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Natural Resources, Physical Capital and Institutions

Evidence from Eurasia

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Abstract

Natural resource abundance can lead to strong economic growth if resource rents are well invested in physical assets and other forms of productive capital. This paper focuses on the case of the resource-abundant economies in Eurasia, which has been less documented in the literature on natural resource-led development than other parts of the world. The analysis shows that the stock of productive physical assets is relatively low, contrary to common perceptions about the Soviet system. The infrastructure that was inherited from the Soviet system primarily serves to meet basic human needs; few assets support the development of competitive and sustainable economies. At a deeper level, the paper documents that low accumulation of physical capital over the past two decades has been driven by weak institutions and economic policies associated with the presence of resource rents, along with a poor public investment management process. This paper complements existing empirical studies by presenting evidence on the mechanisms through which natural resources and physical capital have interacted in setting Eurasian economies on a fragile development path.

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Natural Resources, Physical Capital and Institutions

Evidence from Eurasia[1]

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Sector Boards: Poverty Reduction and Economic Management; Infrastructure.

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Wealth in Eurasia[2] is highly dependent on natural resources. Eighty-five percent of the region's GDP is produced by the five countries—Russia, Azerbaijan, Kazakhstan, Turkmenistan, Uzbekistan—that are rich in hydrocarbon and mineral resources. The extractive industry represents between 10 and 25 percent of these countries' GDP (IMF 2012). In Russia and Azerbaijan, oil generates 25 percent and 64 percent, respectively, of fiscal revenues. The remaining seven countries in the region—Armenia, Belarus, Georgia, Moldova, Kyrgyz Republic, Tajikistan, and Ukraine—depend indirectly on natural resources as well. Naftogaz, the Ukrainian state-owned gas company, accounts for 10 percent of the country's GDP (Mitra and Atoyan 2012).

In principle, the abundance of natural resources offers opportunities to finance sizable investments in capital crucial for economic development. Exploitation of non-renewable natural resources yields extra-ordinary profit (or natural resource rents) which, if well harnessed and managed, can be used to build physical, human, and institutional capital and promote economic and social development. For example, the availability of natural resources within the national economy has played an integral role in the economic development of countries such as Australia, Canada, and the United States. Many mineral-rich countries, such as Botswana, Chile, Indonesia, and Malaysia, have used revenues from their vast natural resources to finance diversified investments and a make a "big push" in industrial development (Sachs and Warner 1997). In contrast, countries such as the Democratic Republic of Congo and Niger have not been able to mobilize natural resources effectively for investment and they remain largely dependent on development aid. Being rich in natural resources does not necessarily lead to sustained, strong growth.

The positive effect of natural resource abundance on economic growth depends on the endowment in (human, institutional and physical) capital. Bravo-Ortega and de Gregorio (2007) found that the larger the stock of human capital, the more positive was the marginal effect of natural resource abundance on growth. Lederman and Maloney (2007) echoed this message, noting that rich countries that successfully used their natural resources to further development outcomes, such as Australia and Norway, did so on the basis of high and growing levels of human capital. Similarly, resource-rich countries with good economic and political institutions are more likely to develop along a path of relative prosperity, instead of being caught in a low-level equilibrium of economic performances or suffer from a "natural resource curse". A similar outcome applies for those countries with good macroeconomic performances in

[2] Eurasia refers to the Post-Soviet states—Russia, and the Central Asian and the Trans-Caucasian Republics—, with the exception of the Baltic States.

terms of high GDP and investment rates and a good stock of infrastructure assets (Gylfason 1999; Barma and others 2012).

The public sector plays a critical role to ensure that natural resource wealth translates into sustainable development outcomes. Natural resources management spans a great many specific and inter-related decisions on the part of the government in interaction with resource developers (private and state-owned) and society. Two key issues emerge in characterizing how a government manages its natural resources: (1) How effectively does a government generate and capture rents from extractive industries? (2) How does the government spend resource wealth and to what extent is it invested in a sustainable, pro-development manner? In essence, outcomes can be reduced to two core areas: generating rents through extraction and taxation, and distributing rents through spending and investment (Barma and others 2012).

Building a solid stock of physical capital is one of the most promising avenues to transform resource wealth into assets that enhance economic growth and collective social welfare. In particular, strong public investment helps the economy accumulate the infrastructure and skills it needs to grow quickly (Commission on Growth and Development 2008). It is a key policy tool to support sustained, strong growth, provided that governments offset the natural resource depletion by reinvesting the rents they receive from extractive industries into productive assets. Too often, resource-rich countries pursue short-sighted, sub-optimal policies by allocating these rents in ways that privilege elite private consumption rather than public investment. This paper focuses on the resource-rich and other countries of Eurasia. It addresses two important questions: does the region fully exploit opportunities derived from natural resource abundance to invest in physical assets? And if not, what are the weak links?

The paper is organized as follows. Section 1 describes the stock of infrastructure assets. Section 2 examines the accumulation of physical assets since the break-up of the Soviet Union in 1991. Section 3 investigates the transformation of natural resource wealth into public capital. Section 4 offers some concluding remarks. The analysis uses several groups of comparator countries, including the EU12, EAP12, and other resource-rich countries in the world.[3]

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[3] Comparator groups include: EU12 (Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia), and EAP12 (Cambodia; China; Indonesia; Republic of Korea; Lao, PDR; Malaysia; Papua New Guinea; Philippines; Singapore; Taiwan, Thailand; Vietnam).

1. INFRASTRUCTURE ASSETS

Geographical Context

There are tremendous geographic challenges to overcome in order to connect Eurasian countries to the rest of the world. Eurasia scores low along the three spatial dimensions accompanying the development process—density, distance and division (World Bank 2009a). Less than a third of the regional population lives in cities, and in Tajikistan and the Kyrgyz Republic urbanization levels are less than 20 percent. Russia counts among its urban areas about a thousand mono-towns, those which are built around a single industry. Some of these mono-towns—particularly those specialized in extractive industries—are in remote areas with difficult accessibility and harsh conditions (World Bank 2011b). Distances within countries such as Russia and Kazakhstan are enormous. Many landlocked countries, such as Kazakhstan, Kyrgyz Republic, Tajikistan and Uzbekistan, are over 3,000 km from the sea. These countries have small domestic markets that are far remote from the greater world economy. Finally, the division index, which captures the sociopolitical geography (religion, ethnicity, and language) is more than 1—compared to about 14 for OECD countries. Within this geographical context, connectivity plays an even greater role in supporting economic development. Without good physical connections, such diversity could breed disparity rather than prosperity.

Relative to the rest of the world, some countries in Eurasia are highly exposed to future climate change relative to today's natural variability. There is evidence that average temperatures across Eurasia have already increased by 0.5^{o}C in the south and 1.6^{o}C in the north (Siberia), and overall increases of 1.6 to 2.6^{o}C are expected by the middle of the century. Eurasian countries are also facing a changing hydrology, and more extreme events—droughts, floods, heat waves, windstorms, and forest fires. Sea level has been rising in the Black Sea. The most exposed countries to climate extremes include Russia and Armenia, and to a lesser extent, Tajikistan (World Bank 2009b).

How relevant is this exposure to climate shocks for infrastructure? The high exposure to climate shocks adds stress to the existing infrastructure systems. Rising temperatures and a changing hydrology have a negative effect on water systems. Sea level rise threatens the destruction of numerous ports and towns along the Russian, Ukrainian and Georgian coasts. With rising summer temperatures, the power sector is under stress to respond to peeks in electric demand and periods of intense heat strain the transmission networks. More intense precipitation makes sub-grade pavement less stable and weakens retaining walls. Greater extremes in temperature add to road deterioration, as has already happened in Kazakhstan, where truck travel has to be limited on the hottest summer days when the asphalt softens.

