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ADB Working Paper Series

ICT, ONLINE SEARCH BEHAVIOR, AND REMITTANCES: EVIDENCE FROM THE KYRGYZ REPUBLIC

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Abstract

Infrastructure has always been a fundamental driver of long-term economic growth, but in recent decades information and communication technology (ICT) has supported and accelerated the growth of the global economy in ways beyond the imagining of our ancestors. This study examines the role of ICT infrastructure in facilitating labor markets access and remittance flows for workers from the Kyrgyz Republic. Using a combination of traditional high frequency macroeconomic data and real time internet search information from Google Trends, we take a novel approach to explaining the inflow of remittances to a developing country. In the first attempt to model remittance behavior with GTI data in this context, we use a gravity model. We also attempt to account for both origin and destination labor market conditions, using Kyrgyz language search words to identify both push and pull factors affecting migrant decisions.

Keywords: migration, remittances, infrastructure, internet

JEL Classification: F22, F24, O18, O33, L86

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1. INTRODUCTION

Infrastructure has always been a fundamental driver of long-term economic growth, but in recent decades information and communication technology (ICT) has supported and accelerated the growth of the global economy in ways beyond the imagining of our ancestors. In contrast to traditional transportation infrastructure, the deployment of ICT infrastructure has facilitated pervasive information exchange, which, along with other social and economic implications, has had important impacts on labor mobility (Hartje and Hübler 2017; McAuliffe 2018; Leng et al. 2020; Kotyrlo 2020). This study uses new data sources to better identify and measure the economic contributions of ICT, focusing on how it facilitates labor market access and efficiency.

The mobility of the labor force is often analyzed using administrative and survey data. In the context of remittances, this has recently been exemplified by Yoshino, Taghizadeh-Hesary, and Otsuka et al. (2020), who use panel data from long-established migrant senders to reveal “life cycle” transition developing country access to external capital, from early reliance on migrant remittances to later hosting of foreign direct investment. In the majority of developing countries, however, the lack of administrative records and survey data can be a serious constraint to this kind of analysis. Today, accelerating ICT and access to the Internet provides expanded opportunities to fill the information gap in migrant labor dynamics (Kozachenko 2013; Kotyrlo 2020). ICT is widely used by migrants to send remittances, to obtain information about migration, for travel details, and for everyday contact with families left behind. In all these ways, ICT infrastructure facilitates migration and remittance flows and provides the opportunity to disseminate information among both potential and current migrants.

Along with the widespread use of information technology and Internet access, new sources for measuring migration and remittances have emerged. Online search data represent an important opportunity to analyze human behavior (Varian 2014). The availability of big data has also increased opportunities to measure migration at various stages. Empirical literature using big data for migration studies has expanded recently but is mostly focused on developed countries, such as OECD countries. Thus, Zagheni et al. (2014) use the data of users of the social network “Twitter” for OECD countries to track migration flows. A recent study by Böhme, Gröger, and Stöhr (2020) uses Google search data for OECD countries to assess the predictive power for migration flows and demonstrate that online search data can be a useful proxy for migration intentions and support real-time predictions of migration flows. Golenvaux et al. (2020) find that a long short-term memory (LSTM) approach with Google Trends data provides better results than the linear and ANN models in predicting migration to 35 OECD countries. However, there is a sparse literature for developing countries that use big data for migration and remittance studies. Among them, Nakamura and Suzuki (2021), who use data from Google Trends Index (GTI) to explore the impact of COVID-19 and various other economic restriction policies on job search in the case of Southeast Asian countries, note that migration intention did not increase as it requires time and costs.¹

Thus, recent literature focuses primarily on migration in the case of high-income countries. Intensive labor force mobility and data constraints in developing countries suggest benefits from the use of big data in these countries too. On the other hand, migration statistics in developing countries are less available than big data, while remittances as a consequence of migration flows are represented within monetary authority statistical information more often. Moreover, remittances are sensitive to social

¹ The GTI is explained in detail elsewhere; see, for example, Austin et al. (2021).

and economic conditions in countries of both destination and origin. Therefore, given the volatility of workers' money transfers, high-frequency data from the GTI represent an opportunity for a better explanation of remittance inflow.

This study aims to examine the GTI in explaining the inflow of remittances in the case of one of the developing countries in the World that receives the most remittances – the Kyrgyz Republic. The main contribution of this study to the literature is that it is the first attempt to explore remittance flow with GTI data in a developing country context. To do this, the gravity model is applied. Taking into consideration the fact that remittances of workers from abroad are consequences of the labor force outflow, we attempt to incorporate diaspora intensities in destination countries via the inclusion of search keywords on the Kyrgyz Republic and migration in destination countries. Also, search keywords used in the Kyrgyz Republic are applied to reflect local labor market conditions and search for migration opportunities as “pull” factors.

