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Resource dependence and measurement technology: international and domestic influences on energy sector development in Armenia and Georgia

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The effective measurement of natural gas consumption has become a central component of energy sector development in resource-dependent post-Soviet states such as Armenia and Georgia. Yet, while policy assessments have often emphasized the significance of technology upgrades in increasing the efficiency of gas distribution in Central Eurasia, it is necessary to consider other types of exogenous political and economic influences upon sourcing and adoption of measuring devices by national industries and their resultant impact upon energy sector performance. This study presents empirical data collected in northern Armenia and Tbilisi, Georgia, as well as from secondary sources, in order to examine the effect of both domestic and international factors upon the technology–performance relationship in the natural gas industries, and compares their relative implications for energy sector development in both countries since independence.

Keywords: Armenia; energy; Georgia; natural gas; resource dependence; measurement technology

Introduction

Within the expansive field of post-Soviet or Eurasian studies, the analysis of energy production, transportation and consumption has come to occupy a paramount position in both academic and policy discussions of the Caucasus and Central Asia. The related body of literature produced in recent decades has typically been concentrated in three general areas: (1) the political economy of resource-rich states, or the association between hydrocarbon wealth, authoritarianism and economic development in the countries of the Caspian Basin (Sabonis-Helf 2004; Franke, Gawrich, and Alakberov 2009; Jones Luong and Weinthal 2010); (2) energy security, or the alleged primacy of access to or control over oil, natural gas and electricity supplies and transshipment routes in regional international relations (Karagiannis 2002; Starr and Cornell 2005; German 2008); and (3) various and sundry iterations of the New Great Game theme, or the representation of local energy reserves as the focus of continual geostrategic competition among the major global powers (Edwards 2003; Nuriyev 2007; Kubicek 2013).

Yet, relatively few systematic studies have examined the natural gas sector in those former Soviet republics most heavily dependent on external supplies for basic domestic or industrial necessities such as heating, cooking and electricity generation.[1] The present inquiry seeks to draw insights from the application of comparative institutional analysis in contemporary political science to gas policies in two resource-poor, low-capacity states – Armenia and Georgia – by examining the role of international and domestic influences on energy sector performance in transitional societies (Bunce 1999; Jones Luong 2002; Jones Luong and Weinthal 2006; Closson 2007, 2009). Conventional approaches tend to identify Armenia as an energy 'outsider' due to

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its exclusion from regional infrastructure projects, while Georgia has received much attention as a pivotal transit corridor for the Baku-Tbilisi-Ceyhan and Baku-Tbilisi-Erzurum oil and gas pipelines since their activation in the mid-2000s (Papava 2005). As a result, less recognition has been given to the impact of gas sector reform upon end consumers in these two countries, and thus the welfare of their citizenry.

Policy assessments have often emphasized the significance of technology upgrades in increasing the cost-effectiveness and reliability of gas distribution in Central Eurasia. Yet, it is necessary to consider other types of exogenous influences upon sourcing and adoption of measuring devices by national industries and their resultant effect upon energy sector performance. At the international level, foreign assistance for capacity building in the energy sphere has also been the result of interpersonal contacts and diplomatic interactions. In Armenia, identity-related factors such as diaspora relations and genocide-recognition policies have played a role in technology imports in the gas industry. In Georgia, insurmountable foreign debt and deterioration of infrastructure have motivated previous governments to sanction legal monopolies over the gas distribution system by major regional suppliers such as Kazakhstan and Azerbaijan – sometimes with the brunt of adjustment costs being borne by the public. At the same time, domestic state and non-governmental actors including energy regulators, private companies, producer cooperatives and organizations representing ethnic minorities may seek to offset reliance on foreign technology inputs by contributing to the enhancement of local industrial capacities. Thus, activities that promote energy development at the societal level may arise in response to conditions of dependency, inefficiency or citizen need inadvertently fostered by state energy policies. The contrasting trajectories of this process in both countries, and its attendant consequences for their citizens, invite further investigation.

The analysis presents empirical data collected in Vanadzor, capital of Lori Province (*marz*) in northern Armenia, and Tbilisi, Georgia, beginning in summer 2011, as well as national-level information drawn from secondary sources, in order to investigate the dynamics of resource dependence in contemporary Caucasian societies. These complementary spatial domains help capture similar conditions in the two states and within-case variation between subregions, where high levels of poverty, neglect by central authorities and lack of infrastructure strongly affect gas accessibility in the population, and administrative centres from which policies and practices related to gas distribution originate. In addition, the study makes use of materials such as trade publications, business plans and technical-assistance reports, supplemented by interviews with informants in the field. These are employed to examine the effect of multiple actors upon the technology–performance nexus in the Armenian and Georgian natural gas systems and to compare their relative implications for energy sector development from 1991 to the present. The examination of these cases is presented in two sections. The first considers the international context in which the introduction of measurement technologies has taken place, as a result of political and economic conditions and of the conduct of diplomacy between government representatives, public or private firms and interest groups. The second identifies influential domestic societal actors in each country setting and the role they have played in addressing conflicts of interest that arise between governments, regulatory agencies, industries and consumers. The concluding section presents a comparative summary and interpretation of how interactions between institutions affect energy performance in both states.

Theoretical foundations and research design

This qualitative historical analysis of the natural gas sector in the two energy-dependent nations of the South Caucasus seeks to make two disciplinary contributions. First, it introduces and tests an original model of energy sector development that incorporates theories of interaction between formal and informal institutions in political science (Helmke and Levitsky 2004). In this instance,

formal actors are defined as state officials, ministries, public agencies or industries that are legally authorized to administer energy policies or programmes. *Informal* influences may include personal connections, ethnic affiliations, ideological preferences, or local arrangements and practices among individuals or organizations normally not involved in energy policies that become active in resource-related issues. The research question considers how contacts and associations between these structures positively or negatively influence the relationship between measurement technology and gas sector performance.

