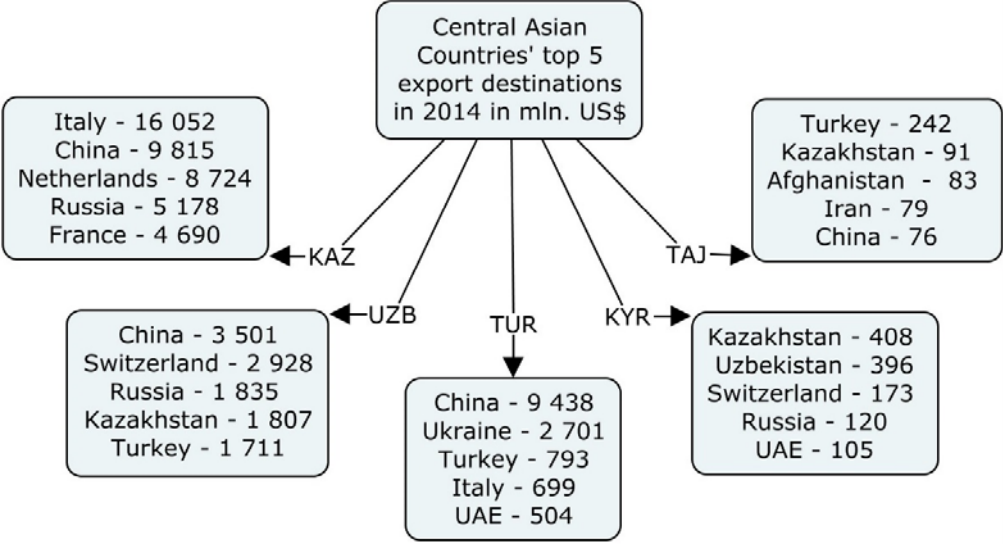


Figure 3.1: Exporting destinations of the CAC.

Data source: International Trade Center

<http://www.intracen.org/> (report for KAZ, UZB, TUR, KYR, and TAJ)

Table 3.1 shows *GDP*, export (*EXP*), energy production (*EPR*) and total primary energy supply (*TPES*) for the CAC in 2014. From Table 3.1 we find that countries KAZ, UZB and TUR corresponding to Group I in the CAC dominate in all categories such as *GDP*, *EXP*, *EPR* and *TPES* compared with other Group II countries: KYR and TAJ. As of 2014, KAZ holds the largest share in the regional production and consumption of energy resources with 55.8% and 51.9%, respectively. KAZ consumes half of its *EPR*, which indicates that export volume of energy resources in this country is large. Correspondingly, KAZ's *GDP* demonstrates the highest share (68.6%) in the region, which is 33 times larger than KYR's

or TAJ's *GDP*. Regarding *EPR*, the second largest share (25.2%) in the region belongs to TUR. The volume of *EPR* in TUR is threefold larger than its energy consumption, which implies that two thirds of TUR's energy is exported to external markets. However, its *GDP* share (11.0%) and TPES share (16.7%) in regional comparison are smaller than those of UZB (16.0% and 27.3%, respectively). UZB has different sketch than its counterparts with the minor variance in its energy production and consumption, due to gradual depletion of its reserves, weak production and growing domestic demand on energy resources. KYR and TAJ have very small and insignificant shares in all three segments of comparison.

Table 3.1: GDP, Export, Energy production and TPES of the CAC in 2013

Country	GDP	EXP	EPR	TPES
KAZ	243.77 (68.6)	90.72(71.1)	169.07 (55.8)	81.54 (51.9)
UZB	56.79 (16.0)	15.35(12.0)	54.12 (17.9)	42.93 (27.3)
TUR	39.19 (11.0)	16.80(13.2)*	76.53 (25.2)	26.26 (16.7)
KYR	7.33 (2.1)	3.10(2.4)	1.75 (0.6)	3.94 (2.5)
TAJ	8.50 (2.4)	1.63(1.3)	1.72 (0.6)	2.45 (1.6)
Total	355.61(100)	127.60(100)	303.21 (100)	157.13 (100)

GDP: Gross Domestic Product (constant 2005 Billion US\$); *EXP*: Export (current Billion US\$); *EPR*: Energy Production (Million Tons of Oil Equivalent); *TPES*: Total Primary Energy Supply (Million Tons of Oil Equivalent); Numbers in parentheses (): % for each country

* TUR's merchandise export only.

Data source: The IEA, World Development Indicators, The World Bank (2016)

<https://www.iea.org/statistics/>

<https://data.worldbank.org/data-catalog/world-development-indicators>

The largest exporter of the energy resources in CA is KAZ with 62.1% of total regional energy export. TUR is the second biggest exporter in the region with its 30.0% of the regional total of energy resources' export. UZB's share is only 7.9% of the total regional energy export

volume. The share of energy in the structure of export commodities of KAZ and TUR constitute more than 80% of their total exports, and, therefore, their economies are critically dependent on the volume of their energy exports. In UZB, this share, compared to its hydrocarbon resources rich neighbors, is not that high, but it is very significant (30%). UZB’s economy is more diverse than that of the other CAC, due to its larger population and broader initial industrial base (Myant & Drahokoupil(2013)). KYR and TAJ are energy import dependent countries, partially relying on their hydro energy resources. KYR imports more 56.8% of its consumed energy resources from neighboring countries, while TAJ’s energy import constitutes 38.5% as of 2014. Figures 3.2-3.6 illustrate the trend of the CAC’s energy trade and *GDP* for 24 years of period.

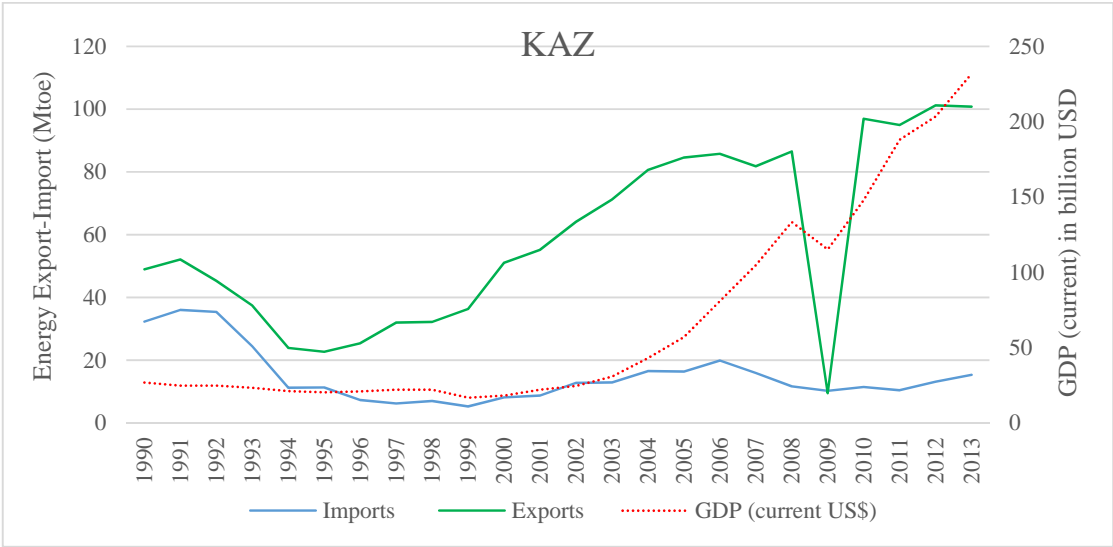


Figure 3.2: The trend of energy trade and GDP of KAZ (1990-2013).

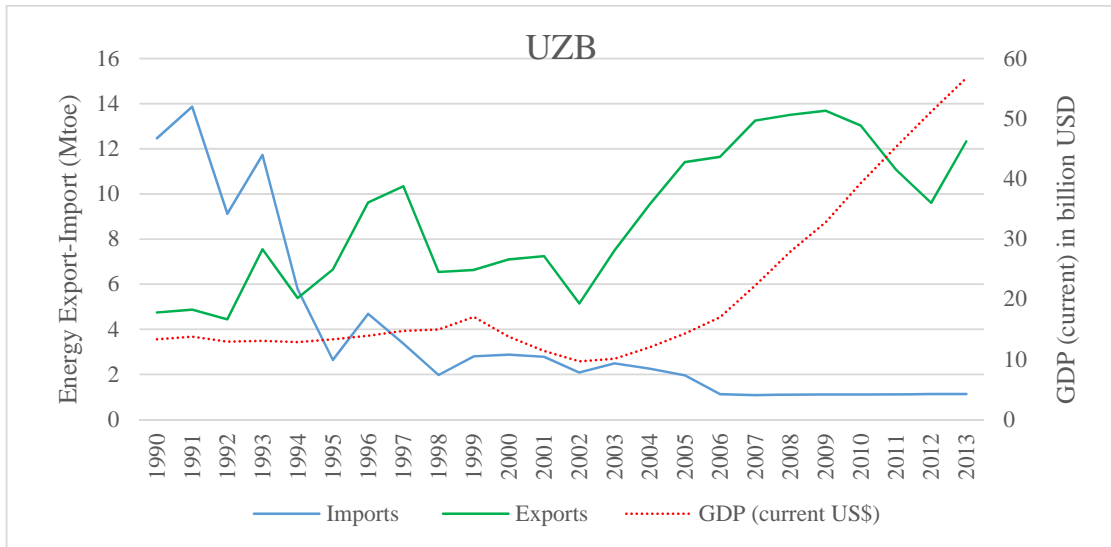


Figure 3.3: The trend of energy trade and GDP of UZB (1990-2013).

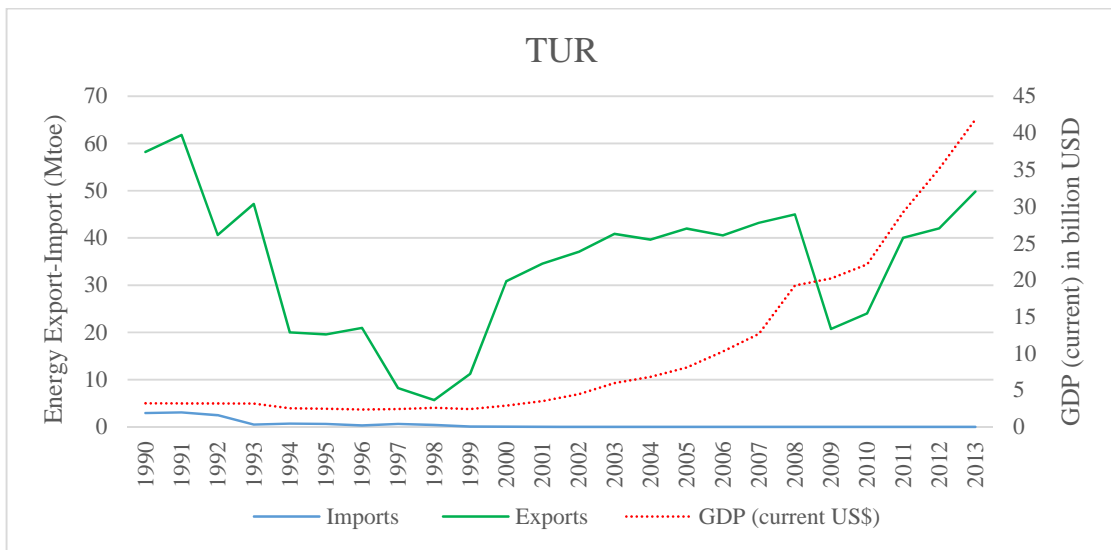


Figure 3.4: The trend of energy trade and GDP of TUR (1990-2013).

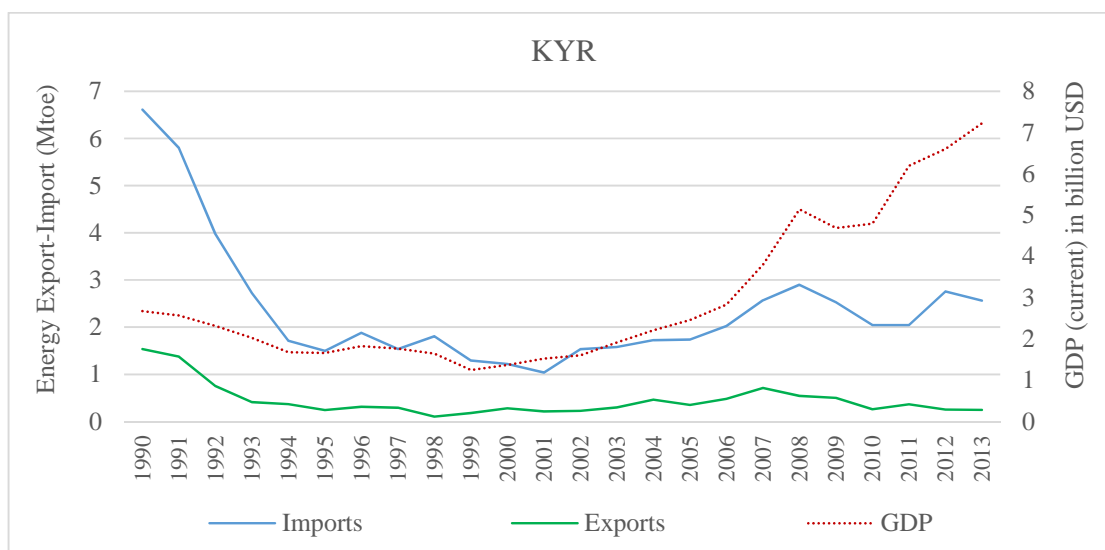


Figure 3.5: Energy export, import and GDP trend in KYR (1990-2013)

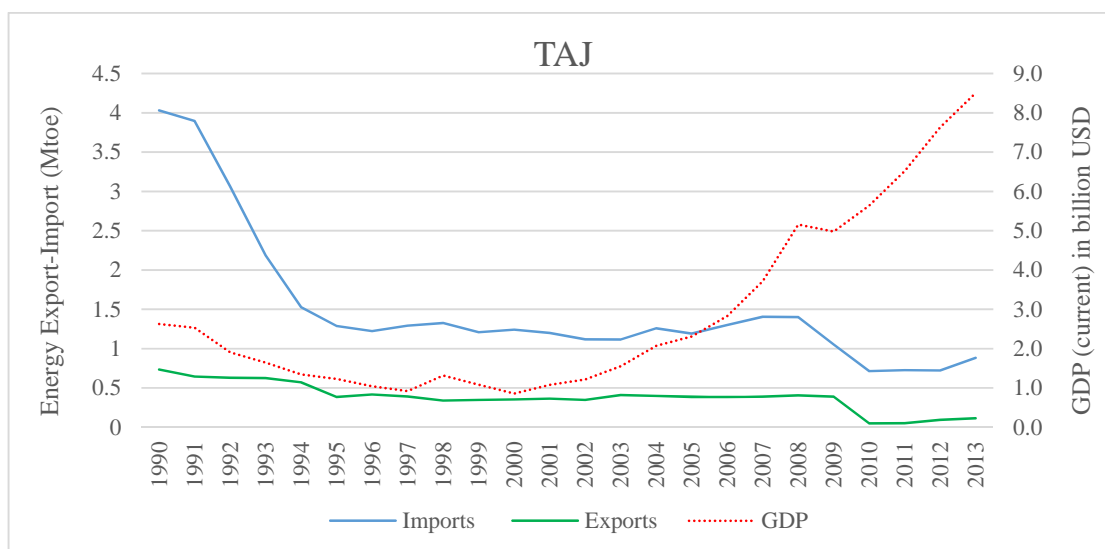


Figure 3.6: The trend of energy trade and GDP of TAJ (1990-2013).