Depending on whether the infrastructure stock is well-constructed, maintained and recent, countries will be more or less able to cope with increasing extremes, weather storms, heat waves, or floods.

Legacy of the Soviet System

Eurasian countries inherited from the Soviet system more infrastructure assets than is typical in countries at similar levels of per capita income. Eighty-nine percent of the road network in Eurasia was paved, compared to less than half in countries at a similar level of development (Annex A). The road network covered rural areas as well, with 75 percent of the rural population living within 2 kilometers of an all-weather road. In addition to the 1.1 million kilometers of roads, Eurasia's public transport sector included 142,000 kilometers of rail, 9,000 km of trolleybus lines, 4,000 km of tram tracks and 0.7 thousand km of subway lines, as well as about 112,000 km of inland waterways, 241,000 km of gas pipeline, and 81,000 km of oil and petroleum pipeline. Rail networks were vast and hauled raw materials and heavy goods across long distances, especially to support the intraregional trading arrangements of the Council of Mutual Economic Assistance. Azerbaijan, Armenia, Moldova and Ukraine, for example, had a railway density comparable to the United States—and four times that of China.

Heavy investments in physical assets during the Soviet years translated into virtual universal access of the population to basic infrastructure services. For example, 98 percent of the population in cities had nominal access to improved water sources and 81 percent in rural areas—a level at par or above that found in middle-income countries. The region's access rate of the rural population to water (87 percent) was notably higher than that in comparator countries (i.e., EAP12 = 80 percent). The access rate to improved sanitation showed significant discrepancies between resource-rich countries (79 percent) and other countries (98 percent) in the region, but was universally high compared to other middle-income countries, such as EAP12 (63 percent). Per capita electric power generation in resource-rich countries of Eurasia was about twice that of the middle-income average. And access to fixed telephone line was well above that found in middle-income countries, with mobile phone penetration equally high. At the break-up of the Soviet system in 1991, Eurasia was endowed with most of the infrastructure to meet basic human needs.[4]

Deterioration in the Asset Base

Although Eurasia inherited a solid infrastructure stock, it rapidly lost the chance to capitalize on this endowment. While the Soviet system supplied a large quantity of infrastructure assets, this stock had

[4] 50 million people were left without access to improved sanitation and 17 million to improved water sources.

little relation to cost (especially of energy), and prices seen by users were suppressed and distorted by heavy state subsidies or internal cross-subsidies. In water, for example, cost recovery was very low, with water utility revenues estimated to cover only 61 percent of operational costs in Russia. This low revenue base translated into a cycle of underinvestment, poor maintenance, rising costs, and deterioration of infrastructure.

The economic decline in the early 1990s was accompanied by a sharp reduction in the production and consumption of some infrastructure services. The maintenance and upgrading of what had come to appear to be an oversized infrastructure stock became an early investment casualty of that economic decline. The consequence was a steady deterioration in the infrastructure stock. For example, in the energy sector, the deterioration in the asset base and the associated loss of both capacity and efficiency proved that, by the end of 2007, a number of countries experienced periodic energy shortages, with a serious energy crunch appearing imminent (World Bank 2010).

Climate shocks further deteriorated the stock of existing assets. Severe floods in Russia, Tajikistan and Georgia led to landslides and slope failures, causing deaths from drowning and collapsing road and railway lines. The 2000-01 drought was estimated to have cost Georgia and Tajikistan 6 and 5 percent of their respective GDPs. Warmer temperatures and resulting ground settlement in permafrost areas of Russia began to destabilize a number of infrastructure structures, including a power station, an airport runway and residential buildings. The effect of poor road design standards, coupled with low maintenance, showed when roads began to deteriorate due to the more extreme heat conditions of Central Asian summers (World Bank, 2009b). For example, the Kyrgyz Republic reports losses of about 200 km of roads every year due to vast distances, difficult terrain, extreme temperatures, excessive loads, and lack of road maintenance budgets.

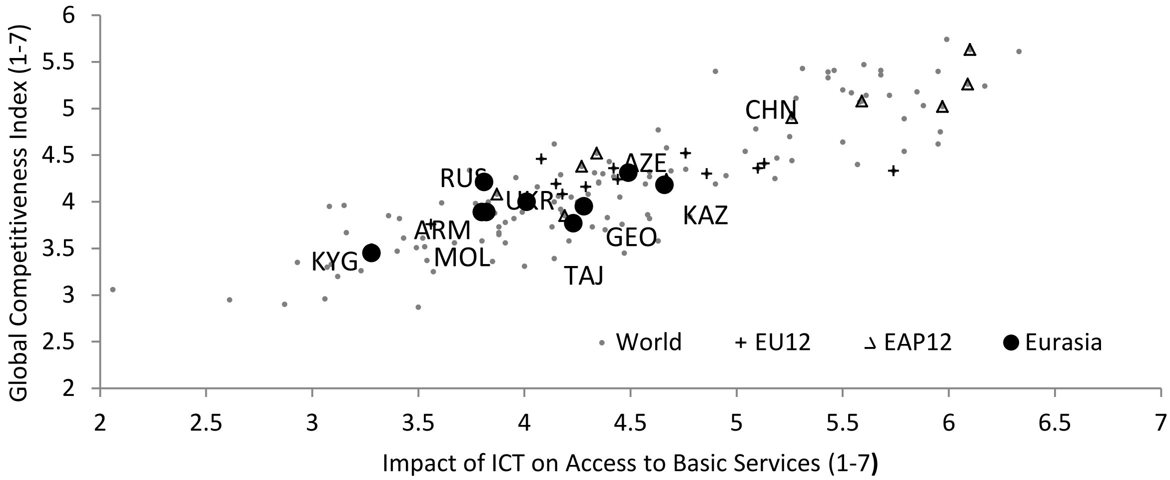
The quality and reliability of infrastructure services became an overarching concern throughout the region. Although Eurasia had nominally high access rates to improved water and sanitation, the quality and reliability of water systems was often poor. Even in capital cities, possibly less than 65 percent of connected households enjoyed 24-hour supply, and performance was typically worse in smaller towns. For example, in Armenia, less than 20 percent of urban settlements had water 24 hours a day in 2000 (Kessides and Khan 2009). According to the 2005 Business Environment and Enterprise Performance survey, transport services worsened, probably reflecting congestion and the declining road quality. With the exception of Kazakhstan (which shows a slight improvement), all other countries in the region showed a decline in the quality of infrastructure services between 1991-95 and 2001-05 (Annex B).

New investments took place in some sectors, including information and communications technology (ICT) and energy. For example, internet bandwidth increased dramatically over the last five years, although only in a few countries. In Russia, less than 10 percent of the population had access to internet services in 2000; half of the population now has access to the internet, compared to 62 percent in the EU12, and 35 percent in EAP12. In terms of power generation, Eurasia lost 10 gigawatts of electricity generation capacity throughout the 1990s, but saw a small rebound between 2000 and 2005, mostly in Russia. However, total electricity generation had not yet recovered to its 1990 level in 2005. As a result, the gap in access to electricity between Eurasia and comparators like EAP12, which used to be quite wide in the 1990s, had significantly narrowed by 2010.

Outgrowth of the Asset Base

Evidence from Asia and high-income countries shows that the demand for infrastructure services continues to increase along with income, once the infrastructure needed to meet basic human needs is in place. That increase in infrastructure demand became apparent in Eurasia in the 2000s. As economic growth rebounded in Eurasia in the 2000s, many countries started outgrowing their asset base. For example, as trade volume and personal income started to grow, the proportion of motor vehicles and the intensity of road traffic increased. Because roads had been designed for smaller loads, increases in the volume of freight and passenger traffic rapidly translated into road overload, deterioration in road conditions, slowdown in traffic speed, and substantial growth in fuel consumption and air pollution. Sustaining the volume of traffic required the reinforcement of pavement for about 70 percent of roads and the construction of new infrastructure (e.g., roadside infrastructure, missing links). As another example, Eurasia's enhanced openness to trade and competition with Europe and Asia made it even more important to be well-positioned on ICT. Eurasia probably had a high penetration rate in fixed and mobile phone lines, but lagged significantly in the adoption of more advanced ICT, such as broadband services—in which a single transmission line can carry a large number of signals, offering high-speed connection to millions of users at the same time—which are critical for competitiveness.