Second, the study seeks to expand upon the method of 'paired comparison' commonly employed in political studies. This involves the structured assessment of two crucial country cases guided by previously established theoretical assumptions and concerns (Tarrow 1999, 2010; Gisselquist 2014). The version of that approach applied in the present study is a 'most similar systems' research design, which relies upon the logic of 'common paths and foundations'. Here, the investigator selects cases that exhibit generally shared characteristics, presumably allowing one to control for error variance and infer cause and effect by isolating the most relevant factors that impact upon the dependent variable – the 'method of difference' (Bunce 1999, 16; Tarrow 1999, 9; Gisselquist 2014, 478–479). Armenia and Georgia have followed similar pathways, from small socialist republics lacking domestic fuel reserves and highly dependent on centrally supplied resources via shared pipelines. Citizens and state-controlled industries in both countries initially consumed a vast quantity of non-competitive public goods. Metering devices for gas consumption were not installed in the Armenian residential sector until the late 1990s.[2] Similarly, household gas supplies in Soviet Georgia were unmetered; fees were collected based upon a flat rate for per capita usage (Merklein & Associates 1997, 3; UNECE 2005, 2). A virtual collapse of energy distribution networks, accompanied by widespread loss, waste and theft, occurred after independence. This was followed by their gradual restoration and privatization, with external support, in the ensuing decades. In addition, both countries continue to exhibit a high degree of dependence upon and penetration of domestic markets by foreign providers. Lastly, they have pursued comparable efforts towards the institutionalization of standards governing energy supply and use, including technologies necessary for the accurate recording and measurement of popular consumption.

Living and working in both countries over a period of several years provided a unique vantage point from which to observe these conditions. In particular, being embedded in the difficult economic setting of Armenian and Georgian cities enabled recognition of the socio-political context of energy technologies beyond the purely mechanical aspects of metering equipment. Further, as will be seen below, it allowed one to identify more unusual combinations of actors and interests that have become involved in the process of gas sector development.

The theoretical scheme displayed in Figure 1 identifies four variables representing three different sets of associations. The first set, XY, signifies the conventional understanding in energy policy of a direct positive correlation between advances in technological inputs for the measurement of consumption and increased efficiency of domestic supply and distribution in both commercial and residential sectors. An assumed increase in accuracy and reliability has also been typically associated with the successful implementation of 'unbundling' or market-oriented reforms, as has been promoted by Western foreign aid institutions (US Agency for International Development, International Monetary Fund, World Bank and European Bank for Reconstruction and Development) since the early 1990s (Merklein & Associates, Inc. 1996, 1997; Hagler Bailly, Inc. 1997, 1998; AED 1999). These policies are predicated on the intuitive logic that the monetary value of a good is inherently linked to the precise determination of the amount consumed ('volumetric pricing'), thus generating incentives for its efficient use and conservation. In sum, this linkage is defined in the present study as *energy sector development*.

However, this simple bivariate relationship does not capture the larger international context in which new technologies are often introduced, including diplomatic interactions and the exchange

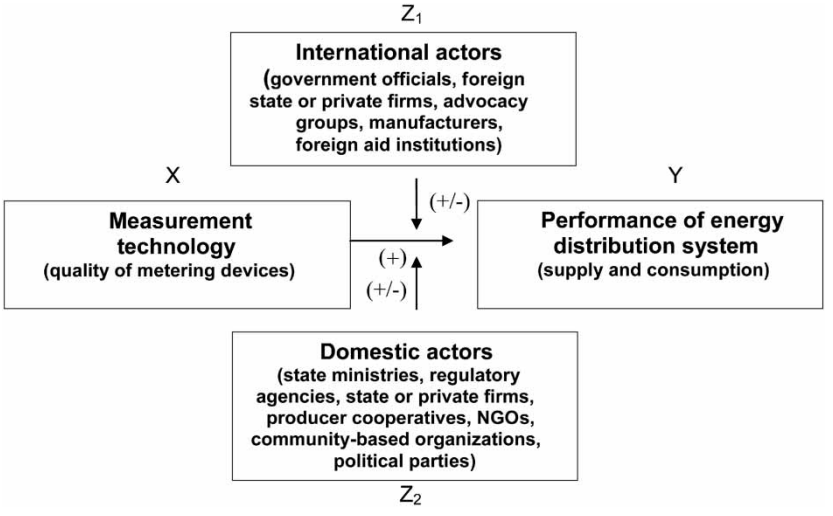

Figure 1. Model of international and domestic influences on energy sector development.

of information and resources between government representatives, state and private energy firms, equipment manufacturers, advocacy groups and foreign aid agencies (Z_1XY). Finally, the relationship between technology and performance is additionally affected by domestic influences (Z_2XY), including the activities of state ministries, regulatory agencies, private firms, producer cooperatives, non-governmental or community-based organizations, and political parties. To include these elements is to recognize the functioning of public utilities such as natural gas services as aspects of a transitional social system in which a variety of actors and institutions are engaged in decision making regarding national energy policy. It therefore additionally reflects the dynamic of responses to elite decisions from within civil society, which are often made in the context of significant intervention in weak or struggling states and economies by international forces.

Yet, it is also necessary to consider the potential pitfalls involved in the comparative method identified by positivist political scientists, namely the lack of 'degrees of freedom' in small-*N* case studies and the resultant failure or inability to identify alternative explanations for an observed outcome (Geddes 1990; King, Keohane, and Verba. 1994, 43–46). The present study seeks to move beyond these limitations. By disaggregating the intervening variables into their constituent parts, one can identify different types of formal and informal actors and structures that have pursued complementary or competing interests and strategies, often in repeated interaction with one another. These actions or behaviours in turn serve as mechanisms that can be isolated and traced across time, thus indicating the logical and empirical links between explanatory and dependent variables (Tarrow 1999, 10–11, 2010, 238–240). This additional specification, combined with attention to 'dual-process tracing', introduces a greater number of observations within a case than if each correlate were treated simply as a single unit of analysis. The application of this framework to the two natural gas economies of interest is demonstrated in the following section.