Data source (Figures 3.2-3.6): The IEA, <https://www.iea.org/statistics/>

World Development Indicators, The World Bank (2016)

<https://data.worldbank.org/data-catalog/world-development-indicators>

3.2 Structure of Trade of Energy Resources in the CAC

Regarding the export-import structure of the CAC, we consider two kinds of trade-related data: 1) total export and import, including goods and services; and 2) only goods. Figures 3.7a-3.7e show the export-import structure consisting of goods and services for each of the CAC during the period from 2002 to 2015. For each country, each year's data consist of two data points, one corresponding to the total export-import data and the other indicating the goods import-export data, respectively. In Figures 3.7a-3.7e, points on the dense line correspond to the former total export-import data for each year and each country while the other points connected with these total import-export data points separately by each branch indicate the goods export-import data. Additionally, in Figures 3.7a-3.7e, each branch line for each year and each country corresponds to the service export-import data, namely horizontal x-coordinate corresponding to the branch line indicates the service export while vertical y-coordinate corresponding to the branch indicates the service import data. Thus the shorter branch line implies that the quantity of service export-import is much smaller than that of goods, i.e., total export-import is dominated by goods.

We find that economies of all five CAC heavily rely on commodity exports. For KAZ, UZB and TUR the main items for export are energy resources such as natural gas, crude oil and fuels, while KYR and TAJ heavily rely on aluminum and gold export. Due to significant rise of energy prices in the world market in the last 15 years and extensive increase of energy extraction volumes economies of KAZ, UZB, and TUR have been transformed to energy

export dependent economies, while economies of KYR and TAJ significantly rely on imports of goods.

Figures 3.7a-3.7e demonstrate the shares of export and import of goods and services in the total volume of export and import of each CAC. The characteristics of export and import of goods and services of all five countries are different. The points on the dense line represent the total amount of export and import while the points on the branch line represent export and import for only goods excluding services. Therefore, the distance between these two points with respect to their vertical and horizontal coordinates represent services' share of import and export, respectively. The data has been obtained from World Bank database on export of goods and services, including export and import of merchandise. Since the data for export and import of goods and services are not available separately for UZB and TUR, we used an approximation method to find the share of service by subtracting export and import of merchandise from the total export and import for goods and services, thus drawing the corresponding figures. Figures 3.7a-3.7e demonstrate these data for the period between 2002–2015 (KAZ, UZB), 2002–2012 (TUR), 2002–2014 (KYR), and 2002–2014 (TAJ), respectively, for each country in the CA region.

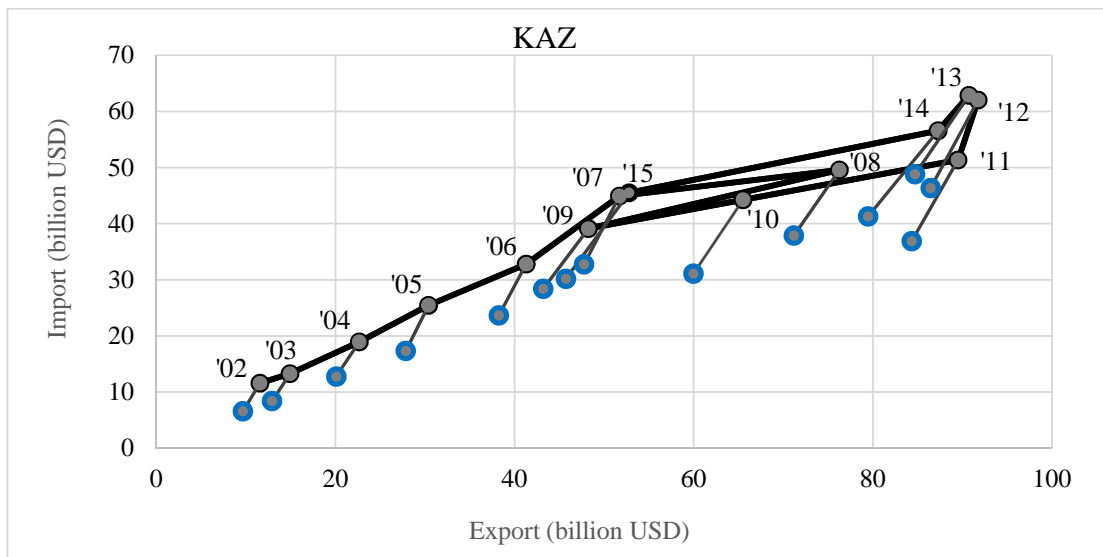


Figure 3.7a: Import-export structure (KAZ, 2002-2015).

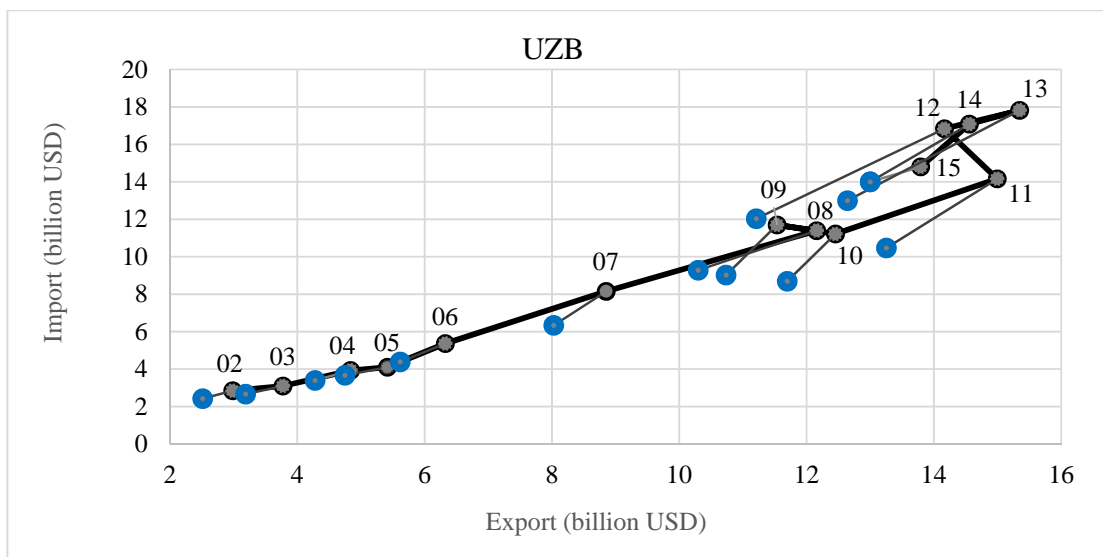


Figure 3.7b: Import-export structure (UZB, 2002-2015).

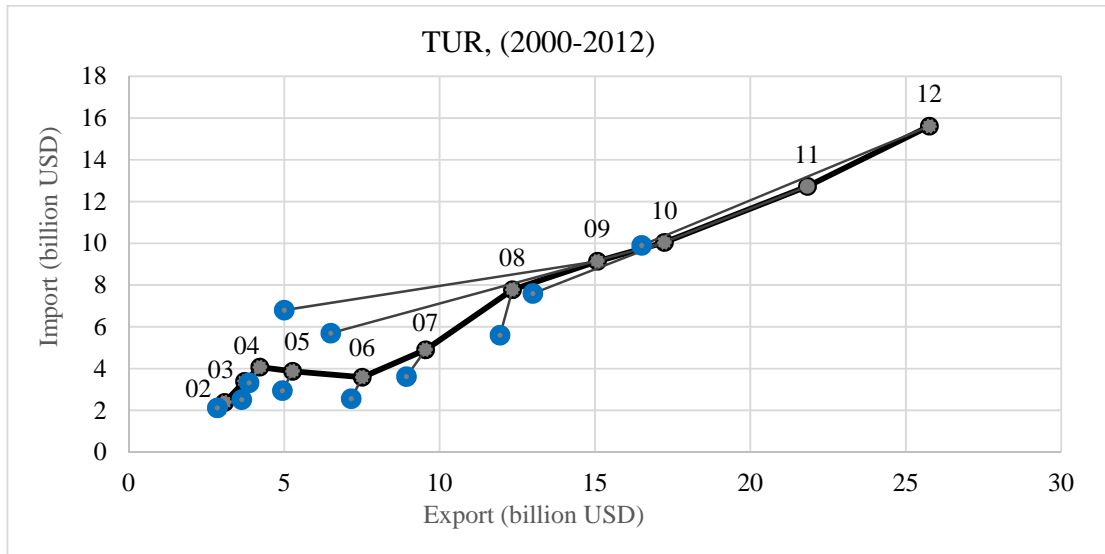


Figure 3.7c: Import-export structure (TUR, 2002-2012).

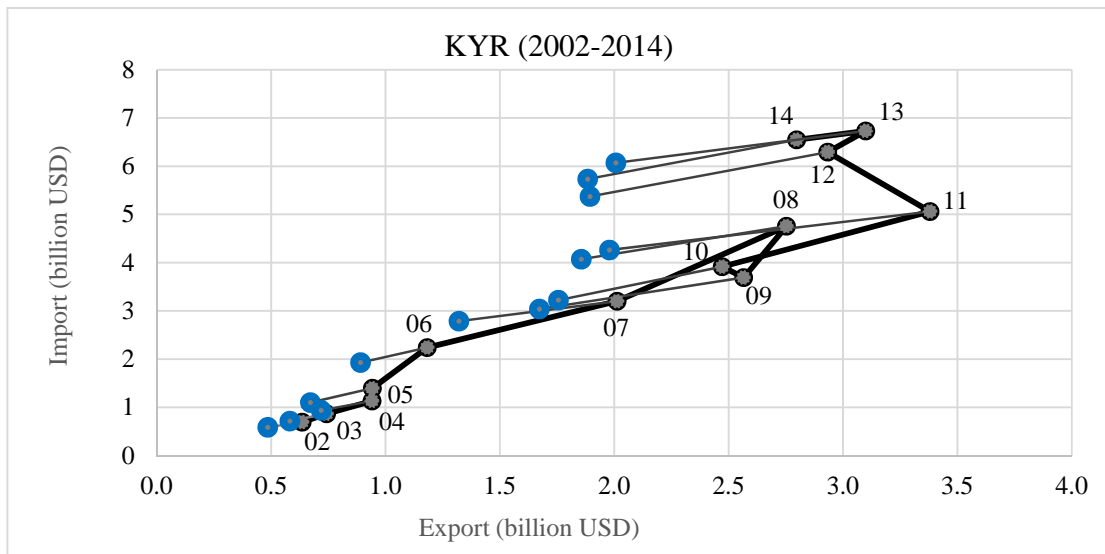


Figure 3.7d: Import-export structure (KYR, 2002-2014).

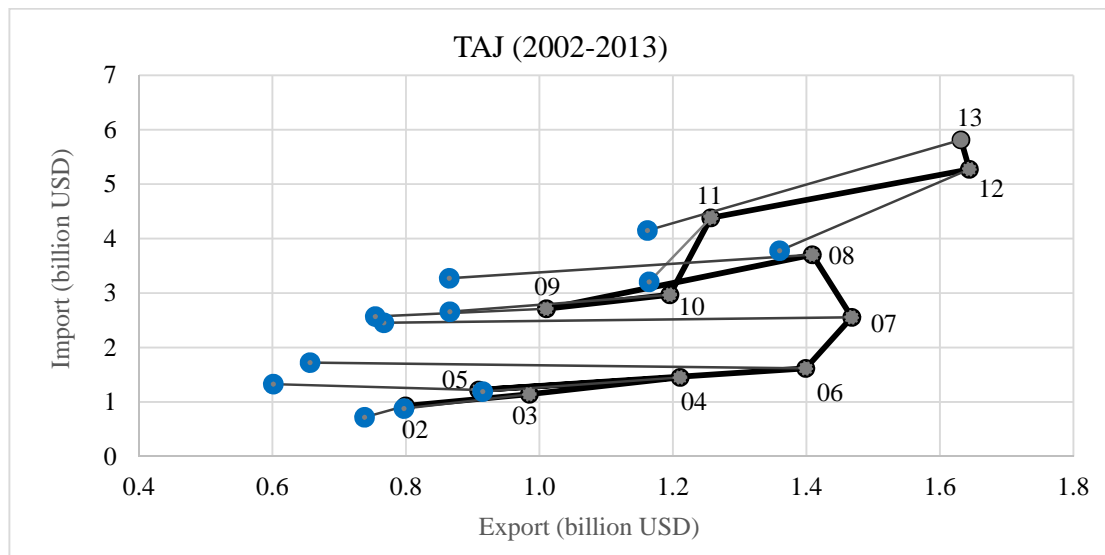


Figure 3.7e: Import-export structure (TAJ, 2002-2013).