Figure 1: *Global competitiveness and supply of second-generation infrastructure*



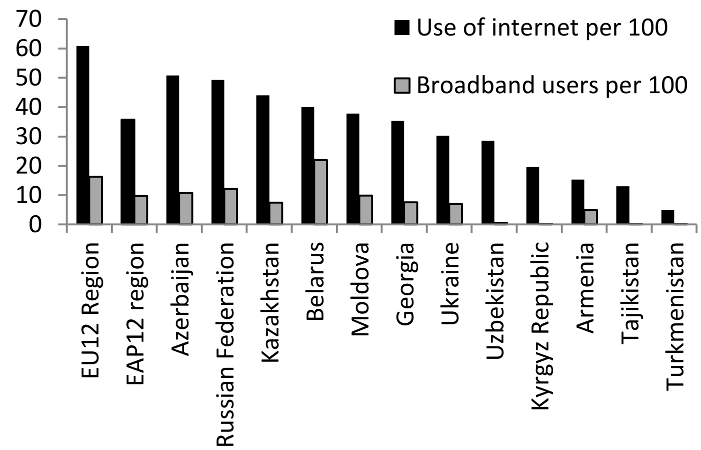
Source: World Economic Forum (2012)
Note: GCI index based on successive aggregations of scores from the indicator level all the way up to the overall GCI score. Uses annual Executive Opinion Survey, ranking out of 144 economies and scores measured on a 1-7 scale.

As income grows, the demand for infrastructure services increases, but for a different type of assets—second-generation-type assets that help in accelerating growth and even shift countries towards a more sustainable development trajectory (World Bank 2011a). Specifically, second-generation infrastructure includes projects that seek to maximize co-benefits among infrastructure sectors, or between these sectors and the environment. An example of first-generation infrastructure is a pipe system that connects households to an improved water source. A pipe system that is enhanced with an ICT solution to optimize water use is an example of second-generation infrastructure (e.g., ICT-based water metering). We find that economies that are most advanced in exploiting complementarities between sectors are also those that are the most competitive (Figure 1).

Is Eurasia well-endowed with second-generation infrastructure assets? We find that Eurasia ranks low or average relative to the rest of the world. For example, ICT solutions are only moderately used to enhance the access to basic infrastructure services (Figure 1). As another example, much of the core infrastructure across sectors is being developed alongside national fiber optic infrastructure. The region is not yet fully exploiting the benefit of sharing the existing infrastructure across the energy, transport and telecom sectors (ducts, towers) or coordinating the linear rights of way across sectors to get more out of the existing infrastructure. More broadly, we find that the region is lagging in terms of the following components (World Bank 2011a):

- ICT infrastructure and policies and systems that support efficient and deep production networks and supply chains;
- Interconnected, environment-friendly transport networks with road, rail, sea, and air links that promote trade and investment within the region and with global markets, and widen access to markets and public services;
- Green energy projects that allow countries to benefit from natural endowments, providing efficient and secure supplies of electricity, coal, gas, oil, and alternative energies;
- Sustainable management of water resources that is aligned with urban growth, change in land use, and agricultural and industrial use.

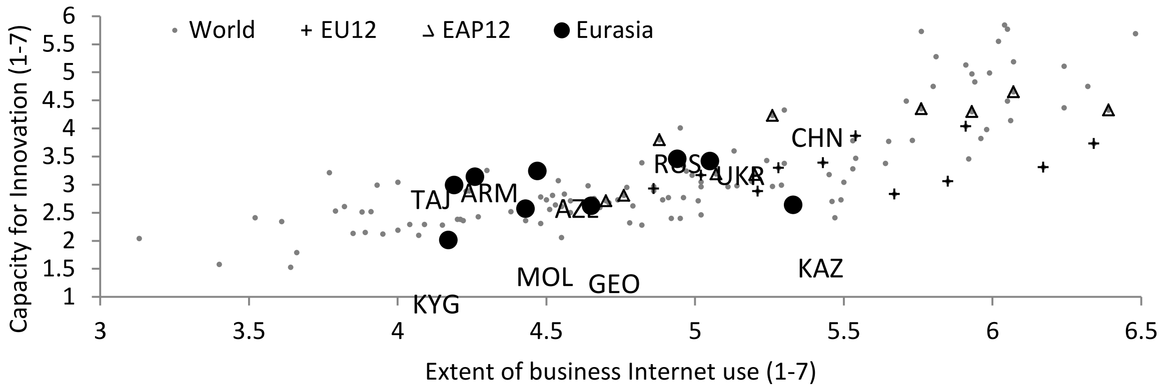
Figure 2: *Internet and Broadband Services*



Source: World Bank, WDI

Some Eurasian countries have been taking off in terms of mobile phone and access to internet services (Figure 2). Mobile phones are very common, but are only used for their voice feature, and are under-utilized for data potential. In the same vein, access to internet services has grown exponentially over the last five years, but its use has been well below its potential. Comparing globally, we find that Eurasia lies ahead of lower middle-income countries, but behind the EU12 and EAP12, with businesses having both a low use of internet and a low capacity to innovate, research and pioneer new products and processes (Figure 3). Part of the problem lies in the limited connectivity of those countries to broadband services. Kazakhstan has about 7 broadband users per 100 people, compared to 30 in the United States. This lag in high-speed connectivity seriously hampers firms' ability to use the internet effectively. This observation is consistent with firms increasingly reporting telecoms has a problem in 2009 relative to 2005, despite significant advances in the physical availability of new technologies in the region (EBRD, 2012).

Figure 3: *Internet use and capacity to innovate*



Source: World Economic Forum (2012)
Note: Annual Executive Opinion Survey, ranking out of 144 economies and scores measured on a 1-7 scale.

Effective and efficient movement across borders and along transport corridors is essential to advance the contribution of trade to economic growth. Many Eurasian countries have vast remote areas with poor connections to other domestic markets, as well as to international sea and air gateways. They struggle with small domestic markets that are remote from world markets and poor transport infrastructure. Unless traded goods are transported expensively by air, they must transit through at least one neighboring state, and frequent changes result in high transaction costs. Infrastructure quality and transport costs were found to be the leading determinants (along with tariffs) of cross-country variations in trade flows in the region after controlling for distance (AsDB 2012). In terms of availability and quality of transport infrastructure, Russia and Kazakhstan rank at par with China (with a score of 4.67 and 4.46, respectively relative to 4.49 for China, on a scale of 1 to 7), but other countries lag behind (the Kyrgyz Republic had a score of 3.81) (WEF, 2012). In terms of transportation costs, we find that the entire region is off track. For example, the real cost of exporting a container is 429 man days (Uzbekistan), compared with 20 days in China (Table 1). It also takes longer to prepare goods for export or import from Eurasia—about 45 days compared with 20 days in China. Transit time and transport costs can be reduced by improving transport connectivity and procedures for trade facilitation.