Case studies

Armenia

International influences on gas sector development

A fundamental characteristic often attributed to the situation of contemporary Armenia is its high level of dependency upon foreign aid and technical assistance, and especially the role of the

global diaspora in contributing financial resources in the form of private transfers or labour remittances – constituting as much as 20% of GDP in 2006 – to support economic and human development in the republic (Policy Forum Armenia 2010, 28). Yet, these relationships have seldom been examined in regard to the importation of measurement technology in the national energy sector. Following independence in December 1991, the economic free-fall engendered by the 1988 Spitak earthquake, the Nagorno-Karabakh War and the blockade imposed by Azerbaijan and Turkey rendered both government and citizens increasingly unable to purchase services. Comprehensive gas deliveries were restored by the majority-Russian-owned ArmRosGazprom (HayRusGazArd) through an agreement between the Ministry of Energy and Natural Resources, Itera International Energy and Gazprom in August 1997, which eventually gained a controlling interest (constituting 80–100% of shares) over the national energy sector (EBRD 2008, 185–186). The renewal of a vertically integrated supply arrangement with Russia thus facilitated the adoption of metering, billing and fee collection requirements for individual consumers.[3]

This linkage is further demonstrated by the manner in which publicly owned and private energy firms and manufacturers in the United States,[4] Iran,[5] France and the Slovak Republic have served as primary suppliers of measuring devices to the Armenian gas industry since the resumption of domestic service in the late 1990s (INOGATE 2012). As a result, these products, along with their positive or negative technical specifications, have often saturated the market alongside locally manufactured devices (Khitarov 2009, 2010). The prominent role of France as a patron of Armenian energy development was consolidated as early as 1988, when the predominantly government-owned Gaz de France established cooperation with the former ArmGazprom state concern based upon its long-standing relations with the Soviet gas industry. This was followed by the founding of the ArmFranGaz joint venture headed by Hayk Balasanian, member of the Permanent Bureau of the Union of French Citizens Abroad (UFE-SA), Armenia section, in 1994, which specialized in conducting feasibility studies on restoring the national gas supply infrastructure. It also demonstrated a motivation for seeking lucrative shares in the Armenian gas industry as a quid pro quo for the delivery and installation of new equipment (Asbarez Armenian News 1997; Sénat 1998, 23, 53).

The trend continued in early 1996, when Gaz de France, then chaired by French-Armenian public figure Jacques Deyirmendjian, was awarded a tender as lead contractor for the USAID and Technical Assistance to the Commonwealth of Independent States (TACIS) pilot project, Technical Support for the Restructuring of the Gas Sector in Armenia (Merklein & Associates 1997, 16). The terms of reference for its objectives included the upgrading of gas equipment manufacturing enterprises and improvement of production processes. However, a sharp divergence in preferences emerged between the market-reform agenda promoted by the donor community, and Gaz de France along with minister of energy and natural resources Gagik Martirosian. The latter party advocated minimal streamlining of the existing system to increase operational efficiency, rather than the objective of full privatization of state enterprises, which had been decreed in December 1995 by prime minister and liberal economist Hrant Bagratian. Nevertheless, during the same year, USAID arranged the delivery of an assistance package containing 2200 household gas meters and industrial units to local distributors to enable accounting methods for newly established services (Marjanyan 2004, 42).

In the wake of the approval of a bill recognizing the 1915 Armenian Genocide by the French Parliament in May 1998, a delegation of senators led by the chairman of the France-Armenia Friendship Group, Jacques Oudin, and accompanied by representatives of major French-based electronics firm Schlumberger Enterprises and Gaz de France, conducted a state visit in Yerevan hosted by the Union of Manufacturers and Businessmen (Employers) of Armenia. The engagement resulted in the signature of a contract with Schlumberger representatives for the importation of a reported 120,000 metering devices. In addition, Gaz de France extended a

partnership offer with ArmRosGazprom in a meeting with president Levan Ter-Petrossian, prime minister Armen Darbinian, and Gagik Martirosian (Asbarez Armenian News 1998; Sénat 1998, 23).[6] In the same month, on the basis of a project on metering, billing and collections completed by USAID two years previously, the newly established National Institute of Standards (SARM) under the Ministry of Economy approved a plan for the installation of Metris 250 diaphragm meters produced by Schlumberger in the residential sector (Hager Bailly 1998, 10, 38, 44).[7]

The embargo on oil and natural gas supplies imposed by Azerbaijan during the Karabakh War has also motivated the central government to develop a domestic capability for gas technology production with assistance from foreign partners. Seeking to draw upon the experience of other post-socialist states in Central Eastern Europe, policy makers initiated commercial diplomacy with Slovakia, which subsequently recognized the genocide in December 2004. In the late 1990s the five-member industrial enterprise of the HayGazArd State Concern, reassembled from the Soviet-era ArmTransGaz Association, operated a Gas Meter Joint Venture Enterprise with the Slovak Khiran Joint Stock Company. Based in Yerevan, and with branches in Idjevan and Vanadzor, this firm specialized in the production of metering equipment, pressure regulators and spare parts (Merklein and Associates 1997, 7).[8]

Such industrial and diplomatic connections have been further reinforced by the work of the ARMES energy consulting firm and the Forum of Armenian Associations of Europe (FAAE), which was founded by the Yerevan-born leader of the Slovak ethnic-Armenian community, Ashot Grigorian and which maintain offices in both countries.[9] In an interview with national energy expert and World Bank Renewable Energy Project coordinator Ara Marjanyan,[10] it was confirmed that after its initial registration in September 1996, ARMES 'was engaged in [some] activities in Armenia related to gasometers [*sic*]' during the national energy crisis, as Grigorian utilized his émigré status and professional experience to assist with the restoration of supplies.

In summation, these contacts and associations have consolidated a mutually reinforcing dependency between external actors that have provided political and economic support for Armenia since independence, and predominant national energy industries, including the implementation of gas metering via imported equipment designs. Thus, as detailed below, the impetus for potential generation of indigenous solutions to gas sector problems may arise from prevailing national conditions of foreign-sponsored development.