Data source (Figures: 3.7a-3.7e): World Development Indicators, The World Bank, (2016)

<https://data.worldbank.org/data-catalog/world-development-indicators>

UN Comtrade Database (2016) <https://comtrade.un.org/>

KAZ demonstrates a balanced increase of export and import for both goods and services, with a growing share for service in its exports and imports (Figure 3.7a). However, ratios for the export of goods and services in KAZ in 2002 were 83.5% to 16.5%, respectively, which changed over the following 10-year period, with a decrease in service's share to 5.8%, but in real amount it increased almost 3 times. The ratio of goods and services import also went through significant change in proportion 56.8% to 43.2% in 2002 and 74.8% to 25.2% in 2012, respectively. KAZ's export-import structure has been steadily growing during the period from 2002 to 2012 in both export and import, then after 2012 up to 2015 it has been decreasing again following the past trend similarly. Also we see that the proportion of the

goods export and import compared with the total export and import is very stable during the period from 2002 to 2012 and after 2012 also as the slope of each branch for each year is very similar. We could also find that the service export and import increase each year as the branch line is getting longer year by year. Moreover, as we see the growth curve of the export-import structure increase in convex form from 2010 to 2012, the increase of export is much faster than that of import; however, from 2013 to 2015, we see the concave form, which implies the decrease in import is much faster.

UZB's trend shows gradual increase in the share of services in both categories of export and import from 15.8% and 14.7% to 20.9% and 28.5% from 2002 to 2012, respectively (Figure 3.7b). UZB's export-import structure grows in convex form from 2010 to 2013, which means the increase of export is much faster than that of import; however, from 2013 to 2015, we see the concave form, which implies the decrease of import is much faster, which means the decrease of import is faster than that of export. Also we see that especially after the year 2008 the branch line is rapidly getting much longer, demonstrating the growth of the share of service in trade. This significant increase in service of UZB's trade was due to significant inflow of Chinese investment and UZB's active participation in rebuilding Afghanistan's infrastructure. But the most significant reason behind this big change is the transit service of UZB transporting TUR's gas to China.

The data for TUR illustrates significant change towards increase of services in both categories from 7.5% to 35.5% and 11.0% to 36.6% in a decade (Figure 3.7c). TUR's export-import structure grows almost linearly. We find a typical fact that branch line gets drastically

longer from the year 2007 with its slope much flatter than before. This means that after 2007 service export and import grew very rapidly, especially the former service export grew much more drastically than the latter import. As we mentioned earlier in UZB's case the drastic growth of service in its trade structure maybe explained by significant Chinese investment into natural gas and oil industries, which is similar or even greater in TUR's case due to the fact that three natural gas pipelines A, B and C were built to transport TUR's gas to China starting from 2009, which eventually pushed public infrastructure development in the country.

For the Group II countries: KYR and TAJ, their trends demonstrate significant increase of export services from 23.6% to 35.4% and from 7.7% to 17.3% from 2002 to 2012, respectively, while import services category shows insignificant change (Figures 3.7d and 3.7e). For two countries of KYR and TAJ in Group II, we find from Figures 3.7d and 3.7e that their data points are above the 45 degree line different from other three countries of KAZ, UZB and TUR in Group I, in which most data points are either around or below the 45 degree line. Also in KYR and TAJ we see that their goods export is very small compared with service export and moreover their goods import is very large, occupying most of their total import.

3.3 Regression Model Analysis on the Trade Issues of Energy Resources

The causal relationship between energy resources exports/imports and *GDP* of the CAC are well demonstrated in the graphs, which show the trend of their *GDP* and energy export/import (see Figures 3.2-3.6). As demonstrated in graphs of Group I countries, export and *GDP* respond correspondingly for each other, while in Group II countries' case, import and *GDP* move corresponding to each other's moves. This trend perhaps is due to the

dependence of resource rich Group I countries to energy resources' export and resource poor Group II countries on energy import. KYR imports are more than half (56.8%) of its consumed energy resources, while TAJ imports a significant part of its energy (38.5%).

We define the following regression model in order to investigate the trade issue related structural characteristics for each country in the CA area.

$$y_t = a_0 + \sum_{i \in N} a_i x_{it} + u_t \quad t \in T \quad (2)$$

where $N = \{1, 2, \dots, 5\}$ and T indicate the set of independent variable indices and the set of periods, respectively, for each country data, and u_t is a normally distributed error term. In the above formulae, we define a dependent variable y_t as the trade issue related one expressed by E : export and I : import. Independent variables are x_1 : GDP , x_2 : energy production, x_3 : FDI (foreign direct investment), x_4 : oil price, and x_5 : natural gas price, respectively.

We show the relation between trade activity and several determining factors which give various degree of impacts. We express the trade activity by using three types of indicators such as "Export–Import" denoted by $E-I$, "Export" denoted by E and "Export+Import" denoted by $E+I$. Tables 3.2., 3.3 and 3.4 show regression results for three cases with dependent variables $E-I$, E and $E+I$, respectively. Each of these dependent variables $E-I$, E and $E+I$ indicate trade balance, export capability and total volume of trade, respectively. Regression models' results given in Tables 3.2, 3.3 and 3.4 have all common independent variables such as Gross Domestic Products (GDP , 10^9 US\$:BUSD), Energy Production

(*EPR*, .10⁹ US\$:BUSD, Foreign Direct Investment (*FDI*, 10⁹ US\$), Oil Price (*OLP*, US\$/barrel), and Natural Gas Price (*NGP*, US\$/bcm).

We find that all regression computation results show very high goodness of fit for the above model with R^2 higher than 0.74 up to 0.99.

From these regression results (Tables 3.2-3.4) we find the following facts, thus derive several new insights. Firstly, *GDP* gives slightly negative impacts on the trade balance ($E-I$) while it gives mostly significantly positive impacts on both export (E) and total trade volume ($E+I$). Slightly negative impacts on the trade balance $E-I$ for all CAC as seen in Table 3.2 imply that *GDP* increases bring export increases; however, similarly sometimes more slightly increases for imports in most CAC, slightly less for TUR. Positive impacts can be seen from the fact that *GDP* increase could bring more active economic activities increasing exports a lot. Especially, we find that *GDP* increase could bring about much higher increases for trade activities denoted by $E+I$.

Generally, in most regression results we find that energy production (*EPR*) brings significantly positive impacts on all trade factors, among them in particular large impacts on export capability (E) (Table 3.3) and trade volume ($E+I$) (Table 3.4). Regarding the impact on $E-I$ (Table 3.2) and E (Table 3.3), we see that only KAZ and TUR have significantly positive impacts. This results from the fact that KAZ produces a large amount of oil and then export it while TUR depends upon natural gas production largely. On the other hand, in both KYR and TAJ, *EPR* has a rather negative impact on trade activities as these countries do not have fossil energy resources such as oil and natural gas, depending on the renewable energy

resources such as hydro power. *FDI* causes significantly positive impacts in both countries such as UZB and TUR although not so significant for other countries. This might come from the recent trend that these countries are trying to obtain large FDI from China, e.g. TUR's case as building a natural gas pipeline connecting with China.

Regarding the impacts due to oil and natural gas price changes on trade activities we find that in most countries except TUR oil price *OLP* increase brings rather negative impacts on the trade balance $E-I$ (Table 3.2) while only TUR has significantly positive impact. On the other hand natural gas price *NGP* increase brings rather positive impacts in all countries except TUR, while only TUR shows a negative impact. This might result from the fact that KAZ and UZB depend upon oil production and export a lot, thus oil price increase brings a negative impact on trade balance as the external demand for oil contracts, while TUR depends on mostly natural gas rather than oil, so oil price increase brings higher trade revenue from higher natural gas export income. Interestingly, natural gas price *NGP* increase brings significantly negative impacts on all trade activities for the natural gas depending country TUR. This may be because natural gas price increase may contract demand from external markets and therefore decreases the income, which leads to less energy trade activities.

In Group II countries KYR and TAJ *OLP* increase has rather negative impacts on the trade balance $E-I$ (Table 3.2) as they might have to import more expensive energy resources thus impacts on trade activities, and $E+I$ can be rather positive. Natural gas price increase brings rather and significantly negative impacts on trade activities E (Table 3.3) and $E+I$ (Table 3.4) for TUR, KYR and TAJ as these countries need to depend upon some other

energy resources beside oil and natural gas, e.g. renewable energy resources such as solar and wind power.

Table 3.2: Regression Results for the Trade Balance ($E-I$)

Country	KAZ	UZB	TUR	KYR	TAJ
Period	1992-2014	1992-2014	1993-2012	1993-2014	1992-2013
<i>Const.(a₀)</i>	14085.6**	-2019.71	-1895.76***	1310.99*	-174.23
(<i>t</i> -value)	(2.597)	(-1.266)	(-4.817)	(1.888)	(-0.3163)
(<i>P</i> -value)	(0.0188)	(0.2227)	(0.0002)	(0.0770)	(0.7550)
<i>GDP(a₁)</i>	-0.1636**	-0.0676***	-0.0770	-0.574***	-0.4286***
(<i>t</i> -value)	(-2.1900)	(-3.2055)	(-0.905)	(-3.7273)	(-4.3762)
(<i>P</i> -value)	(0.0428)	(0.0051)	(0.3807)	(0.0018)	(0.0004)
<i>EPR(a₂)</i>	0.1847*	0.0427	0.0392***	-0.4398	0.5656
(<i>t</i> -value)	(2.031)	(1.2599)	(3.0429)	(-0.8410)	(1.3962)
(<i>P</i> -value)	(0.0581)	(0.2247)	(0.0080)	(0.4127)	(0.1817)
<i>FDI(a₃)</i>	-0.2857	2.0367***	0.9455***	1.5291	-0.4248
(<i>t</i> -value)	(-0.7608)	(5.4518)	(4.1971)	(1.7442)	(-0.8723)
(<i>P</i> -value)	(0.4572)	(0.0000)	(0.0008)	(0.1002)	(0.3959)
<i>OLP(a₄)</i>	-45.32	-10.7516	92.10***	-5.2187	-11.592
(<i>t</i> -value)	(-0.2639)	(-0.8939)	(4.226)	(-0.5116)	(-1.6717)
(<i>P</i> -value)	(0.7951)	(0.3838)	(0.0008)	(0.6158)	(0.1140)
<i>NGP(a₅)</i>	2000.19**	214.73*	-480.91***	38.20	37.18
(<i>t</i> -value)	(2.2765)	(1.9291)	(-3.9759)	(0.6342)	(1.0304)
(<i>P</i> -value)	(0.0360)	(0.0705)	(0.0010)	(0.5348)	(0.3181)
<i>R</i> ²	0.9344	0.9229	0.9924	0.9685	0.9923
adj. <i>R</i> ²	(0.8731)	(0.8519)	(0.9849)	(0.9381)	(0.9847)

Table 3.3: Regression Results for the Export Capability (E)

Country	KAZ	UZB	TUR	KYR	TAJ
Period	1992-2014	1992-2014	1993-2012	1993-2014	1992-2013
<i>Const.(a₀)</i>	8707.42**	2565.51	-646.04*	1149.77***	1785.93**
(<i>t</i> -value)	(2.381)	(0.9802)	(-1.9249)	(3.0450)	(2.4603)
(<i>P</i> -value)	(0.0292)	(0.3407)	(0.0747)	(0.0077)	(0.0256)
<i>GDP(a₁)</i>	-0.0569	0.1078***	0.4851***	0.3456***	0.1232
(<i>t</i> -value)	(-1.1293)	(3.1168)	(6.6815)	(4.1252)	(0.9547)
(<i>P</i> -value)	(0.2742)	(0.0062)	(0.0000)	(0.0007)	(0.3539)
<i>EPR(a₂)</i>	0.3159***	-0.0373	0.0402***	-0.9552***	-0.8650

<i>(t-value)</i>	(5.1523)	(-0.6708)	(3.6609)	(-3.3578)	(-1.6200)
<i>(P-value)</i>	(0.0001)	(0.5113)	(0.0020)	(0.0040)	(0.1247)
<i>FDI(a₃)</i>	0.1672	1.7502**	0.7984***	0.5587	0.2056
<i>(t-value)</i>	(0.6601)	(2.8563)	(4.1560)	(1.1717)	(0.3204)
<i>(P-value)</i>	(0.5180)	(0.0109)	(0.0009)	(0.2584)	(0.7527)
<i>OLP(a₄)</i>	84.9838	66.5552***	46.6434**	10.2319*	0.7323
<i>(t-value)</i>	(0.7338)	(3.3738)	(2.5100)	(1.8442)	(0.0801)
<i>(P-value)</i>	(0.4731)	(0.0036)	(0.0249)	(0.0837)	(0.9371)
<i>NGP(a₅)</i>	2000.81***	7.8001	-447.59***	-34.041	-19.6245
<i>(t-value)</i>	(3.3775)	(0.0427)	(-4.3395)	(-1.0388)	(-0.4126)
<i>(P-value)</i>	(0.0036)	(0.9664)	(0.0006)	(0.3143)	(0.6853)
<i>R²</i>	0.9876	0.9864	0.9988	0.9879	0.7498
<i>adj.R²</i>	(0.9754)	(0.9730)	(0.9976)	(0.9761)	(0.5623)

Table 3.4: Regression Results for the Trade Volume (*E+I*)