Table 1: *Real cost of moving goods in and out of Eurasia*

	Real Export Cost (man days[1])	Real Import Cost (man days[1])	Documents to Export	Documents to Import	Time to Export (days)	Time to Import (days)
Resource-rich (Eurasia)						
Russia	24	26	9	12	21	36
Kazakhstan	45	45	10	13	89	76
Uzbekistan	429	466	13	15	86	104
Azerbaijan	75	73	8	10	43	48
Non Resource-rich (Eurasia)						
Armenia	45	54	6	8	30	24
Georgia	48	46	8	7	12	14
Belarus	35	42	9	10	18	35
Ukraine	47	48	6	8	30	33
Moldova	95	112	7	7	32	35
Kyrgyz Republic	331	359	14	16	64	75
Tajikistan	363	493	11	12	71	65
Comparators (world)						
Poland	7	7	5	5	17	18
China	20	24	8	6	21	24

Sources: World Bank, World Development Indicators; ILO, Employment Data.

Notes: [1] Real Export/Import Cost indicates total cost divided by GDP per worker in the economy per day. Includes costs associated with documents, customs administrative fees, customs broker fees, terminal charges, and inland transport.

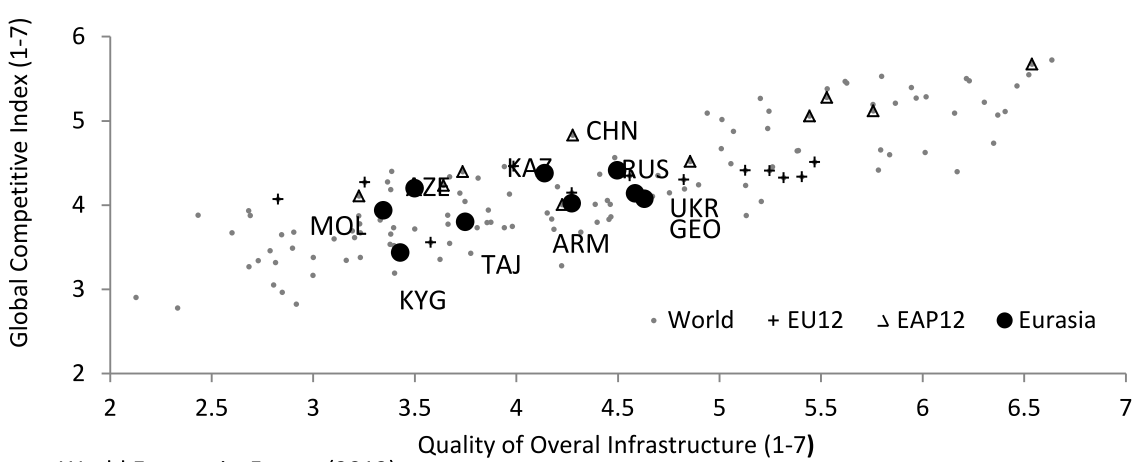
Eurasia, which accounts for 6 percent of the world's GDP but 8 percent of its energy demand, is one of the most energy-inefficient regions in the world both in terms of consumption and production of energy. Sector assets employ old and outdated technologies; most thermal plants, especially coal-fired plants, have been operating well beyond the design life. Russia is one of the largest emitters of CO_2 in the world, after the United States and China. Yet, Russia and other hydrocarbon producers in the region will not be able to supply Western Europe with the energy it needs unless there is a significant ramp-up in the new upstream oil and gas investments, as well as pipeline investments. Together with rising gas prices and concern about the reliance on Russia for fuel, Eurasia is tending towards a growth pattern based on more polluting, but locally available coal, and resistance to shutting down aging nuclear reactors. About half of today's energy infrastructure should be rehabilitated by 2030 (World Bank 2011). The renewal of sector assets provides an opportunity to curtain the carbon footprint and increase the resilience of the sector to climate change.

Eurasian countries are confronting a shared problem of future water shortages. Declines in river runoff due to climate change will compound an already unsustainable management of water (World Bank 2009). In Kazakhstan, where the decline in runoff is expected to be milder, there is a potential problem of water resource management in the Lli River basin, which is shared with China. The Kyrgyz Republic and Tajikistan will have enough water for their own needs but may not be able to meet demand in their role as critical suppliers of water to the region. The water situation in Turkmenistan and Uzbekistan is dramatic, even without climate change: with an economy largely based on irrigated farming, Uzbekistan is the main water consumer of the Central Asia region. Almost all of its water resources come from the mountains located in other countries. Unsustainable water management has caused the Aral Sea to shrink, and measures to manage the stresses in the Amu-Darya River delta—a key source of water for Uzbekistan, Tajikistan and Turkmenistan—will be even more important to refine as the climate changes.

Impact of Infrastructure on Competitiveness and Growth

Cross-country comparisons of infrastructure quality are bedeviled by measurement problems, statistical gaps, and the inherently subjective nature of such assessments. Using the World Economic Forum (WEF)' survey of global business leaders' perceptions, we find that the quality of overall infrastructure remains uneven across the region, with an index ranging from 3.4 (Moldova) to 4.6 (Georgia) on a scale from 1 to 7. We also find that countries with poor infrastructure quality have a lower ranking on the global competitiveness index (Figure 4). Compared globally, Eurasia belongs to the middle-tier of both infrastructure quality and global competitiveness. It lags behind the EU12 and EAP12 on both indicators.

Figure 4: *Global competitiveness and infrastructure quality*



Source: World Economic Forum (2012)

Note: annual Executive Opinion Survey, ranking out of 144 economies and scores measured on a 1-7 scale.

For Kessides and Khan (2009), it was not infrastructure that impeded growth in the 1990s. However, as Eurasian countries returned to more favorable output trends in the 2000s, the deterioration of infrastructure assets (and their quality) added stress on these economies. Using coefficient estimates in Calderon (2007) and its dataset, we estimate the impact of infrastructure on productivity growth for Eurasia. We find that infrastructure development reduced the growth in labor productivity by five basis points per year in 2001-05 relative to 1991-95—an increase in the growth rate of real output per worker of 4.4 basis points due to the accumulation of infrastructure stocks, and a reduction of 9.6 basis points due to the deterioration in the quality of infrastructure services (Annex B).

2. ACCUMULATION OF PHYSICAL ASSETS

Capital formation played an important role in the recent acceleration of GDP growth in Eurasia. A closer look at the 2006-08 period shows that physical capital contributed significantly to GDP growth, explaining between 11 percent (Moldova) and 60 percent (Georgia) of GDP growth performances (Table 2). In earlier years, between 1996 and 2005, physical capital played a less important role in the region, with total factor productivity driving growth performances. Thus, capital accumulation has been a recent phenomenon in the region. In addition, there are distinct differences in the contribution of physical capital to GDP growth between low-income and middle-income countries. In the latter group, the contribution was large (with the exception of Azerbaijan) although slightly below that of countries like China. In the former group, there has been a much wider disparity among countries – from 11 percent in Moldova to 60 percent in Georgia. There is no distinct pattern between resource-rich and other countries in the region. Both groups showed remarkable growth performance over the 2006-08 period. Capital accumulation played an important role in both groups—although with significant variations within each.