Domestic influences on gas sector development

The present-day Armenian gas sector constitutes a legal private monopoly that operates with little or no oversight from either the state energy administration or the regulatory agency for public utilities (Hrayr Maroukhian Foundation 2013, 61–62). These conditions ultimately affect the extent to which the population accepts metering standards introduced by both foreign donors and domestic administrators, and the activities or strategies pursued by societal actors in return. The primary domestic institution concerned with representing citizen energy rights in post-Soviet Armenia was essentially a creation of the state rather than civil society. Its present incarnation, the Public Services Regulatory Commission (PSRC), was first established by presidential decree in April 1997 to address the immediate need to reactivate supplies. It did not assume formalized status until the ratification of the Energy Law in March 2001 (Marjanyan 2004, 18). Its primary competencies in the natural gas sphere include the issuing of licenses for the supply and delivery of services, as well as the consumer model for purchases (PRSC 2012). Significantly, according to the Law on the Commission Budget, as of 2004 its operations are funded directly from the state treasury based upon an annual estimate of maintenance costs and monetary requests submitted to the Ministry of Finance for regular approval, rather than accrued from independently collected taxes and fees (PRSC 2004; Bjork *et al.* 2006, 2). Secondly, it defines market rules in

coordination with the Ministry of Energy rather than in a separate capacity (ERRA 2001; EBRD 2009, 184). Nevertheless, existing legislation defines it as an 'autonomous entity' not subject to interference by any governmental body. Although the PRSC is empowered to set rules and conditions for quality of service that require energy utilities to register consumer complaints, it has no oversight over internal procedures for addressing grievances. But its greatest limitation lies in the realm of anti-monopoly enforcement, for which it shares overlapping responsibilities with the comparatively under-staffed and under-funded State Commission for the Protection of Competition. Because both structures lack independent policy-making functions or legal prerogatives for quality control or prevention of abuses, it essentially plays the role of de facto interlocutor with monopolist firms in determining the price of goods and services (Hrayr Maroukhian Foundation 2013, 49, 75, 81). The ultimate relevance of the PSRC to popular gas consumption lies in the essential dilemma posed for effective regulation of utilities and protection of end users in a market dominated by a foreign energy provider sanctioned by state authorities. This issue is ultimately reflected in ongoing consumer and industry concerns regarding quality of service and implementation of standards for gas pricing. Given the essential role of ArmRosGazprom in the introduction of metering devices in the residential sector, the lack of accountability of firms, inspectors and laboratories creates conditions in which the extortion of fees from citizens – typically through tactics such as extracting charges or fines for replacement of allegedly faulty equipment – has become a side-effect of energy reform (Hrayr Maroukhian Foundation 2013, 61–62).

The frontier of innovation in Armenian energy development is thus arguably being delineated by the phenomenon of community-based organizations. These constitute a hybrid between structures with otherwise unrelated functions and agendas, such as cultural associations representing national minorities, private firms and international non-profit organizations or advocacy groups, as a strategy of pooling otherwise scarce resources to implement independent projects or policies. Among the most significant private companies that have recently assumed the role of 'broker' by forming associations with a broader range of societal actors is A-2 Ltd, an electronics developer and manufacturer. Founded in May 1990 as an outgrowth of the Yerevan branch of the USSR Central Scientific Research Institute ('Agat'), which produced radar and guidance systems for long-range missiles, it is presently a leading designer of thermoregulators for industrial meters. According to interviews conducted by the author with Arkady Khitarov, elected president of the Pontic Greek community (the second-largest ethnic minority in Armenia as of the 2002 census) and director of the Vanadzor branch of A-2,[11] the current structure of Greek representation in Armenia consists of nine individual NGOs unified under the umbrella Elpida (Union of Greek Public Organizations of Armenia) since 1997. In regard to financial resources, Elpida has a considerably closer relationship with the international non-profit organization World Council of Hellenes Abroad (SAE)-Periphery of the former USSR than with the Greek national government. Its current Regional Coordinator Ivan Savvidis, a Pontic Greek business leader of Georgian origin, has also served in the Legislative Assembly of Rostov Oblast and as a deputy to the Russian Federation State Duma. Vanadzor is also the site of its most important institutional feature, an Educational and Scientific Centre established in July 2009, which receives funding through the Embassy of Greece in Armenia. The main office houses a computer training and research centre that has received certification from the National Technical University of Athens and specializes in electronics and software engineering. However, while minimal Greek funding is provided for the technical centre, these finances support the physical facility rather than its research and development activities, which are currently sponsored by the Armenian government. Its current business plan seeks to address two prominent deficiencies in both domestically produced and foreign-manufactured measurement devices installed in the territory of Armenia: the inaccuracy of readings due to extreme seasonal temperature changes; and the

infeasibility of manual data retrieval from devices located in remote mountainous areas (Khitarov 2010). Joint projects that have been initiated in cooperation with A-2 include the replacement of outmoded mechanical gas counters with electronic hardware, the development of wireless data-retrieval systems, and the fulfilment of certificates awarded by ArmRosGazprom for electronic upgrades of existing Russian-manufactured devices (Union of Greek Public Organizations of Armenia, 2013). These activities ultimately aspire to benefit private and industrial users, as well as to generate possible economic opportunities for the small Greek community in the northern provinces.

Finally (as is also discussed in the study on Azerbaijan in this volume), it is necessary to consider other local responses to negative externalities that have emerged as a consequence of government-sanctioned energy development, in which the unaccountability of public utility administrators has affected the relationship between citizens and the state. During preparations for the tendentious presidential elections of February 2008, the Yerevan-based Transparency International Anti-Corruption Center reported an effort by the incumbent Republican Party of Armenia (Hayastani Hanrapetakan Kusaktsutyun, HHK) to supplant the policy of free installation of gas meters previously pursued by local representatives in the politically influential Avan Community (Hamaynk'), whose prefect and HHK member Taron Margarian was re-elected the same year (TIAC 2008).