Country	KAZ	UZB	TUR	KYR	TAJ
Period	1992-2014	1992-2014	1993-2012	1993-2014	1992-2013
<i>Const.(a₀)</i>	3329.22	7150.74	603.68	988.5480**	3746.09**
<i>(t-value)</i>	(0.5334)	(1.3238)	(1.1584)	(2.2257)	(2.4302)
<i>(P-value)</i>	(0.6006)	(0.2031)	(0.2660)	(0.0407)	(0.0272)
<i>GDP(a₁)</i>	0.0497	0.2834***	1.0471***	1.2653***	0.6751**
<i>(t-value)</i>	(0.5789)	(3.9677)	(9.2897)	(12.8396)	(2.4626)
<i>(P-value)</i>	(0.5702)	(0.0009)	(0.0000)	(0.0000)	(0.0255)
<i>EPR(a₂)</i>	0.4471***	-0.1174	0.0412**	-1.4706***	-2.2957*
<i>(t-value)</i>	(4.2721)	(-1.0224)	(2.4174)	(-4.3946)	(-2.0246)
<i>(P-value)</i>	(0.0005)	(0.3209)	(0.0298)	(0.0004)	(0.0599)
<i>FDI(a₃)</i>	0.6201	1.4637	0.6513**	-0.4116	0.8361
<i>(t-value)</i>	(1.4345)	(1.1575)	(2.1835)	(-0.7338)	(0.6134)
<i>(P-value)</i>	(0.1695)	(0.2631)	(0.0465)	(0.4736)	(0.5481)
<i>OLP(a₄)</i>	215.2879	143.826***	1.1887	25.6827***	13.0566
<i>(t-value)</i>	(1.0891)	(3.5338)	(0.0412)	(3.9353)	(0.6727)
<i>(P-value)</i>	(0.2913)	(0.0025)	(0.9677)	(0.0011)	(0.5107)
<i>NGP(a₅)</i>	2001.44*	-199.131	-414.28**	-106.29**	-76.42
<i>(t-value)</i>	(1.9793)	(-0.5285)	(-2.5868)	(-2.7576)	(100.9869)
<i>(P-value)</i>	(0.0642)	(0.6039)	(0.0215)	(0.0140)	(0.4601)
<i>R²</i>	0.9929	0.9867	0.9988	0.9982	0.9684
<i>adj.R²</i>	(0.9860)	(0.9732)	(0.9976)	(0.9964)	(0.9378)

Chapter 4. Energy Production and Trade Policies in the CAC

4.1 Energy Production Policies in Group I Countries

The CAC energy production trend over the last 24 years demonstrates significant growth (see Figure 2.2). This is primarily due to large hydrocarbon reserves in the region, massive investment into energy sectors and government policies to support trade of hydrocarbon resources. According to British Petroleum (2016) KAZ's total proved oil reserve equals 30.0 billion barrels or 3.9 billion tons, representing 1.8% of total world reserves. Another assessment made by the IEA (2015) states that KAZ holds an even larger portion of proven oil reserves in the Caspian Sea basin, which equals 40 billion barrels or 3.2% of the world total. The reserve to production ratio of oil reserves in KAZ shows that oil will be sufficient for another 49.3 years at the current production rate. Another assessment by BGR(2015), based on itemized information on cumulative production, resources, reserves, total amount of energy that can be extracted from the deposit and remaining potential, illustrates the hidden potential of oil resources availability in the region. These assessments include estimation of possible unconventional oil resources in KAZ, which makes the estimate of oil resources even bigger than Saudi Arabia's, ranking KAZ number 7 in oil production, in the list of the top 20 most important countries with crude oil resources. KAZ has a huge potential to develop both fossil fuels, alternative energy resources such as uranium and various renewable energy resources. Further development of renewables in the energy mix through building

wind-farms, solar energy panels, and hydropower plant can substantially increase the potential of the country to supply increasing domestic market demand.

KAZ launched ambitious plan: “Kazakhstan 2050 Strategy” with the main goal of placing the country in the top 30 global economies by 2050. Figure 4.1 illustrates energy future plan for KAZ. KAZ plans to achieve high economic growth through extensive industrialization program, improving investment climate and development of its private sector. In parallel with “Kazakhstan 2050 Strategy”, KAZ has adopted the Green Economy Concept targeting 50.0% of alternative and renewable energy in the energy mix by 2050. Currently the share of such alternative and renewable energy is less than 2.0% in total energy consumption of the country. The Green Economy Concept aims also at reducing energy intensity (per unit of *GDP*) by 25.0% by 2020, from 2008 level.

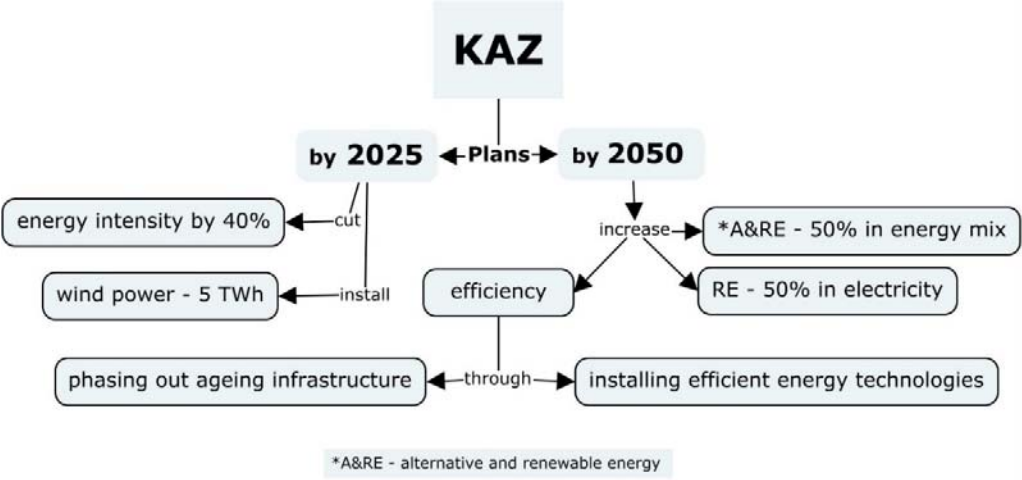


Figure 4.1: Energy future plan for KAZ.

Source: The IEA (2015)

The action plan for the development of alternative and renewable energy for 2013-20, and the program of wind power development to 2030 are specific policies designed in correspondence with the above mentioned major plans.

Other national plans envisage diversification of the economy away from hydrocarbons, raising productivity in the manufacturing and agricultural sectors, increasing the share of non-oil exports through improvements in the business environment, modernization of enterprises, and creation of new high value-added export-oriented sectors. Until 2030 the gradual but significant increase of KAZ's population is projected by UN Department of Economic and Social Affairs reaching 20.2 million from current number 17.6 million, which is 12.2% increase. In period 2002-2012 KAZ's energy demand almost doubled due to strong economic growth and rising living standards. Ambitious plan for the future and the population perspective in KAZ predicts greater energy demand in near future, and such demand growth requires serious deliberations and creating preventive measures.

Our quantitative analysis of energy production and GDP growth in KAZ demonstrate strong correlation between these variables, almost proportional growth of energy production to the GDP growth, which means that KAZ should continue to boost energy resources production. If KAZ takes hydrocarbon resources conservation policy the current growth can be jeopardized by domestic energy demand growth in the future due to its significant population growth and rising of living standards in the country aiming to enter the list of top 30 global economies by 2050.

UZB's proven crude oil reserves are relatively small totaling 0.6 billion barrels or 0.1 billion tons. Although its oil reserve is not as large as KAZ's, it is sufficient to supply domestic demand. Oil reserve in UZB is estimated as sufficient for another 25.3 years at current rate of production. Presence in UZB of another potentially viable energy resource: shale oil reproduces different perspective for UZB's future. UZB holds the largest share of shale oil resources in CA equaling 1200 Mt (World Energy Council (WEC)(2016)). UZB is endowed with relatively smaller volume of natural gas reserves in comparing with its rich neighbors TUR and KAZ. Its natural gas reserves equal to 1085.9 bcm as of 2015 (WEC(2016)). Even though that its reserves are relatively smaller than its neighbors' reserves, UZB's natural gas production capacity is considerably high with almost 60.0 bcm of natural gas produced annually since 2004, which makes this country number 14 largest producer of natural gas in the world. UZB consumes large portion of its produced gas internally (48.8 bcm). With its current production rate, UZB's natural gas will be sufficient for another 18.8 years.

Despite its relatively smaller amount of hard coal resources, UZB ranks 16th in the world with 1,375 Mt hard coal reserves (as of 2014), which constitute 0.2% of global reserves sufficient for 27 years to exploit with current production rate. Production of coal has been increased more than 1.5 times in last decade and the current "coal development program 2018" envisages strategy to boost production through investing in the newest technologies, building modern infrastructure and switching gas-fired power stations to coal, which diversifies its energy supplies and improves electricity reliability. UZB's hydropower potential has more

enough room to generate additional energy units for its economy. Since 2002 UZB could increase energy production from hydro by 81.2%, which is the strongest increase in supply from any fuel in UZB (IEA(2015)). The solar energy is considered as potentially viable energy source for energy hungry economy of UZB. The actual duration of solar light in UZB is between 2800 and 3180 hours depending on the latitude and topography of a given region (Hakimov et al.(2007)). This abundant sunshine provides enormous potential for a large-scale conventional and thermal solar power. In recent years UZB has focused in development of solar power in its remote areas, where costs of solar power are now often cheaper than constructing high-voltage power lines (OECD/IEA(2015)). The wind power potential of UZB has been estimated as more than 520 GW installed on an area of 17 000 km² with electricity generation capacity 1.07 billion kWh annually (Zakhidov and Kremkov(2015)).

UZB doesn't have super ambitious and long-strategy for 2050 (Figure 4.2). The government of UZB has a plan to move to upper-middle income status by 2030 raising its GDP per capita almost double than current level. It plans to attain this target by advancing its industrial sector through attracting significant amount of foreign investment and capital. UZB's energy sector characterized as an old and outdated energy infrastructure with very low energy efficiency. This deficiency is fueled by steady increase in demand for energy products, which causes frequent blackouts, oil and gas supply cutoffs, turning energy supply extremely unreliable. Moreover, this distress is added by waste of energy in UZB's energy heavy industries, which absorb lion's share in energy. UZB is considered as the most energy

inefficient country in Europe and CA with losses equaling 4.5% of *GDP* every year (OECD/IEA(2015)).

Thus, UZB’s current key objective is securing uninterrupted and reliable energy supply in domestic market. UZB recognizes availability of considerable room for saving energy through upgrading its industrial sector, rehabilitation of old and inefficient power plants, electricity transmission lines, gas and oil pipelines. For this reason the large projects are currently under way introducing advanced energy efficient technologies for its old and new thermal power plants, and energy heavy industries. Industrial Modernization and Infrastructure Development Program for 2011-15, included 34 billion USD of investment in the energy sector. Of that, 5 billion USD was for the rehabilitation and modernization of the electricity sector (the Power Sector Development Program), and more than 20 billion USD in oil and gas exploration (OECD/IEA(2015)).

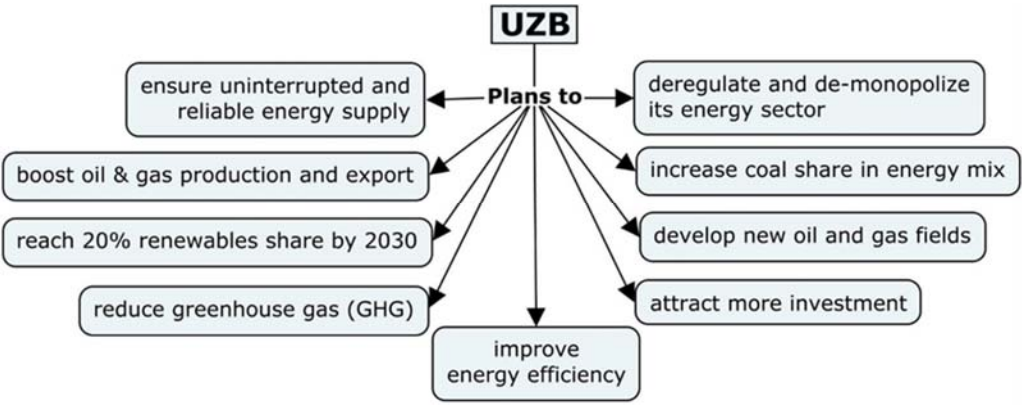


Figure 4.2: Energy future plan for UZB.

Source: The IEA (2015)

Diversification of its energy mix is another priority for UZB government to insure reliable energy supply through increasing the volume of inexpensive coal in electricity generation and promoting renewable energy expansion. The Development Program for Coal Industry for the period of 2013-2018 proposes modernization of outdated coal mining equipment and aged coal-fired electricity generation, as well as construction of new coal-fired electricity generation plants. As for renewables UZB government has a plan to increase its share in energy mix from current 1.8% to 20.0 % by 2030. In this regard the Presidential Decree on Measures to Boost Alternative Energy Sources (2013) envisages introduction of Law on Alternative Energy Sources and other normative acts to give preferences for investment into renewable energy projects in the country.

All of the problems growing within the energy sector of UZB found their reflections in our quantitative analysis where the role of energy production in the growth of economy is declining significantly in recent years. In order to recover its energy production and secure sustainable growth UZB needs to invest on development of renewables and alternative energy sources, which are widely available in the country and have great potential.

In energy sector development TUR government has adopted the Oil and Gas Development Plan 2030, which emphasizes gas and oil production should increase fourfold and tenfold accordingly by 2030 reaching to 250 billion cubic meters (bcm) of natural gas and 110 million tons (Mt) of crude oil. In 2013, the construction of a 2 billion USD port on the Caspian Sea launched exclusively for oil product exports. At present rehabilitation of an old and aged refineries, including building new oil processing plants are another goal to

increase its oil export potential. TUR's proved oil reserves are relatively small equaling 0.6 billion barrels or 0.1 billion tons. The reserve to production ratio of oil reserves in TUR is sufficient to produce in its current rate only for 6.3 years. According to the BGR(2015) TUR's oil reserves are two times larger than UZB, with total resources exceeding more than 4 times. The WEC(2010) illustrates TUR's shale oil reserves as equal to 1100 Mt, which is relatively huge. TUR holds first place among CAC, with 32.3 tcm (9.4% of world total) of proven natural gas reserves as of the end of 2015 (BP(2016)). TUR is one of the largest gas resource holders in the Caspian region and has the fourth largest total offshore and onshore gas reserves in the world, behind Iran, Russia, and Qatar. TUR ranks in the top 20 the most important countries exporting natural gas to the world with 41.6 bcm or 4.1% of world natural gas export share. With the completion of construction and start of the operation of the Central Asia-China gas pipeline this number is expected to increase twofold in coming years. Figure 4.3 illustrates energy future plan of TUR.