Table 2: *Sources of GDP growth, 1996-2008*

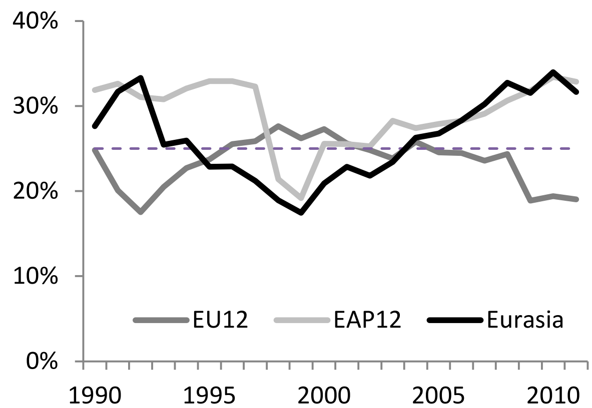
	2006-08			**1996-2005**		
	GDP growth	Contribution to growth (percent):		GDP growth	Contribution to growth (percent):	
		Total factor productivity	Physical capital		Total factor productivity	Physical capital
Resource-rich (Eurasia)						
Russia	7.0	38.5%	54.7 %	3.8	128.9 %	-31.5%
Kazakhstan	7.3	32.8%	47.7%	6.2	90.1%	-4.8%
Uzbekistan*	8.3	71.1%	12.1%	4.5	80%	0%
Azerbaijan	20.7	75.3%	19.9%	10.7	60.7%	36.4%
Non Resource-rich (Eurasia)						

Armenia	10.7	42.9%	52.3%	9.4	95.7%	18.1%
Kyrgyz*	4.6	21.7%	51.4%	4.6	21.7%	52.2%
Georgia	7.6	59.2%	60.1%	6.4	-29.7%	131.2%
Moldova*	5.1	105.1%	11.1%	2.2	190.1%	-54.5%
Comparators (world)						
China	11.5	38.2%	59.2%	7.8	20.5%	71.8%
US	1.4	-28.2%	83.1%	0.9	27.2%	45.5%

Source: Conference Board, Total Economy Database (January 2012)
Note: (*) denotes low-income country.

At the break-up of the Soviet Union, fixed capital formation in Eurasia was more than twice that in EAP12. By 2010, it had fallen to 21 percent of GDP, which is well below the level observed in EAP12 (35 percent of GDP). Eurasia fares better when changes in inventories are included (Figure 5). We find that gross domestic investment has been trending upward over the last decade, reaching levels that are comparable to the 25 percent of GDP or more experienced in the fast-growing Asian economies (Commission on Growth and Development 2008). What has been the decomposition of that investment trend between the private and public sectors?

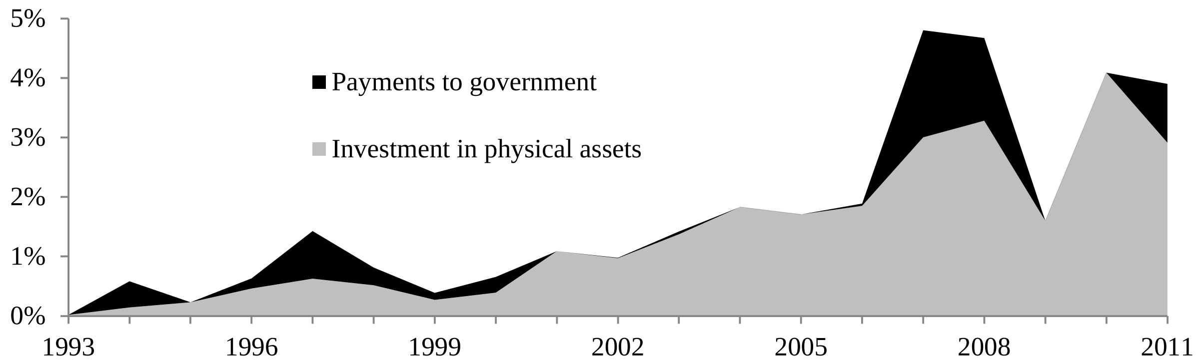
Figure 5: *Gross domestic investment* 1/
(as a share of GDP)



Source: World Bank, WDI
Note: 1/ outlays on fixed assets additions plus net changes in the level of inventories.
2/ overall investment rate in developing countries growing at an annual rate of 7 percent over the last three decades = 25 percent of GDP.

To examine investment trends by the private sector, we use data on private sector participation in infrastructure (PPI). This dataset does not include private investments in the extractive industry and manufacturing sector. We find that PPI was historically low, but that the private sector financed 132 infrastructure projects in the region, equivalent to $143 billion, over the last ten years. This represents an average of $14 billion per year—an amount which is insignificant in view of Eurasia's investment requirements. It was targeted at only a few sectors—with sixty percent in telecommunications, 34 percent in energy, and transport and water together obtaining less than 10 percent of the total regional inflow. Russia dominated the inflows, by attracting 73 percent of the region's PPI. This represents, however, less than 5 percent of Russia's GDP, with a significant share derived from the privatization of state-owned assets rather than new investments (Figure 6). When including the extractive industry and manufacturing sector, total investments by the private sector in Russia accounted for 10 to 15 percent of GDP (Figure 8).

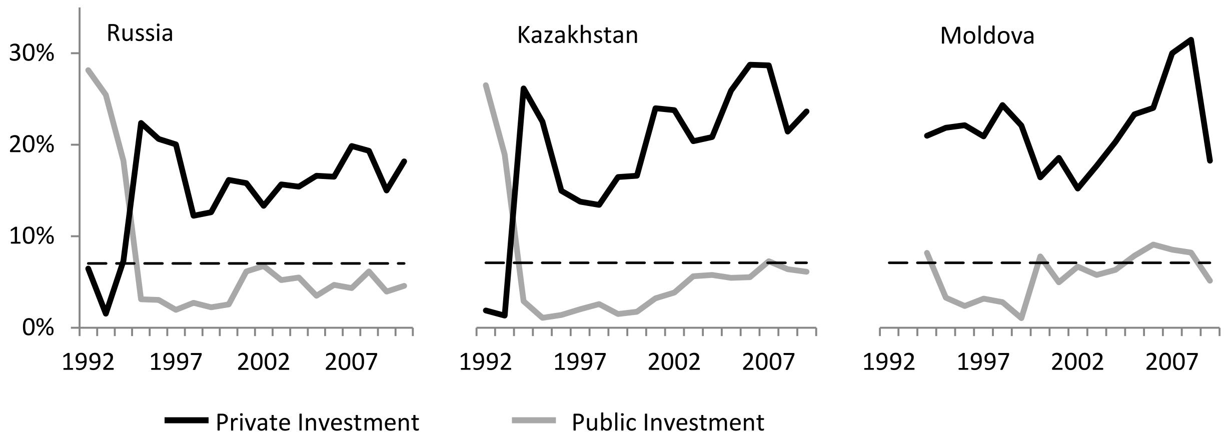
Figure 6: *Russia - Private participation in infrastructure* (as a share of GDP)



Source: PPIAF PPI Database, 2013
Note: Data includes: electricity generation, transmission, and distribution; natural gas transmission and distribution; fixed or mobile local telephony; domestic long-distance telephony; international long-distance telephony; airport runways and terminals; railways; toll roads, bridges, highways, and tunnels; port infrastructure, superstructures, terminals, and channels; potable water generation and distribution; sewerage collection and treatment.

Public investment collapsed and has never recovered its pre-1991 level. At the break-up of the Soviet system, the public sector owned and operated all infrastructure and non-infrastructure related assets, resulting in little commercial orientation and weak incentives for cost recovery. Public investment in capital represented a significant share of government budgets. In the 1990s, and later in response to the global financial crisis in 2008, governments in Eurasia severely cut their overall budgets. In Russia, for example, public investment fell from 28 percent of GDP in 1992 to 3 percent in 1995 (Figure 8). This level of public investment is relatively low compared to the 7 percent of GDP for infrastructure only in the fast-growing Asian economies (Commission on Growth and Development 2008). There is no marked difference between the resource-rich countries, such as Russia and Kazakhstan, and the other countries in the region like Moldova. If anything, there has been indication that public investment in the latter group is now higher than that in their resource-rich neighbors. This observation is consistent with other findings, which noted much lower public investment in the resource-rich developing countries than in the non-resource rich ones (IMF 2012), and a level of domestic investment inversely related to dependence on primary product exports (Gylfason 1999).

Figure 7: *Public and private investment* (as a share of GDP)



Sources: Penn World Tables (total investment); IMF World Economic Outlook (share of investment); World Development Indicators (GDP). Note: Public investment (in infrastructure only) = 7 percent of GDP in fast-growing Asian economies.