More recently, the conduct of the local territorial production and operational services in enforcement of metering regulations has fostered citizen grievances with the private gas monopolies as well as the state regulator. In 2005, SARM initiated a policy of conducting mandatory laboratory evaluations of household meters at five-year intervals. Following the most recent sequence, implemented over a 10-month period in 2010, ArmRusGazprom determined that slightly less than 3% of the over 80,000 inspected units showed signs of external interference (Arminfo News Agency 2010). However, the lack of independent monitoring of the testing process creates incentives to engage in dishonest practices toward consumers. Recently formed civil society organizations that provide legal representation and consumer protection services have increasingly intervened in such incidents. The Anti-Corruption Advocacy and Assistance Centre, originally launched by USAID through a contract with US-based international development firm Casals and Associates and currently directed by the civil rights advocacy group Armenian Young Lawyers Association, operates multiple branches nationwide. This network has been successful in providing mediation and support for citizens in Gyumri, Kotayk and Tavush Provinces (*marz*es) and the Yerevan capital district that have been subject to fines for unverified claims of meter tampering or unnecessary replacement fees by inspectors and department staff (AAC 2011, 2012; AYLA 2012a, 2012b). However, despite the benefits provided in terms of protecting the welfare of end users, it is unclear whether such measures have significantly affected the general condition of the licensee and billing system in the Armenian gas sector.

Georgia

International influences on gas sector development

In the case of Armenia, the traditional role of Russia as sole energy provider was central to the reconstruction of the national gas industry in the late 1990s. In Georgia, the hegemonic presence of Russian energy suppliers in the Caucasus has driven the pursuit of diversification, including alternative sources of technology inputs from a wide range of American and European manufacturers. The absence of reliable technologies for measuring consumption levels of imported Russian gas also played a primary role in the conclusion of new commercial agreements with alternative regional suppliers, in particular the major Caspian energy producers after 2005. The location of the main gas metering station on Russian territory prevented Georgian officials

from accessing data on the actual volume of imports, rendering them unable to verify either the quality or the total amount consumed. Further, despite the gradual reconstruction of the gas sector into the mid-2000s, residential services were characterized by endemic non-payment, meter tampering and offering of bribes to inspectors in exchange for waiving or under-reporting of fees. As a result, between 1996 and 2002, Gazprom alleged that the Georgian gas industry had accumulated a massive debt, approaching USD 91 million. These conditions were combined with institutionalized corruption within Russian-Georgian industrial and business groups that maintained a vested interest in a lack of credible accounting and reporting in order to maintain access to the flow of rents (Jervalidze 2006).

A major catalyst for the introduction of foreign-made metering devices in the post-Soviet period was the discrepancy in equipment specifications and accounting standards between Russian and Georgian distributors at the Sioni border-crossing point for main gas pipelines. A fact-finding mission conducted by the International Gas Consulting Company in May 1998 recommended US-manufactured Sonic Flow Meters and Super-Flo computerized flow regulators to replace those previously installed at the Red Bridge (Krasny Most) and Gardabani stations on the borders with Armenia and Azerbaijan (Burns & Roe Enterprises 1998, 79). At the same time, a notable rift emerged concerning the recommendations of foreign advisors and the directors of the Production and Technical Departments of the Gardabani gas-fired thermal power plant. The administrators sought funding from USAID for the installation of separate metering facilities that would remain under their jurisdiction. This indicated a resistance to the formal coordination of measurement standards with officials of the national distributor, standard practice in the US commercial gas industry (Burns & Roe Enterprises 1998, 85).

In December 2004, after receiving a guarantee of restored supplies from Russian Gazprom daughter enterprise GazExport following a recent debt dispute, the former state distributor TbliGaz commenced the installation of new meters produced by the Russian–Italian joint venture LukAgip in the Vake district of Tbilisi, which were purchased by the company rather than consumers at a price of GEL 45 (USD 25) per unit. However, by January of the following year, this activity provoked a backlash among subscribers, who demanded the return of old units that had been dismantled by company inspectors. Presumably, the policy of replacement was based upon a commercial deal rather than necessity due to malfunctioning equipment (Daily News 2004, 2005).

In April 2005, negotiations were conducted between the Austrian and Georgian Ministries of Foreign Affairs to plan and finance an evaluation of the state-owned Tbilisi gas distribution network by a team of leading engineers employed by the energy service provider Wien Energie. This was reciprocated with a visit by a delegation of seven local experts hosted by Vienna Gas Company (United Nations Economic and Social Council 2005). The results of the exchange established an agenda for the urgent rehabilitation of the existing city metering system, which was characterized by the absence of technical standards, ease of tampering, and lack of regular calibration of individual units. The following month, the Tbilisi City Council hosted an international workshop sponsored by the United Nations Economic Commission for Europe (UNECE), Current State and Prospects for the Rehabilitation of the Local Natural Gas Infrastructure. Over 50 participants from Bulgaria, Estonia, the Russian Federation and Ukraine attended the meeting, as well as a representative of the Organization for Security and Cooperation in Europe. The assessments and recommendations of the delegates set in motion pursuit of funding, installation of updated equipment and assistance with drafting of new energy legislation.

The eventual bankruptcy of TbliGaz in December 2005 led to the signing of a memorandum between Georgia and Kazakhstan for the purchase of the decrepit capital distribution network by the state-owned KazTransGaz, followed by the formation of KazTransGazTbilisi in May 2006

(Reuters 2005; Daly 2009). Beginning in spring 2007, the company directorate commenced a policy of removal, inspection and replacement of existing Chinese-manufactured metering devices in the main entrances of residential apartments, and imposed payment of mandatory service fees to enforce compliance with the accounting system. These policies were advertised as a functional necessity given the preceding conditions of widespread theft among the population. However, the lack of involvement of third parties in the evaluation process has fostered periodic allegations of abuse. As related to journalists by Manana Kakhabrishvili, a resident of the Varketili micro-district (Suvarian 2008):

> The representatives of the company visited all families … [and] verbally warned us to change the meters. And if we refused, we will be fined or the gas will be cut. … [We] have to take old meters to the office of KazTransGaz for a technical examination. We have to write a notification that our meter does not work or does not work properly. If their experts conclude that the meter was damaged, the subscriber will be fined with the price equal to 300–500 cubic metres. Besides that, we are told to buy and install new meters with our own expenses.