Notwithstanding that the country has developed hydrocarbon resources extraction in large scale, there were less attention and investment made to its electricity and heat supply sectors, which made electricity and heat supply unreliable with frequent outages and high losses. TUR's renewable energy potential is almost as large as in other Group I countries with ample solar and wind potential. However, TUR does not have any important projects on extracting this valuable resource. Diversification of energy export markets is one of the key objectives of oil and gas rich TUR. Building an access to diverse energy importing

markets can minimize TUR's future export risks, which TUR has experienced with Russia in the past.

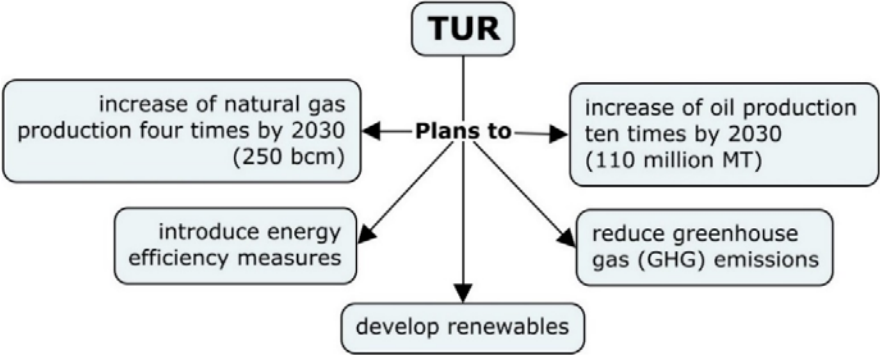


Figure 4.3: Energy future plan of TUR.

Source: The IEA (2015)

TUR has made substantial advance in developing its economy and population living standards. It has jumped from middle income status to upper middle income level just in a decade with its GDP per capita change from 970US\$ in 2002 to nearly 7,000US\$ in 2013. The natural gas exports has played a main role for this significant and positive change, which exceeded 90.0% in its total export volume. TUR's next goal is to reach high-income status by 2025, through sustainable growth, increased private sector participation, and diversification of the economy, which envisaged in the National Program for Socio-Economic Development of TUR for 2011-2030.

TUR's economy is considered as energy intensive economy. An old and inefficient energy infrastructures need upgrading. Demand side inefficiency arising from extensive energy subsidies is another serious issue to be handled in TUR. TUR's energy consumption has increased 2.5 times in the last two decades and it is predicted to rise further with

population growth from current 5.3 million to 6.5 million in 2050. The government should create strong renewable energy policy and support various researches on solar and wind energy application, and provide serious incentives to private and public businesses for construction windmill farms and solar panels. This in turn can substitute growing energy demand in local market and free up valuable natural gas and oil for export.

4.2 Energy Production Policies in Group II Countries

The National Sustainable Development Strategy for 2013-2017 is the main document specifying the course for KYR's development. In the long term it aims at building a strong and independent country that is part of the developed countries with robust economic growth and high attractiveness for investors. In the short term it aims at becoming dynamically growing economy with stable growth in its general citizens' income, which will lead to reduction of poverty and social progress. The National Energy Program and the Strategy for the Fuel and Energy Sector Development for 2008-2010 with an Outlook to 2025 envisages ensuring reliable electricity and heat supply through improving energy efficiency of production, transmission and distribution of electricity and heat with modernization and new technologies, and increasing hydro and coal-fired generation capacity. Figure 4.4 illustrates energy future plan of KYR.

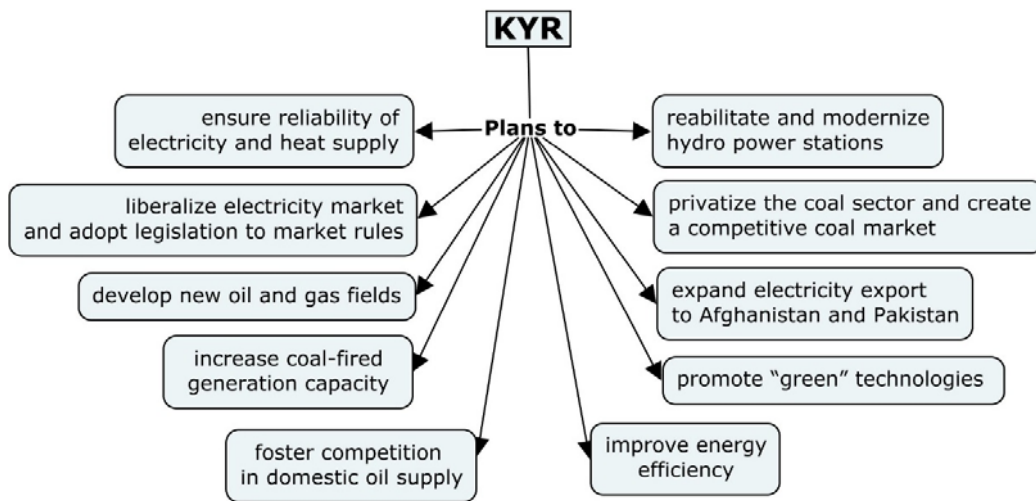


Figure 4.4: Energy future plan of KYR.

Source: The IEA (2015)

KYR is hydrocarbon resource net importer country. It does not have significant oil and natural gas reserves, largely depending on imported fossil fuels. KYR's proven oil and natural gas reserves are very small, estimated at only 5 Mt and 6 bcm, respectively. Current oil and gas extraction gradually decreasing over 20 years due to depletion of reserves and aged equipment. However, KYR is rich in coal reserves and ranks 16th among the top 20 most important countries possessing hard coal resources. KYR has more than 70 coal deposits, but most of them are difficult to exploit.

KYR is an upstream country with large hydropower infrastructure developed during the Soviet Union. Hydropower accounted 30.1% of total primary energy supply in KYR in 2014. But the country's hydropower potential is very high approximately ten times more than what is currently utilized (3091 MW in 2015). Upgrading and modernizing old and aged energy infrastructures can save the country up to 25.0% in electricity and 15.0% in heat

(OECD/IEA(2015)). But still continuing energy subsidy policy of the country does not allow to provide funding energy efficiency measures and attract foreign investment for the planned projects. For example, raising energy efficiency could increase hydro energy output and decrease the loss of energy, which could be sent for export to neighboring countries.

Our regression analysis of GDP and energy production variables in KYR demonstrated significant and positive correlation for the Period II, which is probably due to the significant increase in the volume of coal production in the country in the last years. Our analysis suggest that KYR can secure sustainable economic growth through investing into domestic energy production, especially coal and renewables.

TAJ has developed long-term strategy for 2030 with the main target decreasing poverty level in the country by half and increasing middle class from current 22.0% to 50.0%. But, another major strategic plan envisaged in this program is ensuring reliable energy supply to all citizens. At present TAJ excessively relies on its unstable hydropower generated energy source, which is available at seasonal intervals depending on the time of the year. Constant blackouts and breaks in gas and oil supplies is habitual for most regions of the country, where more than 70% of country's population reside. Figure 4.5 illustrates energy future plan of TAJ.

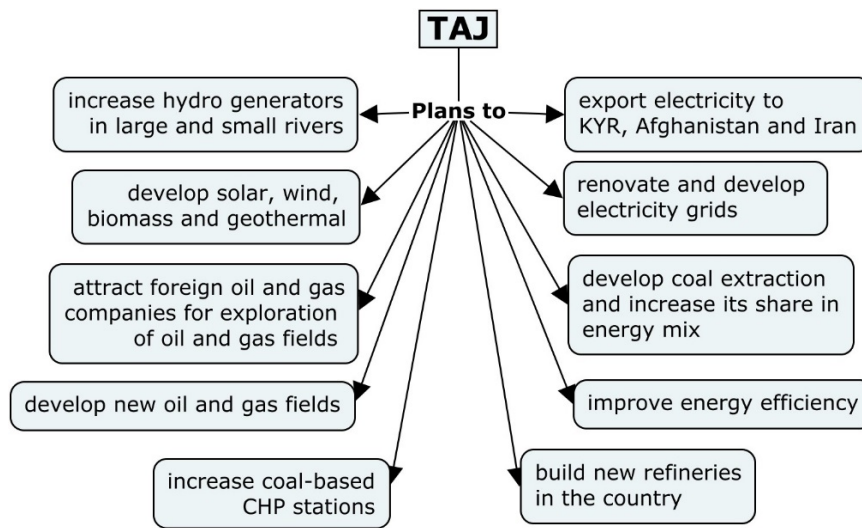


Figure 4.5: Energy future plan for TAJ.

Source: The IEA (2015)

The favorable geographical location of TAJ made it a dominant player in the CA water management system allowing to build large dams and huge hydroelectric generation plants. During the Soviet Union the large hydropower infrastructures have been developed in the country. The TAJ civil war after the break of the USSR and disintegration of republics made financing of such projects impossible and caused suspension of the incomplete projects for indefinite time. The TAJ civil war ended in 1997 giving the way to gradual recovery and growth of economy, which generated increased demand for energy supply. Hydropower potential of TAJ is considered as the largest in the world and it ranks first in terms of hydropower reserves per territorial unit (UNDP(2014)). It has abundant hydropower reserves, with a technically feasible electricity generation potential of 317 TWh/y, which makes it the eighth-largest country for hydropower potential and one of the top countries for per-capita production worldwide (OECD/IEA(2015)). TAJ's untapped hydropower generation potential

is huge and to date it uses only about 5.0% of its available potential. According to the TAJ government, TAJ's river system accounts for an estimated 4.0% of the world's hydropower resources (UNDP(2014)).

Although TAJ's hydro power potential is huge its hydrocarbon reserves are very limited. Oil and natural gas reserves are insignificant with only 2 Mt of proven oil reserves and 6 bcm of natural gas. Its coal deposits are also relatively small with estimated at 375 Mt and 3,700 Mt of resources (BGR(2015)). TAJ's economy heavily relies on its unstable hydro power resources, and in times of deficiency it needs to import expensive oil and gas, which are inaccessible most of the time due to political hardship in relations with neighbors. To counter this obstacle the TAJ government decided to switch from oil and gas to inexpensive and readily available coal. This change is reflected in 100 time's increase of coal supply in energy mix of TAJ in the last decade just from negligible levels in 2002 to 0.2 Mtoe in 2012 (IEA(2015)). The government is also projecting rehabilitation of existing thermal power plants and building new coal-fired generations, which will add more demand for coal production and supply.

The past energy consumption data for the last 10 years demonstrate gradual and steady increase in energy consumption in TAJ reaching 2533 Mtoe in 2014 from 1957 Mtoe level in 2004. The birthrate in TAJ is the highest in the region and its population is predicted to increase by 1.6 times until 2050 reaching 14.2 million from current 8.4 million. This means further strong increase in energy demand, which will necessitate an appropriate measures for energy resource management and demand supply. Old, outdated and underdeveloped

infrastructure, particularly transmission and distribution lines, create the main bottleneck in energy crisis and need an urgent rehabilitation and modernization.

Our quantitative analysis for TAJ's GDP growth and energy production demonstrated positive correlation in both periods. This is positive and significant due to relatively stronger energy production volume, particularly hydropower, which is added by recent coal extraction development in the country. In order to make sure sustainable economic growth in the country TAJ needs to prioritize the development of its domestic energy production by investing into renewable and coal production.

4.3 Energy Trade Policies in the CAC

Transition from the Soviet Union to independence and open market economy necessitated all five CAC to build trade relations with neighbors and outside world. Since all countries of the region were less developed in the Former Soviet Union and mainly agricultural based economies, except KAZ, they immediately recognized that the export of their raw materials and natural resources can support their economies and may attract foreign direct investment into those areas. The CAC started to diverge in terms of international integration. Already by 1998 Kazakhstan, Kyrgyzstan and Tajikistan had joined several major RTAs with Russia, including the CISFTA in 1994, EurAsEc and SCO in 1996, while Uzbekistan and Turkmenistan were only observers (Mazhikeyev et al(2015)). Starting from 2000 the world prices for the primary export goods (oil, gas, cotton) had an increasing trend, which accelerated trade volumes and FDI inflows into the region. As a result all countries in the region enjoyed growing trade since 2000. The new discoveries of oil and gas reserves

attracted colossal investment into energy sector in hydrocarbon rich countries of CA, which eventually resulted in energy production growth and export. KAZ's oil reserves increased significantly, while both UZB and TUR discovered huge reserves of natural gas and developed extraction and production. KYR and TAJ also attempted to use their potential on development of hydro energy generation with further export of electricity to southern neighbors Afghanistan and Pakistan under CASA-1000 project with the support of World Bank and other international organizations.

After massive investment into development of oil, gas and coal extraction the share of energy in the structure of export commodities of KAZ and TUR reached more than 80.0% out of countries' total export, which made these countries dependent on energy exports and vulnerable to external risks such as oil and gas price decline. This kind of risk may affect UZB's economy as well since the share of gas exports in this country reached 30.0% of total export and forecast to grow further due to government's policy on development of coal for domestic demand and freeing natural gas for export. Among these three hydrocarbon resources rich countries KAZ is the biggest exporter with 62.1% out of regional exports volume, followed by TUR with its 30.0%. UZB's share is only 7.9% share, but expected to grow (Figure 4.6).