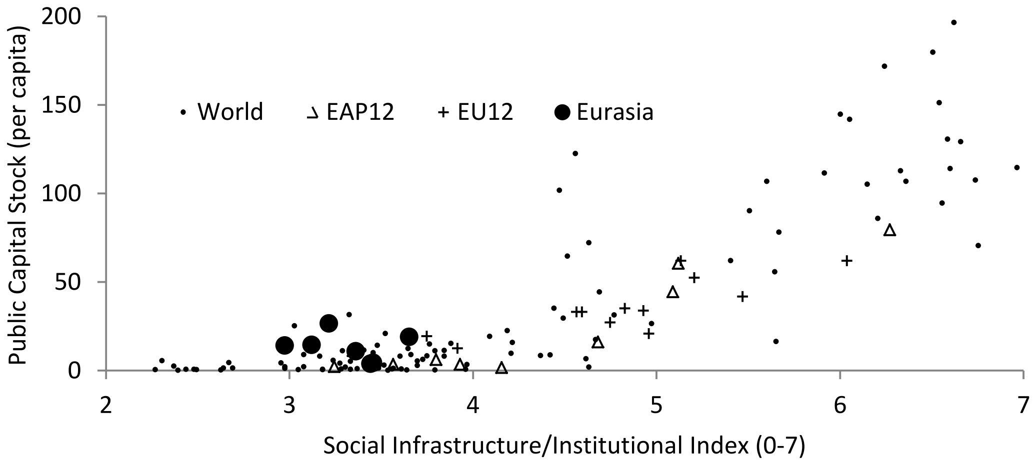
The dramatic drop in public investment has shifted the composition of total investments towards the private sector; however, the volume of private investment has not been anywhere near enough to compensate for the decline in public investment spending. In Russia, the composition of total investment shifted from 90 percent public sector in 1993 to below 20 percent by 2012. Similarly, in other Eurasian countries, the public sector now accounts for 20 to 30 percent of total current investments, comparable to that in EAP12.

Why do some countries invest less than others in physical capital? For Hall and Jones (1999), differences in capital accumulation are fundamentally driven by differences in institutions and government policies across countries, which they call "social infrastructure". By social infrastructure, they mean the institutions and government policies that determine the economic environment within which individuals accumulate skills and firms accumulate capital and produce output. Social institutions that protect the output of productive units from diversion—such as expropriation, confiscatory taxation, and corruption—tend to accumulate more capital and produce more output per worker. Hall and Jones (1999) define a social infrastructure index as a combined measure of economic institutions. This index is the average of five categories (law and order, bureaucratic quality, corruption risk, risk of expropriation, and government repudiation of contracts).[5] It ranges between 0 and 7, with 0 signifying the worst

[5] Due to data revisions in 1996 and 1997, Risk of Expropriation and Government Repudiation of Contracts were combined into a new indicator, Contract Viability. The Social Infrastructure Index numbers cited in this paper are derived from an average of the three remaining indicators and the new indicator, over 2003-2012, following the basic methodology used by Hall and Jones. Benchmarks used by Battacharrya and Collier (2011) were adjusted accordingly.

institutional quality. The region ranks low on the social infrastructure index (3.32) relative to the EU12 (4.84) and the EAP12 (4.32). Moreover, we find a close association between the quality of the social infrastructure and the per capita stock of public capital across countries, suggesting that countries with a lower institutional quality also exhibit a lower stock of public capital (Figure 9).

Figure 8: *Public capital stock and institutional quality* (average 2003-12)



Sources: author's own calculations based on Hall and Jones (1999) for adjusted social infrastructure index; WDI and IMF WEO for the public capital stock.

In developing countries, capital formation is hampered by the quality of the public investment management system (Barma and others 2012). For example, weaknesses in the selection process of public projects could lead to oversized projects. In this case, public investment does not necessarily turn into productive physical capital. Gupta and others (2011) constructed a new public capital series that explicitly control for investment efficiency levels. They relied on the Public Investment Management Index (PIMI)[6] described in Dabla-Norris and others (2011), which depends on institutional factors, such as the quality of project selection, management and evaluation, and regulatory and operational frameworks.

The PIMI-index in the region ranges from 1.41 (Kyrgyz Republic) to 2.39 (Kazakhstan) on a scale from 0 to 4, suggesting poor efficiency in the public investment management process. These indices are applied to the public investment spending series. The low value of these indices means that not all public investment spending translates into productive physical capital. In fact, the cumulative public investment spending should be discounted by a factor ranging from 40 to 65 percent (depending on the country) to control for deficiencies in the public investment management process. As a result, the

[6] The PIMI Index is the average of the score for each stage of the public investment process (project appraisal; project selection; project implementation; and project evaluation). Countries with good investment processes have high scores. Scores for these stages are between 0 and 1, so that the total PIMI score is between 0 and 4.

"actual" stock of public capital created in Eurasia may be less than half of what traditional estimates of capital stock using cumulative investment spending suggest.

3. TRANSFORMATION OF RESOURCE WEALTH INTO PUBLIC CAPITAL

For resource-rich countries, the conjunction of high global commodity prices and natural resource discoveries provides a major new source of finance. The governments of these countries possess legal entitlements to the rents generated by the depletion of natural assets. They have the opportunity to tax these rents and use this revenue to acquire the public capital crucial for economic development. Since the revenues from the exploitation of non-renewable natural assets are intrinsically unsustainable, countries should offset such depletion by accumulating more physical capital and other forms of productive assets. Those countries that build a solid stock of physical capital are more likely to develop along a path of relative prosperity. In contrast, countries in which resource rents contaminate the political process of public investment decision-making, and thereby lower the accumulation of public capital, are more likely to achieve sub-optimal economic performances.

In a global dataset on public capital and resource rents in 45 developed and developing countries, including some Eurasian countries, Battachyrrya and Collier (2011) found that resource rents did not augment the public capital stock. If anything, higher rents were associated with lower stocks of public capital. They also found evidence of such an outcome in the case of point source natural resources (minerals, oil and gas), but not in the case of less appropriable agricultural and forestry resources. In other words, non-renewable point source resources reduced public capital, while potentially sustainable forestry and agriculture did not. They interpreted this negative association between resource rents and public capital as evidence of governments plundering natural resources, rather than converting them into more productive forms of assets.

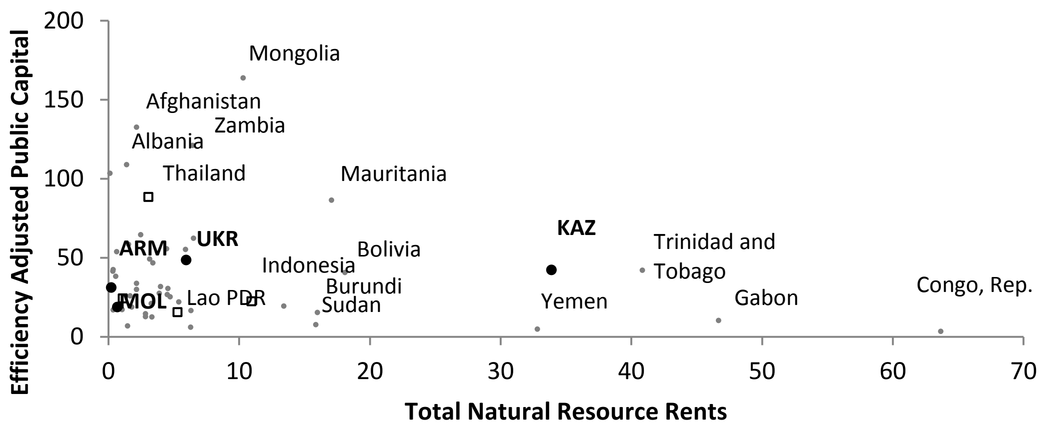
The accumulation of physical capital is undermined by weak government policies and institutions that are associated with resource rents. Battachyrrya and Collier (2011) used the Hall and Jones (1999)' social infrastructure index as a combined measure of economic institutions. They found that countries below a certain threshold of institutional quality are more likely to suffer from a low stock of public capital.[7] We find that Eurasia's institutional score is well below that threshold. Thus, the accumulation of

[7] The un-adjusted institutional index score threshold is 3.1. For comparison, Mexico averages 3.3 under the original methodology. After adjustments for the availability of data, the score for Mexico is 4.1.

public capital in Eurasia may have been undermined weak economic policies and institutional quality associated with the presence of resource rents.