In October 2008, the national regulatory agency announced that the practice of extracting obligatory fees was a violation of state laws governing the determination of tariffs for natural gas services; the cost must be absorbed by the company. The agency also attempted unsuccessfully to impose financial penalties for these policies. Yet, due to delays in implementation, the decision to enact new rules governing the use of metering devices did not enter into legal force until July 2009. Thus, KazTranzGaz representatives announced that as of 10 August, fines would be demanded from consumers who had not replaced meters determined to be malfunctioning or damaged. Ultimately, these conflicts fostered a resort to traditional practices of bypassing and non-payment by subscribers, ending with the eventual replacement of the Kazakh management board due to outstanding debts by the company.

Domestic influences on gas sector development

Perhaps the most significant domestic energy actor in Georgia since independence is the Georgian National Energy and Water Supply Regulatory Commission (GNERC), which was established in 1997.[12] While the GNERC was originally instituted as a publicly recognized civil association that functioned without direct government supervision, subsequent legislation altered its status to that of intermediary between central authorities and the energy industry (Dzidzikashvili 2010). These provisions define it as an autonomous regulatory body authorized by constitutional and municipal law, funded through taxes and fees paid by regulated entities rather than the state budget, and not attached to any other agency (GNERC 2007). Since 1999, its responsibilities specific to the gas sector include the issuing of licenses for transport and distribution, regulation of supply systems, monitoring of compliance with licensing terms, and administering penalties for violations (Hagler Bailly 1999; Dzidzikashvili 2010). The most significant function of the GNERC in reconciling government and commercial interests with the needs and rights of citizens is its role in the setting of tariffs for natural gas services and consumption. According to law, these are to be calculated through an independently determined methodology officially registered with the Ministry of Justice (Hagler Bailly 1999). These provisions further entail an obligation to protect the end user from price increases imposed by state or private monopolies (Transparency International Georgia 2008).

Yet, shifts in state energy policy were introduced during the past decade, in which the United National Movement (Ertiani Natsionaluri Modzraoba) party, led by president Mikhail Saakishvili, sought the rapid privatization and sale of strategic energy assets in order to maximize revenues generated by foreign direct investment. These reforms altered the legal status of the GNERC, introducing potential conflicts of interest between the

government and those bodies empowered to represent the welfare of natural gas consumers. First, two amendments to the Law on Electricity and Natural Gas introduced in December 2005 transferred responsibility for determining the natural gas balance and market rules from the GNERC to the Ministry of Energy, reducing its independence (Transparency International 2008). Secondly, after the deregulation of foreign gas supplies in January 2006, the GNERC lost oversight over pricing of imports, which became the sole purview of the Georgian Oil and Gas Corporation established through a merger of former state enterprises. The Georgian Oil and Gas Corporation also assumed the role of government representative in all negotiations with foreign suppliers, further limiting public knowledge of the tariff-setting process (Jervalidze 2008).

Despite these political tensions, the GNERC has taken some initiative in addressing the task of altering and upgrading the technical specifications of existing meters to better serve consumer needs.[13] Independent studies conducted by GNERC's Natural Gas Department have revealed flawed methods for calculating gas losses by distribution licensees, and a negative effect of extreme cold temperatures at high altitudes on the accuracy of readings, with a resultant discrepancy between administered tariffs and actual rates of consumption (Namgaladze 2008, 2009). These findings have been used to advocate for the rights of end users and exert pressure upon distributing companies and the National Agency of Metrology, Technical Regulations and Standards to resolve these issues.

A significant example of the formation of voluntary associations to address gas technology issues in Georgia was the Permanent Commission Foundation convened by the General Directorate of TransGaz in April 1998 (Burns & Roe Inc. 1998). Its primary purpose was to monitor and assess the functioning and performance of existing distribution infrastructure (pipelines and metering stations) and measuring devices, as well as the open dissemination of information to public and private organizations. Its offshoot Ecology and Underground Metal Communications NGO, EcoEngineering, played a leading role in organizing the May 2005 UNECE workshop attended by private-industry representatives and public-interest groups, as well as local administrative officials and scientific experts (UNECE 2004). Based upon a preliminary assessment of the dire condition of the Tbilisi gas distribution system, Ecoengineering chairman Ivane Zazashvili, in coordination with the database manager of the UNECE technical cooperation programme Gas Centre, also arranged the donation of pipeline leakage detection equipment by Gaz de France, which had previously made significant investments in the Armenian gas industry (UNESCO 2005).

The negotiated acquisition of the rural gas transport system by the State Oil Company of the Republic of Azerbaijan (SOCAR) in 2008 is further representative of the extent of external intervention and reliance upon foreign technological inputs in contemporary Georgia. The presidential programme Gas in Every Village, initiated in 2010, expanded the national transmission network into settlements that had lacked access, surpassing even Soviet standards of comprehensive gasification. A relatively under-examined dimension of the activities of SOCAR and its partner firms is their impact upon the diverse ethnic and religious communities of the Georgian regions (*mkhareebi*), which continue to exhibit a perceptual divide between state and society despite a decade of efforts towards electoral and constitutional reform. In 2008, residents of the Telavi and Marneuli Districts (raioni) in Kakheti and Kvemo Kartli, respectively, charged that the Telavgas and Marneulgas distributors purchased by Wissol Petroleum Georgia had introduced drastic increases in tariffs. This was combined with obligatory replacement of meters that had successfully passed previous laboratory inspections, at an inflated price of GEL 240 (USD 135), with threats to disconnect service as a penalty for noncompliance (Mtsivlishvili 2008). These events fostered plans to organize a community protest. As expressed by resident Elene Beruchashvili to the NGO Human Rights Centre:

> The inhabitants of my district paid over GEL 100 back in 2005 when the district was first gasified. … [We] installed the new meters which were sanctioned by an inspection lab at the time. No one from Telavgas had demanded to change the meters till the spring of 2008. No one said we had to pay more than we had already spent. We have been experiencing problems with Telavgas ever since it was bought by Wissol.