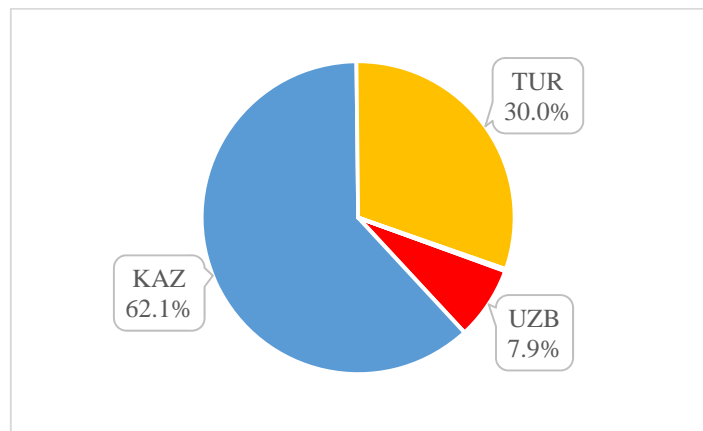


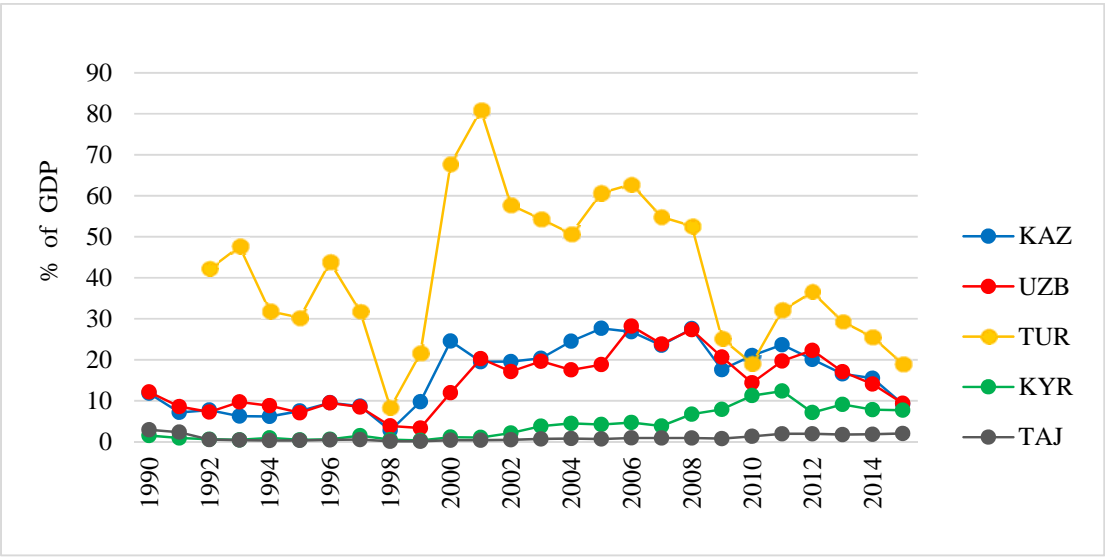
Figure 4.6: The share of energy exports in CA energy exporting countries

Source: IEA, <https://www.iea.org/statistics/>

The CAC's export destinations are limited due to their location in landlocked region of the Eurasian continent. They inherited the infrastructure from Soviet Union connecting only to the north: Russia. The lack of direct access to the sea and major energy consumer markets of Eurasia, and overdependence on Russian ports and pipelines kept these CAC's trade from developing. Therefore, the CAC promote the policy of building diverse routes to main energy consumer markets. KAZ, UZB, and TUR in cooperation with China already built three natural gas pipelines, increasing Chinese investment, production of gas and export from all three countries. KAZ together with India are considering another alternative route for oil export, by building oil pipeline to the south: to India. TUR ranks in the top 20 the most important countries exporting natural gas to the world with 41.6 bcm or 4.1% of world natural gas export share (BGR(2015)). TUR is doing every possible action to find alternative market for its natural gas, in order to decrease its overreliance to Chinese import. TAPI, a Turkmenistan-Afghanistan-Pakistan-India pipeline, is another route, which TUR is

considering to build to support its growing gas production and export. UZB has close and reliable relations with Russia, which buys large share of its exported gas. Location of UZB in the heart of Central Asia gives a good opportunity to direct its gas to all available and future markets through connected grids of all four other CAC.

The available data from World Bank as shown in Figure 5 indicates that the share of rent from natural resources has increased sharply in both groups I and II countries, starting in 1998, with marked spike in resource rich countries. TUR's share of rent from natural resources reached 80.9% of its GDP in 2001 and dropped to 18.9% in 2015, whereas KAZ's and UZB's share reached 24.5% and 20.2% respectively, maintaining same level over the last 15 years. By and large developing countries plan to achieve income growth and poverty decline. The main ingredient in the recipe of such advancement is to affect productivity increase and job creation, which require substantial amount of capital investment.



Data source: The World Bank: Diversified Development. Making the most of natural resources in Eurasia, 2014.

Figure 4.7: Total Natural Resources Rents in the CA during 1990-2014

According to the World Bank research from 2014 the 10 year period 2000-2010 as shown in Table 4.1 exhibited positive changes in both productivity and employment growth in all five economies. TUR, TAJ and KAZ had the highest productivity growth rates, while KAZ, UZB and TUR showed the highest employment growth rates. These positive changes in employment and productivity growth rates indicate notable and meaningful improvements in the efficiency in the use of energy resource rents in the CAC.

However, Table 4.1 shows that the volatility rate of output is particularly high in all countries of the region, except UZB, which could to some extent diversify its economy making it less specialized. The economies of TAJ and TUR are prone to high volatility due to overdependence on single export commodity such as natural gas for TUR and aluminum for TAJ and to fluctuations in the world prices of these commodities. High volatility rate has negative impact on steady economic growth of any country and in case of commodity driven economies of the CAC it makes their economies even more prone to the world financial crisis. The magnitude of high volatility has been felt by far in most recent two world crisis followed by sharp decline in commodities prices resulting contraction of sizes of economies and incomes. Persistent declining trend of commodities price and demand for major export goods since 2011 have even more damaging effects on economies of the CA. Thus it is important that we consider what strategies would be the most adequate to achieve sustainable growth

with minimum harmful effects from external risks such as global crisis and commodities price changes.

Table 4.1: Annual average changes in employment, labor productivity, and volatility (2000-2010)

Country	Employment growth	Productivity growth	Volatility of output
KAZ	2.2	5.9	3.3
UZB	2.9	3.6	1.1
TUR	2.2	10.9	4.8
KYR	1.9	2.1	3.3
TAJ	1.8	6.2	8.3

Unit: in percent

Note: The data taken from the World Bank: Diversified Development. Making the most of natural resources in Eurasia. 2014

The change, occurred in the world politics and foreign policies during the last decade, has significantly changed the trajectory of trade in the CAC. They expanded their oil and gas pipeline routes enabling to export directly to growing and potential markets, which significantly impacted economic growth in these countries. The net growth in oil demand comes entirely from non-OECD countries: for each barrel of oil eliminated from demand in OECD countries, two additional barrels of oil are consumed in the developing world. India and Nigeria are the countries with the highest rates of oil demand growth. China becomes the largest oil-consuming country in the early 2030s. Hydrocarbon resource rich CAC's energy trade policies envisage these trends and have a target to export their energy resources to those markets.

Chapter 5. Regression Models Forecasting for Planning Future Energy Strategies

5.1 Institutional foundations for growth and Current Energy Situation in the CAC

Acemoglu and Robinson (2013) claim that economic institutions are very important for the prosperity of the country, but the quality of economic institutions are determined by politics and political institutions in the country. Auty (2001) asserts that macro-economic policies of the mineral-rich economies should be buttressed by adequate institutions to maximize the transparency of public finances and the accountability of the government for the successful development of their mineral-driven economies. In case of CA the countries of the region inherited their economic and political institutions mainly from the Soviet Union. They tried to transform these institutions into modern ones, adhering to the principles of democracy and market economy during the post-soviet development. Tables 5.1a and 5.1b demonstrate the indicators of governance and institutional quality in the CAC in 1996 and 2016, which illustrate change in 20 years. Tables 5.1a and 5.1b show indices for the Control of Corruption (CC), Government Effectiveness (GE), Political Stability (PS), Regulatory Quality (RQ), Rule of Law (RL) and, Voice and Accountability (VA) in the CAC. Estimates give the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5. The lower the score the worse the indicator's quality. Government Effectiveness indicator in KAZ turned from -0.9584 in 1996 to -0.0607 in 2016, Political Stability index got better from -0.3689 in 1996 to -0.0446 in 2016, Regulatory Quality and Rule of Law indices improved from -0.3341 and -1.1865 in 1996 to -0.0999 and

-0.4172 in 2016. Only Voice and Accountability index turned negative from -0.9647 in 1996 to -1.2888 in 2016. This means that KAZ could achieve significant progress in changing the structure and core of its political and economic institutions, which had direct impact on business environment and redistribution of country's oil wealth. UZB also made positive changes in developing its indicators of governance and institutional quality. Despite these improvements, two indicators: Control of Corruption and Voice and Accountability turned negative in the last 20 years. In TUR the most important indicators, such as Control of Corruption, Regulatory Quality, Rules of Law, Voice and Accountability worsened. In Group II countries TAJ could achieve significant improvements in Political Stability, and other indicators, except Rule of Law and Voice and Accountability. KYR demonstrated the worst performances in all indices, except Voice and Accountability.

To conclude the CAC could improve to some extent their economic and political institutions responsible for sustainable growth and development. Natural resource rich KAZ and UZB made particular improvements in developing their institutions, while TUR and KYR made lesser changes. But still, there is big window for further improvement in all countries of the region. The positive changes over the years in institutional qualities indicators of the CAC can be considered as a reliable justification for our quantitative analysis and findings and for the future forecasts. In addition, it is worth to take into account that the region is in the process of transformation and the future growth depends on policies of countries in the region and further development of trade with other major energy consuming markets. Uncertainty in the southern borders of the region holds back further expansion of CA gas and oil to major energy

hungry countries: India, Afghanistan and Pakistan, which is possible through building new pipelines.

Table 5.1a: Index of institutional quality in the CAC in 1996 and 2016

	CC		GE		PS	
	1996	2016	1996	2016	1996	2016
KAZ	-1.1328	-0.8046	-0.9584	-0.0607	-0.3689	0.0446
UZB	-1.1288	-1.1964	-1.2006	-0.5958	-0.5457	-0.3437
TUR	-1.0215	-1.4640	-1.1497	-1.1400	0.4486	-0.3117
KYR	-0.9939	-1.0785	-0.3806	-0.8985	-0.1743	-0.6556
TAJ	-1.2730	-1.0729	-1.4061	-1.0213	-2.1139	-0.7924
CC – Control of Corruption; GE - Government Effectiveness; PS – Political Stability Source: World Bank Database, 2017						

Table 5.1b: Index of institutional quality in the CAC in 1996 and 2016

	RQ		RL		VA	
	1996	2016	1996	2016	1996	2016
KAZ	-0.3341	-0.0999	-1.1865	-0.4172	-0.9647	-1.2888
UZB	-1.7768	-1.6202	-1.2392	-1.1333	-1.6004	-1.8867
TUR	-1.3766	-2.0912	-1.4874	-1.5580	-1.5773	-2.1279
KYR	-0.2981	-0.3527	-0.7255	-1.0953	-0.7870	-0.4899
TAJ	-1.5216	-1.0932	-1.6482	-1.1777	-1.6458	-1.6725
RQ – Regulatory Quality; RL – Rule of Law; VA – Voice and Accountability Source: World Bank Database, 2017						

KAZ's economy is the largest in the region with the highest *GDP* and *GDP* per capita. As data analysis reveal, energy production in KAZ has positive impact on its economic growth. This impact is mainly due to export of its hydrocarbon resources to its major trade partners in Europe, China and Russia. The petroleum industry in KAZ accounts for more than 30.0% of the country's *GDP* and more than half of its export revenues (BIM(2016)). KAZ's total proved oil reserve equals to 30.0 billion barrels or 3.9 billion tons, representing 1.8% of world

total reserves. The Kashagan oil field is the new super-giant oil field, believed to be the fifth largest in the world, with total reserves of as high as 50 billion barrels of oil. The prospect of Kashagan oil field is promising to make twice as large as current capacity in coming years, with all potential extracted oil being directed to export, since KAZ's oil consumption is much smaller than its production. The growing export revenues partly come from natural gas as well. KAZ is endowed of natural gas with 2.0 tcm of proven reserves, 18th highest in the world. But associated petrol gas composes the main portion of these reserves, which means that the large portion of it is reused in production of oil. It is predicted that with the start of oil production in Kashagan oil field KAZ may significantly increase in production of associated gas sufficient to meet local demand and export. KAZ's 90.0% of power is generated by thermal power plants (75.0% coal fired plants and 15.0% gas fired plants). Other than hydrocarbon resources KAZ's renewables resource potential is huge. The potential of wind energy is over 18 times the capacity of electricity generating plants currently installed in KAZ (Karatajev et al(2016)). If KAZ can invest to renewable energy development and start to supply its domestic demand it can free hydrocarbons and boost its fossil fuels export, which can lead to much more robust economic growth in the country.

This important measure should be much urgent issue for UZB, where the relationship between energy production and *GDP* growth is far weak, and got even worth in the second period (2008-2014) with negative coefficient, showing the sign of growing problems in its energy sector. In the last 6 years total energy production in UZB declined 10.0% from 64.184 Mtoe to 57.858 Mtoe (Figure 5.1). This decline came mainly from oil and gas sectors, which

was caused by depleting resources and lack of sufficient investment into energy industry (OECD/IEA(2015)).