Among the various dimensions of economic policies and institutional quality, the public investment management process played a key role in defining the "actual" stock of public capital. We find that high resource rents are still associated with a low "actual" stock of public capital (Figure 9). We calculate the "actual" stock by adjusting traditional estimates of the public capital stock for the quality of the public investment management process. We use the "natural resource rent" measure from the World Bank's adjusted net savings dataset as a proxy of resource dependence of a country. Although the statistical significance of the relationship between resource rents and the "actual" stock of public capital is relatively low, the association does point out towards an important area for future research.

Figure 9: *Natural resource rent[1] and efficiency-adjusted public capital stocks [2]*
(Average: 2001-05, in percent of GDP)



Sources: Author's calculation based on IMF (2012); Gupta and others (2011); and World Bank, WDI.
Notes: [1/] Include energy (oil , natural gas, coal), minerals and forestry. Rents of a particular commodity is defined as the difference between its world price and average extraction costs, both expressed in current US dollars.
[2/]Derived from Gupta and others (2011). PIMI index available for 55 low and middle-income countries only.

4. CONCLUSION

This paper focuses on the case of the resource-abundant economies in Eurasia and makes three contributions to the economic literature on natural resource-led development: first, our study indicates that the stock of productive physical assets in Eurasia is relatively low, contrary to common perceptions about the Soviet system. Infrastructure assets primarily serve to meet basic human needs, but very few support the development of competitive and sustainable economies. We find that the "actual" stock of public capital created is less than half of what is suggested by traditional estimates of the capital stock using cumulative investment spending. Second, we present further evidence on the interaction between natural resource abundance and physical capital. Our analysis highlights the fact that high resource rents have been associated with a low "actual" stock of public capital in Eurasian countries. Third, our results suggest that the weak institutions and government policies associated with resource rents have been a transmission mechanism from natural resource abundance to low public capital stock. Thus, improving the quality of institutions could significantly benefit public investment and foster the sustainability of growth performances in the region.

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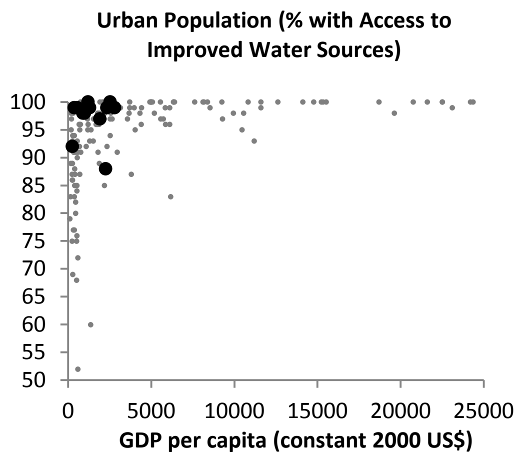
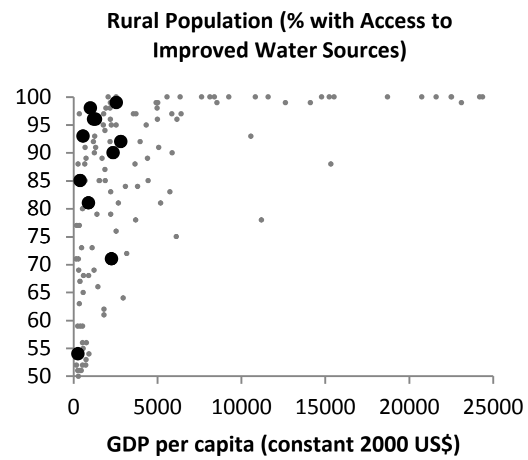
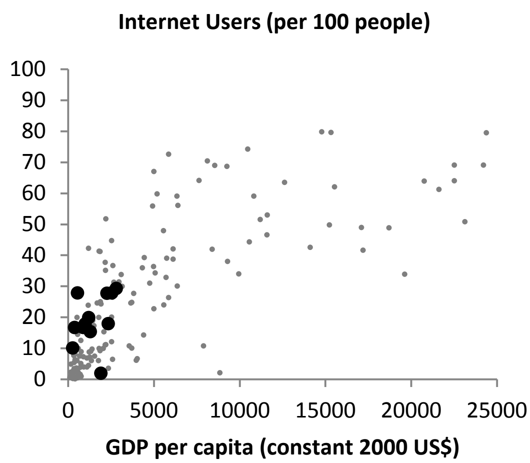
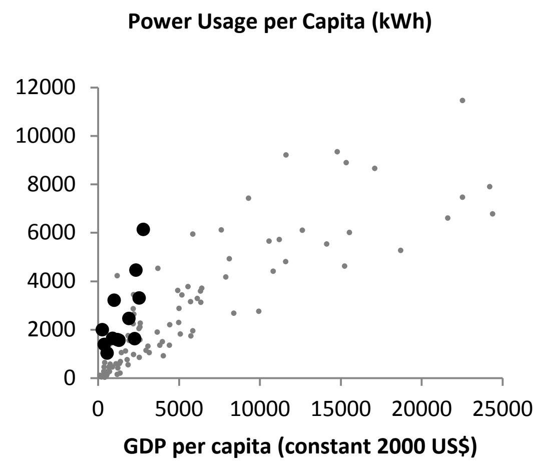
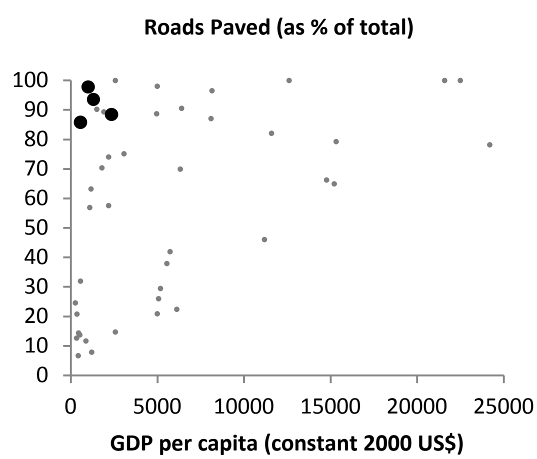
Annex A – Access to Basic Infrastructure Services, Eurasia and rest of the World