In several villages in Guria, SOCAR Georgia Gas has implemented the relocation of functioning meters from the inside to the outside of residences to simplify inspection. While this service is performed free of charge, residents are obligated to fund replacement of malfunctioning devices, while others have alleged the imposition of fees totalling GEL 250 GEL (USD 141) for removal and testing without their consent. Independent journalists described company actions as 'violence' which imitated the earlier conduct of KazTransGazTbilisi (Rezonansi 2009; Gogelia 2011).

A distinctive trend is the manner in which popular discontent regarding mandatory evaluation and replacement fees has overflowed into the sphere of opposition politics. In autumn 2008, the Georgian Labour Party (Sakartvelos Leiboristuli Partia, SLP) held a news conference and protests that called for expulsion of KazTransGaz and nationalization of assets in response to discriminatory price hikes which allegedly benefited the Saakashvili government. In January 2009, party representative Paata Jibladze introduced a petition to prohibit obligatory charges for replacement of meters. In July, a rally was held at the GNERC office to protest SOCAR policies. In the same month, National Democratic Party (Erovnul-Demokratiuli Partia, EDP) MP Guram Chakhvadze established a special commission to provide assistance to subscribers and reduce fines for new meters from GEL 600 to GEL 125 (USD 400 to USD 70), which was described as 'an act of violence and swindle' by the provider. Most recently, demonstrations organized by the EDP and SLP were held at the offices of KazTransGaz and the GNERC in the months preceding the 1 October 2012 parliamentary election, demanding that the cost of replacement meters be absorbed by the company rather than by citizens (Rustavi 2 2008, 2009a, 2009b, 2009c; Channel One Georgia 2009, 2012). However, it is not clear whether these actions have elicited a direct response from former or incumbent officials, given their absorption into general pre-election public discourse.

Results and interpretation

Table 1 presents a chronological summary of data derived from the two case studies detailed above. Each observation identifies a chain composed of linkages between international and domestic actors that occurred in each country, for a total of 25 interactions. The respective columns identify the state, year of the event, actor types, influence upon energy sector development and estimated direction of its impact (positive, neutral, or negative) from 1991 to present. The criteria for evaluating these outcomes lie in whether the behaviours and interests of formal and informal institutions involved in gas policies were convergent or divergent. Four categories indicate the effectiveness or ineffectiveness of prevailing rules and procedures: *complementary*, where informal factors facilitate or reinforce existing arrangements; *accommodative*, where they contribute to compromise and reduction of tensions between differing interests; *substitutive*, where they carry out functions that formal structures are unable to perform; and *competitive*, in which they challenge or reject ineffectual policies (Helmke and Levitsky 2004, 728–730).

Of the 13 interactions examined in the case of Armenia, diaspora-related contacts during the 1990s served to complement state gas policies in the majority of observations. An exception is the second chain, in which a French state-owned firm and the Ministry of Energy unsuccessfully sought to maintain socialist-era standards in opposition to both Western aid agencies and the prime minister. In addition, the joint business projects pursued by A-2 and Elpida/ERC in Armenia since 2009 have played a substitutive role by developing more advanced and efficient devices that provide an alternative to foreign technology imports.

Table 1. International-domestic interactions and energy sector development since 1991.

State	Year	International–domestic interactions	Influence on energy sector performance	Direction of influence
Armenia	1994	Foreign state firm–foreign advocacy group–domestic state firm	complementary	+
	1996	Foreign aid agency–foreign state firm–domestic state ministry	accommodative/ competitive	±
	1996–present	Foreign private firm–foreign advocacy group–domestic private firm	complementary	+
	1998	Government officials–foreign private firm–foreign state firm–NGO	complementary	+
	1998	Government officials–foreign private firm–foreign state firm–domestic private firm	complementary	+
	1998	Foreign aid agency–domestic state agency–domestic state ministry–foreign private firm	complementary	+
	2008	Political party–government officials–consumers–NGO	substitutive/ complementary	±
	2009–present	Community-based organization–foreign advocacy group–domestic private firm–producer cooperative	substitutive	+
	2010–2012	NGO–regulatory agency–foreign state firm–consumers	substitutive	+
Georgia	1998	Foreign aid agency–foreign private firm–domestic state firm	accommodative/ competitive	±
	1998	Domestic state firm–domestic private firm–producer cooperatives–government officials	accommodative	±
	2004	Foreign state firm–foreign private firm–domestic private firm–consumers	competitive	–
	2005	Foreign state ministry–domestic state ministry–foreign private firm–domestic state firm	complementary	+
	2005	NGO–foreign aid agency–government officials–foreign private firm	complementary	+
	2005	NGO–foreign aid agency–foreign state firm	complementary	+
	2008–2012	Regulatory agency–government officials–foreign state firm–political parties–consumers	substitutive/ competitive	±

In contrast, of the 12 interactions analyzed in Georgia, interests between actors were complementary in only half. In the first chain, formed in 1998, state-owned plant directors bargained to receive external funding to avoid the oversight of metering practices recommended by US advisors. In the second and third chains, formed in 1998 and 2004, producer cooperatives played a mediating role between the Georgian government, state industries and the public, while gas consumers challenged metering deals reached between foreign suppliers, state distributors and joint enterprises. Complementary relations include activities of state ministries and energy-related NGOs that helped arrange legal, technical and financial support from foreign governments and donor agencies for the rehabilitation of the Tbilisi gas distribution system in 2005. At the same time, the role of identity-related factors such as the diaspora in supplying foreign technical

assistance is not evident in the Georgian case. Georgia also exhibits little equivalent to the hybrid functions of Armenian firms and ethnic community-based organizations in developing independent technical innovations.