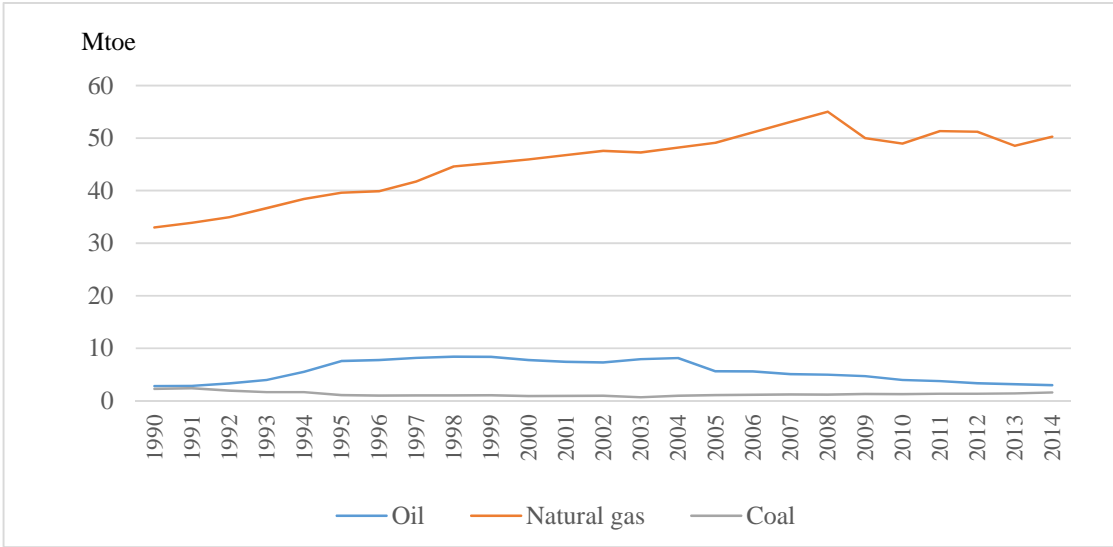


Figure 5.1: Oil, natural gas and coal production in UZB during 1990-2014.

..... Source: The IEA, <https://www.iea.org/statistics/>

Taking into account UZB’s depleting oil reserves and contraction of its oil production in recent years, and the positive impact of FDI on both its trade balance and export, focus on bringing more FDI into its economy would be strategically reasonable for UZB. UZB has already introduced comprehensive legislative packages providing investor privileges, financial incentives and guarantees for foreign investors, including special investment zones and tax breaks. But still many challenges remain, such as bureaucratic barriers, unfavorable currency regulation, excessive state interference and regulation on trade, price control, weak privatization process and property rights, and corruption (OECD/IEA(2015)).

The analysis of *EPR* and *GDP* growth examination in TUR revealed positive and statistically significant relationship between these variables, particularly for the period “after” the Lehman shock year 2008. Stronger growth in TUR’s energy production in the second period was activated by start of gas export to new alternative destination after construction of gas pipeline connecting TUR, UZB and KAZ with China in 2009. TUR has huge potential, enough to supply also its southern neighbors Afghanistan, Pakistan and India. It holds 32.3 tcm of proven natural gas reserve, which is equal to 9.4% of world gas reserves as of end 2015. It is one of the largest gas resource holder in the Caspian region and has the fourth-largest total offshore and onshore gas reserves in the world, behind Iran, Russia, and Qatar. There are 153 gas fields in TUR, including 142 onshore and 11 offshore gas fields in Caspian Sea. The largest gas fields are Dauletabad and Galkynish (also known as South Yolotan), located in the Amu-Darya and Mugrab basins with estimated reserves of 1.7 tcm and 1.3 tcm respectfully. With considerable increase of gas extraction from giant Galkynish gas field TUR could boost its gas production by 11.2% in 2014 (BGR(2015)).

The examination of relationship of trade balance with these variables *GDP*, *EPR*, *FDI*, *OP* and *NGP* in TUR has revealed that *EPR*, *FDI* and *OP* have positive and statistically significant impact on its trade balance. *EPR* in TUR has been growing steadily since 1998, which positively impact trade balance in the country through supporting mainly natural gas and oil exports. The positive impact of oil price to TUR’s trade balance could be explained by relatively stable production and export volumes of oil, while natural gas production and export showed its negative response price fall in international market. The volume of *FDI* to

TUR economy significantly increased after 2006 (Figure 5.2). This change is closely related with the opening of the country to the world as the change in its foreign policy.

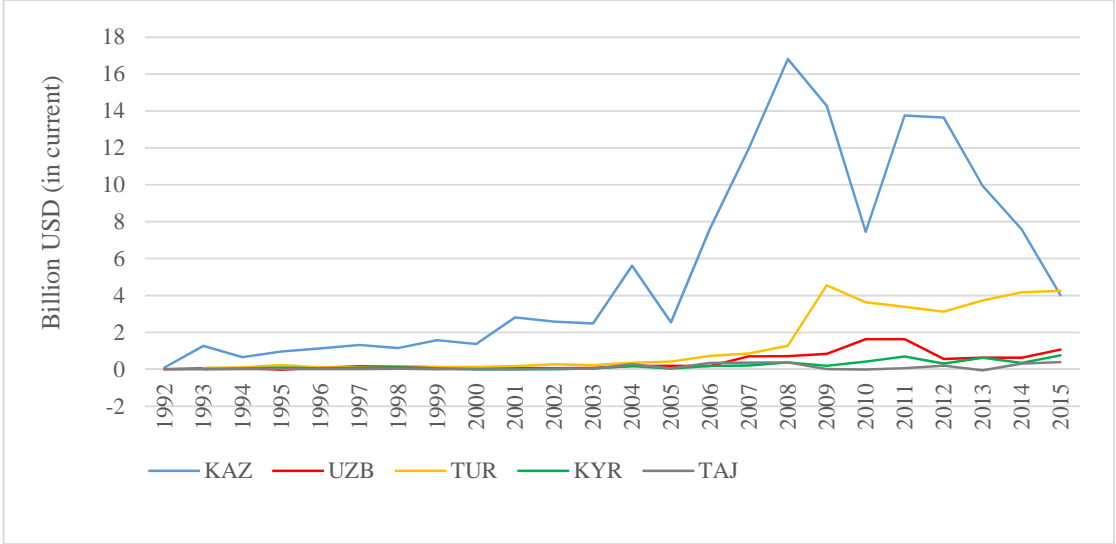


Figure 5.2: FDI Net inflows in the CAC (1992-2015).

Source: World Development Indicators, The World Bank (2016)

<https://data.worldbank.org/data-catalog/world-development-indicators>

The regression result for the period – I in KYR shows negative coefficient and insignificance of the relationship. However, this relationship “after” the Lehman shock year 2008 demonstrates positive outcome, and it is statistically significant. KYR’s energy mix has been dominated by hydro energy, which represented more than 80.0% of it since 2000. The situation changed by sizeable increase of coal production in the country starting from 2008. Its share in KYR’s energy mix increased from 9.1% in 2006 to 34.4% in 2014. KYR is the largest resource owner of coal not only in the region but also in the world, ranking number 16 among the top 20 most important countries possessing hard coal resources (BGR(2015)) (Table 5.2). Hydropower potential of KYR is ten times more than what is currently utilized

(3091 MW in 2015) (BGR(2015)). Through rehabilitation of old hydropower stations, transmission and distribution networks, and building new ones KYR can boost its energy production to supply its growing domestic demand, which eventually reduces its dependence on imports of hydrocarbons and impacts positively to its economic growth.

The regression results (see Table 2.2b) show positive and significant relationship between *EPR* and *GDP* growth in TAJ “before” and “after” the Lehman shock year 2008. This is due to steady increase in energy production in TAJ, which grew 0.7 times in 16 years period. However, the disposition of TAJ’s energy production is very similar to KYR’s energy production trend, only with differences in the volume of produced hydropower and coal. In 2006 the share of hydro power in TAJ’s energy mix represented 94.6%, which later declined significantly due to the growth of coal production, which reached to 21.5% in total energy mix of TAJ in 2014. TAJ can boost its energy production by turning its hydro and coal potentials into operation through attraction of foreign and domestic investment, which will impact economic growth in the country.

Table 5.2: The CAC’s Fossil Fuels Production and Reserves in 2014

Country	O.P.	O.R.	N.G.P.	N.G.R.	C.P.	C.R.
KAZ	82.1	4,082	32.1	1,929	109.0	25,605
UZB	3.2	81	59.3	1,632	<0.05	1,375
TUR	13.2	178	69.3	9,934	-	-
KYR	<0.05	5	<0.05	6	0.3	971
TAJ	<0.05	2	<0.05	6	0.6	375

O.P.: Oil Production; O.R.: Oil Reserves; (unit: Mt.); N.G.P.: Natural Gas Production; N.G.R.: Natural Gas Reserves; (unit: bcm.); C.P.: Coal Production; C.R.: Coal Reserves; (unit: Mt.)

Source: The IEA (2015), BGR (2015)

5.2 Assumptions for Forecasting Future Energy Strategies

As the past data for the CAC illustrate that all five countries' economies in the region experienced continuous growth showing large differences in its degree, we assume that this growth will continue with different pace. Our growth assumption for the year 2030 is based on two speculations: First, we take into consideration the previous trend of growth of variables: *GDP*, *EPR*, *Net FDI*, *OLP* and *NGP*, for the period of 15 years (2000-2015); Second, we also take into account the forecast of international organizations: the WB, IMF, IEA, International Futures (IFs) forecasting system (IFsFS) and the Pardee Center for International Futures at the University of Denver. Using IFsFS's forecast of *GDP* growth for 2030 in the CAC we calculate the predicted volume of *EPR* in the CAC employing coefficients of our first regression model: given in (1) in Chapter 2.

In our regression computations we observed the data for two periods: Period I (1998-2008), and Period II (2009-2014). Regression results for the Period II exhibit the recent trend in economic development of the CAC and therefore in making our assumption the second Period regression coefficients could give us more accurate predictions. Accordingly, we use coefficients of regression for the Period II in our computations.

Computational results are described on Table 5.3, which forecasts *EPR*'s volume in the CAC by 2030. Almost all countries' *EPR* is forecast to grow by 2030, except UZB. TUR's *EPR* is predicted to become four times larger than it was in 2014. KAZ's *EPR* will experience only 24% increase in comparing with 2014 *EPR* data, while UZB's *EPR* is projected to decline 0.04 times reflecting depletion of its oil reserves.

According to BMI (2017) despite its large gas production potential, TUR's actual gas production will remain limited by its export options, since Russia and Iran increasingly reducing TUR's gas. This maybe partially true taking into account recent developments in international political arena, with EU and other countries' sanctions to Russia, depreciation of oil and gas prices, Iran's developments of its domestic pipelines, which decrease demand for TUR gas. But at the same time TUR is discussing with its southern and western neighbors regarding building new routes and pipelines, which equally may increase the demand for TUR gas and accordingly increase production of natural gas and oil.

With current reserves and investment into KAZ's oil and gas industry BMI (2016) estimates that KAZ can steadily increase its oil production until 2024. Aitjanova et al. (2015) predict this growth even until 2035 with double increase in output, but this increase may not be feasible due to recent developments of renewables in energy industry and further decrease of demand to unaffordable oil.

Table 5.3: Energy Production Forecast for 2030 in the CAC

Country	<i>GDP</i>			<i>EPR</i>
	GDP.G.	F.G.	EST.	FC.
KAZ	6.57	3.13	338.3	218.0
UZB	6.88	5.11	139.7	53.6
TUR	8.08	5.27	95.82	323.7
KYR	4.06	3.21	11.93	2.6
TAJ	7.16	4.91	18.47	3.9

GDP G.: Average annual *GDP* growth rate in 1990-2014; *F.G.*: Forecasted average annual *GDP* growth until 2030; *EST.*: Estimate for 2030 (Billion USD); *FC.*: Forecast of *EPR* for 2030

Source: World Development Indicators, The World Bank (2016), World Energy Outlook 2014, IEA, and International Futures (IFs) forecasting system (IFsFS), <http://pardee.du.edu/>

In the next step, in order to forecast the future impact of the CAC's *EPR* on their trade issue, we integrate our *EPR* data for 2030 together with the predicted data for *GDP*, *Net FDI*, *OLP* and *NGP* to our regression model, shown in (2) in Chapter 3.

Table 5.4 presents our assumption on future growth in percentage, while Table 5.5 shows the future growth in 2030 in comparison with the data for 2014.