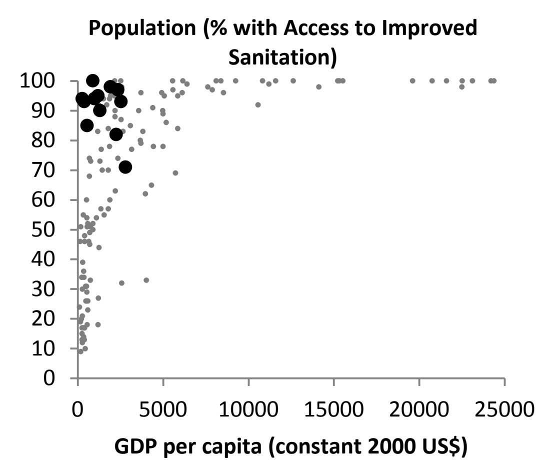












Source: World Development Indicators, World Bank

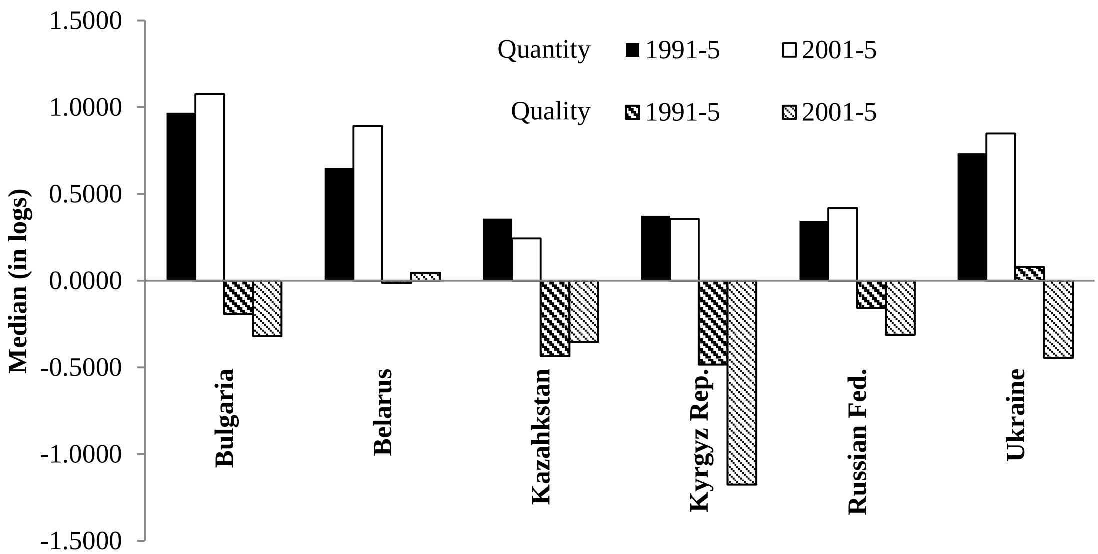
Annex B – Infrastructure Development and Productivity in Eurasia (*)

(*) From Calderon, Cesar, 2007. "Infrastructure and Productivity Growth in the ECA Region: A Macro-economic Approach." World Bank (unpublished manuscript).

Using econometric estimates for a sample of 136 countries from 1960 to 2005 based on panel data on three infrastructure sectors (telecommunication, electric power, and transportation), Calderon (2007) evaluated the impact of faster and better quality infrastructure stock accumulation on economic growth.

Aggregate or synthetic indices of infrastructure stock and quality are built following Alesina and Perotti (1996) and Sánchez-Robles (1998) using specific indicators and producing new indices based on mutually uncorrelated data to reveal new data dimensions. The "principal components" analysis aggregates different sets of components into a new measure of stock and quality of infrastructure—it is defined by a vector of weights $a=(a_1, a_2,\ldots,a_n)'$ on the standardized physical indicators of infrastructure $K_1, K_2,\ldots, K_n$ resulting in the linear combination $P_1= a_1X_1 + a_2X_2 + \ldots + a_nX_n$.. The aggregate index of infrastructure stock is constructed by aggregating individual physical measures of infrastructure of the telecommunication sector, the power sector and the transport sector. The aggregate index of the quality of infrastructure services is generated in an analogous fashion. Figure 11 shows the results.

Figure 10: *Aggregate Index of Infrastructure Stock and Quality, 1991-1995 and 2001-2005*



Source: Based on Calderon dataset (2007).

Notes: The aggregate index of infrastructure stock is constructed by aggregating individual physical measures of infrastructure of the telecommunication sector, the power sector and the transport sector. Telecommunication sector: number of main telephone lines per 1,000 workers, and number of telephone lines and mobile phones per 1,000 workers. Electric power sector: electricity generating capacity of the economy expressed in megawatts per 1,000 workers. Road network: length of the total road network (in km per sq. km. of surface area) or the length of the paved road network. The aggregate index of the quality of infrastructure services is generated in an analogous fashion. Telecommunication: waiting time for the installation of main lines expressed in years. Electric power: percentage of transmission and distribution losses in the production of electricity. Transport: share of paved roads in total roads. All indicators are rescaled to 0-1 in such a way that higher values indicate better quality of infrastructure services. All variables are expressed in logs.

Calderon ran a regression on growth in real output per worker on a standard stet of growth determinants and on aggregate indices of infrastructure stock and infrastructure quality, using the generalized method of moments (GMM) for dynamic panel data. The non-infrastructure determinants of growth included are: (a) human capital, (b) financial depth, (c) the real value of exports and imports, (d) average inflation rate, (e) real consumption, (f) terms of trade shocks, and (g) the initial value of real worker output.

Table 3: *Infrastructure development on productivity growth, 1960-2005*
Dependent variable: growth rate of output per worker

Infrastructure development	
Infrastructure stock	0.885 **
(first principal component of stocks)	(0.13)
Infrastructure quality	0.578 **
(first principal component of quality measures)	(0.07)
Control variables	
Initial output per worker	-0.829 **
(in logs)	(0.14)
Education	1.323 **
(Secondary enrollment, in logs)	(0.31)
Financial development	0.507 **
(private domestic credit as % of GDP, logs)	(0.12)
Trade openness	0.208 **
(trade volume as % of GDP, logs)	(0.10)
Institutional quality	1.710 **
(ICRG index, logs)	(0.23)
Lack of price stability	-1.793 **
(Inflation rate)	(0.19)
Government burden	-3.529 **
(Government consumption as % of GDP, logs)	(0.30)
Terms of Trade shocks	0.040 **
(first differences in log terms of trade)	(0.01)
Number of countries	86
Number of observations	558

Source: Calderon (2007)
Note: robust standard errors are reported in parenthesis below the coefficient estimates. ** implies significance at the 5 percent level.

Calderon assessed the impact of infrastructure stock and quality on productivity growth, using an unbalanced panel data of 5-year period observations over the period 1960-2005, with a total number of observations equal to 588. Table 3 reports the regression results obtained from the productivity growth equation augmented by the synthetic indices of infrastructure stock and quality of infrastructure. He found that the aggregate index of infrastructure stock and the quality of infrastructure services have a positive and robust relationship with real output per worker. Thus, these results suggest a positive contribution of infrastructure development to growth.

Using the coefficient estimates in table 3, Calderon (2007) estimated the effect of infrastructure development on productivity growth. The impact of infrastructure development is first estimated in a representative Eurasian country in 1991-05 and in 2001-05. The dataset includes five Eurasian countries (Russia, Ukraine, Kazakhstan, the Kyrgyz Republic, and Belarus). The median country in 1991-95 is the Kyrgyz Republic with value for the index of quantity of 0.37, and Russia with value for the index of quality of -0.15. The median country in 2001-05 is Russia with values of indices of quantity and quality of 0.41 and -0.31.

The evolution of infrastructure in the median Eurasian country in 2001-05 relative to 1991-95 is characterized by an impressive surge in the penetration of telecommunications, but deterioration in the quality of infrastructure services. This implies an increase in the growth rate of real output per worker of 4.4 basis points due to the accumulation of infrastructure stocks, and reduction of 9.6 basis points due to a deterioration in the quality of infrastructure services. In sum, the increase in infrastructure development reduced the growth of labor productivity by 5.2 basis points per year. In Kazakhstan, for example, productivity growth declined by 5.4 basis points due to worsening of infrastructure development (mainly explained by a decline of 10 basis points due to stocks). In the case of Russia, a faster accumulation of infrastructure stocks explains an increase in productivity growth of 6.6 basis points per year, while the worsening of the quality of infrastructure services accounts for a decline in productivity growth of 9 basis points. This yields a decline of productivity growth of 2.4 basis points per year.