In four instances from 2010 to 2012, Armenian citizens sought third-party intervention by the NGO sector for legal advice or resolution of payment disputes due to the inability of the PRSC to enforce consumer protection. Conversely, the relative independence initially enjoyed by the Georgian regulator in terms of financial autonomy, power to define market rules and calculation of tariffs has allowed it to play a greater role in representing consumer interests.

Lastly, the strongest contrast between conditions in both countries is the extent to which metering policies have become politicized. In Armenia, the ruling party has utilized free installation of meters in the capital to cultivate electoral support among its constituents. In contrast, in six instances between 2008 and 2012, Georgian opposition parties incorporated popular discontent with the metering practices of KazTransGaz and SOCAR into their challenge to incumbent governments. Georgian citizens have also devised informal forms of substitution and resistance such as collective refusal of payment, formation of special committees, and demonstrations in competition with formal energy administrators.

Conclusion

While the effective measurement of energy consumption in former Soviet states has been a central concern of the international policy community, its larger social and political context has seldom been addressed in academic treatments of Eurasian energy issues. The present study has sought to identify dependency and innovation in metering technology as the essential link between macro-level structural issues of gas sector performance and its impact upon citizens of post-socialist systems that have experienced various challenges in providing resources to vulnerable populations. The analysis presented above seeks to account for the larger variety of actors and institutions that participate in decision making on gas sector development in the resource-poor states of the South Caucasus. In particular, the Armenian case demonstrates how ethnic identity can interact with political influence in a manner that solidifies economic dependency while inspiring local innovation. Conversely, the relative absence of these variables in Georgia underscores the constraints and costs of liberalization and diversification away from Russian providers via replacement by Caspian gas monopolies. At the same time, to address the question of generalizability and scope conditions (or the need to account for the presence of similar phenomena across a greater number of societies), the present theoretical approach might be extended and applied to a larger sample of energy-dependent former Soviet states, such as the Eastern European/Slavic Republics (Ukraine, Belarus and Moldova). In sum, these preliminary findings suggest the potential for a comparative institutional perspective to augment conventional approaches and contribute new insights to the study of regional energy policies, which incorporates the role of more complex interactions that occur within the standard technology–performance relationship.

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Notes

1. The centrality of gas-fuelled appliances in these economies is further underscored by their relative affordability, often fostering conversion in economically vulnerable households.

2. This stands in sharp contrast to the electricity sector, where metering was traditionally concentrated in individual households, which fostered a distinctive policy of relocating devices to common sites to combat tampering (i.e., turning back the counters of mechanical meters by hand) long before privatization of power supplies was initiated.
3. An initial attempt at accounting for household gas consumption was made with a restart programme implemented from 1995 to 1996 that installed master meters to record collective usage in several villages and relegated responsibility for fee collection to municipal authorities. However, this effort was unsuccessful due to disputes among residents regarding payment for unequal rates and the inability to enforce compliance.
4. The major role of global energy exporters in providing technology to Armenia is also exemplified by the joint US–Russian plant operated by Emerson Process Management/Rosemount and Metran Industrial Group in Chelyabinsk Oblast.
5. The burgeoning cooperation between Armenia and Iran in securing an auxiliary to Russian gas and technology supplies during the past decade is exemplified by the joint venture Gaz Souzan Armenia, based in Najafabad Industrial Zone in Isfahan, which since 2005 has become a major supplier of diaphragm meters and pressure regulators to the Armenian market.
6. These diplomatic linkages were further reinforced beginning in spring 1999, when Gaz de France (and initially the US branch of Schlumberger) extended an offer to finance construction of the Meghri-Sardarian section of the Iran-Armenia Natural Gas Pipeline as part of a consortium including Gazprom and the National Iranian Gas Company.
7. The AL 250 diaphragm meter is another type of flow-measurement device commonly used since the 1990s, which operates upon the principle of differential pressure of fluids or gases entering and filling separate valves within the unit.
8. The signing of a bilateral cooperation agreement between the government of Armenia and the Committee for Standardization, Metrology and Certification of the Slovak Republic in September 1997, followed by an Economic Trade and Scientific-Technical Cooperation instrument in February 2000, served to bolster these activities. During the administration of state tests of national metrological standards implemented by SARM in the mid-2000s, a certain proportion of evaluation procedures were conducted by its counterpart in Slovakia. At the turn of the past decade, the former Premagas Slovakia (now a subsidiary of Elster Group) was active in the supply of diaphragm meters to the Armenian market, as well as the installation of joint assembly lines for equipment production in both Armenia and Iran.
9. The FAAE subsequently facilitated the formation of the subsidiary Forum of Armenian Businessmen in Europe, which at its first annual meeting declared its objectives to be the 'creation of close ties between Armenian businessmen for future collaboration, the necessity of developing communication systems, the establishment of economic relations with Armenia and to develop collaboration of similar institutions for future investments'.
10. In correspondence dated 31 July 2013.
11. The first of these interviews were conducted between 5 and 18 July 2011.
12. The GNERC presently operates under the 20 November 2007 amendments to Article 4 of the Georgian Law on Electricity and Natural Gas, and Article 2 of the Law on Independent National Regulatory Authorities, enacted 15 October 2002.
13. At the same time, the participation of national-minority NGOs in energy development as observed in Armenia is not apparent in the Georgian case. For instance, according to a report on the social service and development programmes administered by British Petroleum in cooperation with Mercy Corps during the construction of the Baku-Tbilisi-Ceyhan and Baku-Tbilisi-Erzurum pipelines in 2004, the leadership of the Federation of Greek Communities of Georgia was unfamiliar with its activities, despite the fact that they traversed the Pontic and Urum settlements of Tsalka District.

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