Table 5.4: Assumption (Growth in Percentage)

Countries	<i>GDP</i>			<i>EPR</i>			<i>Net FDI</i>		
	I	II	III	I	II	III	I	II	III
KAZ	6.6	3.9	338.3	5.1	1.7	218.1	3.6	3.6	12.1
UZB	6.9	6.2	139.7	0.1	-0.3	53.6	4.0	4.0	5.6
TUR	8.1	6.5	95.8	3.6	9.3	323.7	10.0	10.0	9.6
KYR	4.1	4.6	11.9	2.3	2.0	2.6	8.0	8.0	1.0
TAJ	7.2	5.9	18.5	2.3	4.9	3.8	5.0	5.0	0.9

I: Average annual growth rates of *GDP*, *EPR* and *Net FDI* in period 2000-2015; II: Forecasted annual growth rate of *GDP*, *EPR* and *EPR* in period 2015-2030; III: Estimates of *GDP*, *EPR* and *Net FDI* for 2030 (*GDP* and *FDI* in billion USD and *EPR* in Mtoe)

Source: World Development Indicators, The World Bank (2016), World Energy Outlook 2014, IEA, and International Futures (IFs) forecasting system (IFsFS), <http://pardee.du.edu/>

We are interested in measuring the size of impact of five variables described above on three factors such as the trade balance $E-I$, export capability E , and total volume of trade $E+I$ in the CAC. In Tables 5.4 and 5.5 we build our forecast for 2030. Data under number "I" is the average annual growth rate of *GDP*, *EPR*, and *Net FDI* in the CAC, which is used as reference data for prediction of the future growth. Under number II we use the forecasted data from international organizations: IEA, International Futures (IFs) forecasting system (IFsFS) and the Pardee Center for International Futures at the University of Denver. Data under number III shows the forecasted data for 2030. We forecast *GDP* growth of Group I

countries for 2030 lower than it was during the past 15 years. This is due to high growth in commodities' price, particularly oil (8.6% annual growth), compared to predicted 1.5% annual growth by 2030. We use assumptions of the *OLP* for I, II and III for all five countries as 8.6, 1.5 and 125, respectively. Assumptions on the *NGP* for I, II and III for all five countries are 1.9, 0.9 and 6.3, respectively. We know that the oil price grew drastically after 2000 and continued until 2008, and again after the short break peaked high. The average annual growth rate of the oil price in 2000–2014 constituted 8.6% reflecting oil demand and OPEC's stratagem. According to the IEA's World Energy Outlook 2014 the price of oil for 2030 is predicted 125 USD, which gives us an estimation of 1.5% average annual growth of oil price in comparing with 2014 price. In our computations we rely on IEA's forecasted *OLP*, based on the following reasons, which demonstrates the slowdown in *OLP* growth in coming years: 1) The growth of renewables share in world energy consumption due to technology developments and gradual decrease of cost for such technologies; 2) The development of shale oil in US and Canada and other main oil consumer countries, which balances the growth of oil price, mainly driven by Organization of the Petroleum Exporting Countries (OPEC). For *NGP* forecast, in the similar way, we look back to the past trend of growth in *NGP* in 2000-2014, which illustrates 1.9% average annual growth in *NGP*. However, IEA forecasts moderate growth for coming 2030 with 0.9% average annual growth rate. As we had admitted earlier about steady growth of renewables share in energy mix, and development of shale oil and shale gas in recent years, the demand for natural gas may not be strong as in previous years. However, because of governments' policies and commitments

on lowering CO₂, demand for the cleaner energy sources, global demand for natural gas is predicted to increase in the future. Taking into account these factors we based our forecast for *NGP* on IEA's forecast for 2030.

Table 5.5: Assumption (Growth in Numbers)

	<i>GDP</i>		<i>EPR</i>		<i>Net FDI</i>		<i>OLP</i>		<i>NGP</i>	
	2014	2030	2014	2030	2014	2030	98.9	125	5.4	6.3
KAZ	183.0	338.3	166,2	218.1	7.5	12.1	98.9	125	5.4	6.3
UZB	53.8	139.7	55,8	53.6	0.6	5.6	98.9	125	5.4	6.3
TUR	34.9	95.8	77,9	323.7	4.1	9.6	98.9	125	5.4	6.3
KYR	5.8	11.9	1,9	2.6	0.3	1.0	98.9	125	5.4	6.3
TAJ	7.4	18.5	1,7	3.8	0.3	0.9	98.9	125	5.4	6.3

Units: *GDP* and *Net FDI* in billions USD, *EPR* in Mtoe, *OLP* and *NGP* in USD

Source: World Development Indicators, The World Bank (2016), World Energy Outlook 2014, IEA, and International Futures (IFs) forecasting system (IFsFS), <http://pardee.du.edu/>

5.3 Numerical Results and Their Analysis for the Future Forecasting

We show numerical results for forecasting the target year 2030 for each of *E-I* (trade balance),

E (export capability) and *E+I* (total volume of trade) in Table 5.6.

Table 5.6: Numerical Results

		2014	2030, Estimate
KAZ	<i>E-I</i>	1.12	2.51
	<i>E</i>	67.72	83.60
	<i>E+I</i>	124.29	164.69
UZB	<i>E-I</i>	-25.26	2.23
	<i>E</i>	14.55	33.80
	<i>E+I</i>	31.63	65.37
TUR*	<i>E-I</i>	10.15	20.98
	<i>E</i>	25.71	69.54
	<i>E+I</i>	41.37	118.09
KYR	<i>E-I</i>	-3.75	-5.57
	<i>E</i>	2.79	4.38
	<i>E+I</i>	9.34	14.34
	<i>E-I</i>	-4.18	-7.49

TAJ	<i>E</i>	1.63	2.09
	<i>E+I</i>	9.34	14.34

(Units: billions USD)

* TUR's data for *E-I*, *E*, and *E+I* are for 2012

In KAZ *EPR* has the huge impact on its trade. Trade balance *E-I* is forecast to improve more than twice by 2030, while export capability *E* and total volume of trade *E+I* are predicted to grow significantly. We also found that *GDP* growth in KAZ has a positive impact on *EPR*. In a nutshell, *EPR* is strongly correlated with *GDP* growth and healthy trade even in 2030 forecast figures in KAZ.

In our model for the Period I, the UZB's *GDP* growth showed high correlation with its *EPR*. However, this correlation disappeared in the second period. The reason may be due to capacity/production constraints of UZB. This is the red flag. Our hypothesis was that *GDP* growth should bring *EPR* growth provided there is potential. In UZB case, our regression results is showing that *EPR* could not catch up the *GDP* growth. Accordingly, the *EPR* impact on foreign trade is statistically insignificant. This can show the diversification of the UZB economy, which may work effectively, and moreover (at the same time) this might also imply to severe reserve constraints of the fossil fuels, and thus not utilizing the huge potential to produce renewable energies. Although our forecast for 2030 foreign trade shows that there will be no trade deficit, we can highly recommend UZB government to utilize huge potential to produce the renewable energies which can further strengthen the foreign trade indicators.

For TUR, the *GDP* growth was highly correlated with *EPR* in both periods; however, the Period II demonstrated stronger impact of *GDP* growth on *EPR* growth. This is possibly due to building of new pipeline routes to China followed by large volume gas exports and

massive Chinese investment into energy sector of TUR. Trade balance $E-I$, export capability E and total volume of trade $E+I$ in TUR are expected to grow more than twice by 2030, which demonstrates the highest positive impact of EPR on trade indicators among the CAC.

Interestingly enough KYR's GDP growth turned to have positive correlation with EPR in the Period II. This is partly due to significant increase of coal in energy mix of KYR during the Period II. As we have mentioned in UZB case, we generally believe that GDP growth should be positively correlated with EPR growth. This might imply that policy makers should consider other alternative energy sources, such as wind, solar and biomass. At the same time, KYR's EPR has statistically significant negative correlation with E and $E+I$. The possible reason for this negative correlation is energy import dependence of KYR economy. In our forecast of 2030 foreign trade figures, the trade balance is expected to be negative, which highlights the importance of investing in domestic EPR . KYR has vast potential of developing hydro energy generation with further exporting opportunities. It is also rich in coal reserves, and development of extraction of coal can free the country from fossil fuel import dependency.

In TAJ GDP growth has positive correlation with EPR in both periods. This correlation is weak in the Period II mainly due to possibly lower investment and lower growth in EPR . TAJ's EPR has statistically significant negative correlation with $E+I$. The possible reason for this negative correlation is energy import dependence of TAJ economy. Likewise KYR, TAJ also imports its oil, gas and coal resources from hydrocarbon rich neighbors. In our forecast of 2030 foreign trade figures, the trade balance of TAJ is also expected to be negative,

while export capability E and total volume of trade $E+I$ in TAJ are expected to grow slightly by 2030. TAJ has significant volume of coal reserves, however, the infrastructure to extract coal is underdeveloped and requires substantial investment to develop.

Chapter 6. Conclusions and Policy Recommendations

6.1 Summary and Conclusion

The main objective of this study is to examine the impact of energy production on economic growth and trade in five CAC, and to find future energy strategic policy focusing upon the trade of energy resources in the CAC. We are interested in CA as these countries possess great volume of hydrocarbon resources, and demonstrated strong growth in production and export of energy resources in recent years, supported by each country's independent energy policies and strategies. The study covers the time period of 23 years starting from 1992 (following the collapse of the Former Soviet Union (FSU)) up to 2014.

To investigate the relationship between energy production and economic growth we use mathematical model explaining correlation of *EPR* and *GDP* by applying this model for two periods of growth in the CAC economies: "before" and "after" the Lehman shock year 2008, as 1998-2009 and 2009 -2014. To investigate the impact of energy production (*EPR*) on trade, we apply another mathematical model using data on *GDP*, *EPR*, *FDI*, *OLP* and *NGP* as independent variables and trade balance (*E-I*), export potential (*E*), trade (*E+I*) data as the main dependent variables. The data analysis on the CAC economies distinguish countries into two categories: a) countries with large *GDP*, *GDP* per Capita, energy production and export volumes, and b) countries with smaller *GDP*, *GDP* per Capita, energy production and export volumes. Based on these characteristics we divide the CAC into two groups: Group I (KAZ, UZB and TUR) and Group II (KYR and TAJ).

The relationship between *EPR* and *GDP* has been proved positive for both periods for KAZ, TUR and TAJ. In KAZ energy production grew almost proportionally to its *GDP* growth, reflecting its massive production and export growth of oil with favorable price increase in international oil market. Estimations for TUR's energy production and economic growth demonstrate the higher elasticity for its Period II on the grounds that the natural gas pipeline to China was completed in 2009 and TUR started exporting its natural gas to China. Interestingly, regression computation gave positive and significant result for TAJ in both periods, which has vast potential on hydro power generation. The historical data of TAJ's *GDP* and energy production demonstrate balanced and interdependent growth in this country.

Estimations for UZB gave two different outcomes. In Period I we could detect the statistically significant relationship between energy production and economic growth. But in Period II estimations for UZB exhibited decrease, reflecting its oil depletion and growing dependency on imported oil. The negative relationship between *GDP* growth and *EPR* in UZB for the Period II demonstrates less dependency of UZB economy on energy production and export. While this in a certain degree testifies more diversified status of UZB economy, which is favored widely, actually it makes negative influence to its economy. Therefore UZB should take vigorous measures to make best use of its hydrocarbon reserves and potential of its renewable sources by creating attractive environment for foreign capital inflow into its energy sector and other industries.

Opposite to UZB's case, in KYR's case the second period demonstrated statistically significant and positive relationship between energy production and economic growth, which is the result of significant growth in coal production in the country after 2008. The sizeable increase of coal production in the country changed its share in KYR's energy mix from 9.1% in 2006 to 34.4% in 2014.

GDP impacts trade balance, export potential and total trade differently. It has slightly negative effect on trade balance, while it gives mostly significant and positive impacts on both export and total trade volume. *GDP* increases bring export increases, however, similarly sometimes more slightly increases for imports in most CAC. Energy production brings significantly positive impacts on all trade factors, among them in particular large impacts on export capability and trade volume. It has significant positive impact on trade balance and energy potential of two large energy exporting countries KAZ and TUR. Hydrocarbon resources poor countries KYR's and TAJ's *EPR* has rather negative impact on trade activities since countries depend on import of fossil energy resources such as oil and natural gas. *FDI* causes significantly positive impacts on trade balance of UZB and TUR, reflecting large *FDI* from China.

Oil price increase brings rather negative impacts on the trade balance, while only TUR has significantly positive impact. On the other hand natural gas price increase brings rather positive impacts in all countries, except TUR. This might result from the fact that KAZ depend upon oil production and export a lot, thus oil price increase brings a negative impact on trade balance as it decreases demand for oil, while TUR depends on mostly natural gas

rather than oil. Therefore oil price increase brings higher trade revenue from higher natural gas export income. Interestingly, natural gas price increase brings significantly negative impacts on all trade activities for the natural gas depending country TUR.

Our findings can be summarized as follows:

1. *EPR* growth has a statistically significant positive impact on *GDP* growth in fossil-fuel rich KAZ, UZB, TUR, and hydro energy rich TAJ.
2. *GDP* growth has positive impact on export potential and total volume of trade in the CAC, although it has slightly negative impact on trade balances.
3. *FDI* had a significant influence on balances of trade in the cases of UZB and TUR.
4. *EPR* brings for Group I countries significantly positive impact on all trade factors, among them in particular large impact on export capability and trade volume.
5. Group II countries' *EPR* has rather negative impact on trade activities since countries depend on import of fossil energy resources such as oil and natural gas.
6. *OLP* and *NGP* increases bring positive impact on the trade balance of TUR and KAZ, respectively.

6.2 Policy Recommendations

Since *EPR* is correlated with *GDP* growth and healthy trade even in 2030 forecast figures, we can recommend Group I countries to continue to focus on energy production by investing more on exploration works of new hydrocarbon reserves, upgrading infrastructure in both demand and supply side through energy saving policies and development of renewables, where all the CAC has huge potential.

The negative correlation of energy production and economic growth in UZB's second period raises concern and requires from its policymakers to reconsider energy policy in the country. UZB has a huge potential and its hydrocarbon reserves are considerably high. Contraction of its inefficient and dominant energy consumption, including energy saving measures may help UZB to improve its situation. Although our forecast for 2030 foreign trade shows that there will be no trade deficit, we can highly recommend UZB government to utilize huge potential to produce the renewable energies which can further strengthen the foreign trade indicators.

In Group II countries *GDP* growth is positively correlated with *EPR* for both countries in the Period II, which suggests investment into development of other types of fuels in the country may provide sustainable growth. *EPR* has statistically significant negative correlation with total trade *E+I* in both *KYR* and *TAJ*, since both countries significantly rely on imports of energy resources. Our forecast for 2030 demonstrates negative foreign trade figures for both *KYR* and *TAJ*, which stresses the importance of investing into development of domestic *EPR*, especially in coal and renewables.

In this research we established the correlation between energy production and economics growth in the CAC and recognized the importance of further increase of energy production for sustainable growth of respective economies. In addition, the CAC have a considerable room to improve productivity and this room is large not only in their energy sectors, but in all sectors of their economies. Productivity growth is the backbone of economic growth, which requires substantial amount of capital investment. Therefore the gradual redistribution

of revenues from the commodity export into productivity growth in all sectors of economies should be the long-target goal in the CA economies. This in turn can make their economies more diversified, stronger to unpredictable and vulnerable external factors, such as demand decline and price fall of commodities. Improving indicators of governance and institutional qualities should be another priority for the CAC since the better the indicators the more foreign and domestic investment can be invested into their respective economies to promote production and improve productivity in order to support sustainable growth in the CAC.

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