2. BACKGROUND

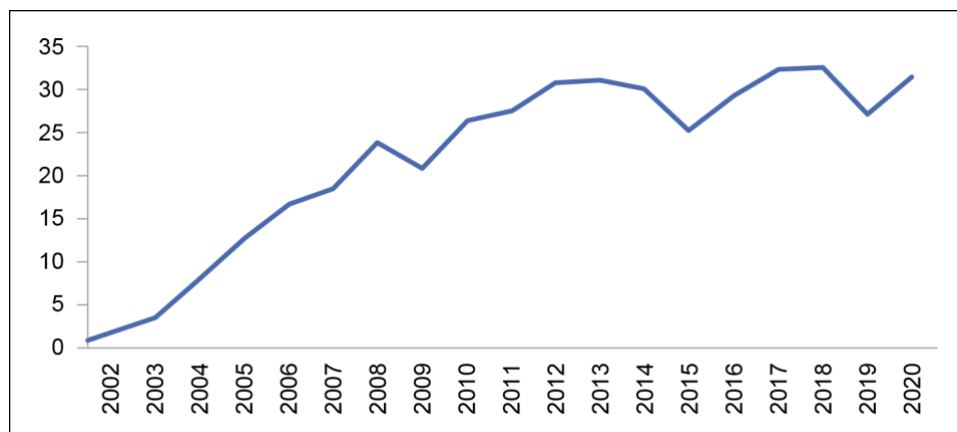
The Kyrgyz Republic is a landlocked country in central Asia. The decrease in the industrial production capacity and overall fragility of economic production after the dissolution of the USSR led to a low capacity to generate job places in the labor market. Nowadays the economy of the country is heavily reliant on the mobility of the labor force and the inflow of remittances. Although there are no systematically available data on the exact number of temporary and permanent labor migrants abroad, reports indicate that there are between 700,000 and more than one million people who qualify as labor migrants.² Given that the total population of the Kyrgyz Republic is 6.7 million, this is an important share of the labor force. The Russian Federation is the destination for almost 90% of the migrant workers from the Kyrgyz Republic. Fewer migrants currently work in Kazakhstan, and more recently in Turkey and the Republic of Korea.³ Because of the common history within the USSR and the fact that the Russian language is spoken in the Kyrgyz Republic, the Russian Federation and Kazakhstan are the main destinations for labor migrants. Moreover, the accession of the Kyrgyz Republic to the Eurasian Economic Union in 2015 simplified the process for labor migrants from member states, such as the extension of the period without registration, removal of the history and language exams, and the requirement to obtain permits for a job.⁴ Therefore, the majority of labor migrants from the Kyrgyz Republic have relatively high intensity in coming back and going for labor migration.

Remittances sent by labor migrants represent a significant population income source. Remittances in the Kyrgyz Republic accounted for 30% of GDP and ranked third in the world in terms of the volume of remittances as the share of GDP (see Figure 1).

² For instance, see: <https://www.kg.undp.org/content/kyrgyzstan/en/home/presscenter/pressreleases/2021/09/migration-research.html>; <https://ria.ru/20210607/migranty-1735950028.html>.

³ <https://reliefweb.int/sites/reliefweb.int/files/resources/WFP-0000135311.pdf>.

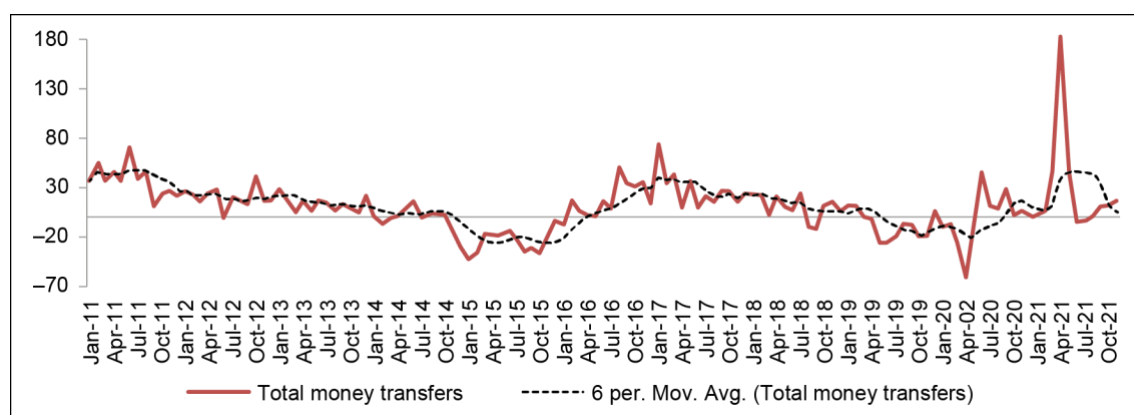
⁴ Aziza Shamyrbekova: “Has Labor Migration to Russia Improved for Kyrgyz? Accession to the Eurasian Economic Union provided some relief to Kyrgyz migrant workers, but difficulties remain,” 1 December 2021. <https://thediplomat.com/2021/12/has-labor-migration-to-russia-improved-for-kyrgyz/> (accessed 21 January 2022).

Figure 1: Remittances Received as % of GDP, Kyrgyz Republic (2002–2020)

Source: World Bank, World Development Indicators (accessed 27 December 2021).

Migrant workers face challenges with the COVID-19 pandemic, which has forced some of them to return; this has increased their difficult social and economic situation,⁵ especially during the first year of the pandemic, 2020.

Generally, the volatility of the remittance inflow into the Kyrgyz Republic is significantly related to the economic situation in the Russian Federation. Year-on-year (YOY) growth rates of money transfers into the Kyrgyz Republic were negative from late 2014 up to the beginning of 2016, following the recession and economic slowdown in the Russian Federation. With the start of the COVID-19 pandemic, the growth of money transfers declined with the strict lockdown measures in the Russian Federation, especially in Moscow, and reached the lowest level at minus 62% YOY in April 2020. This was reflected a low base in April 2021 recovery at plus 183% YOY. According to the National Bank of the Kyrgyz Republic's data on money transfers up to November 2021, money transfers accounted for USD2.5 billion.

Figure 2: Growth Rate of Money Transfers
(Monthly, %, Year-on-Year)

Note: Money transfers refer to transfers of individuals through transfer systems.

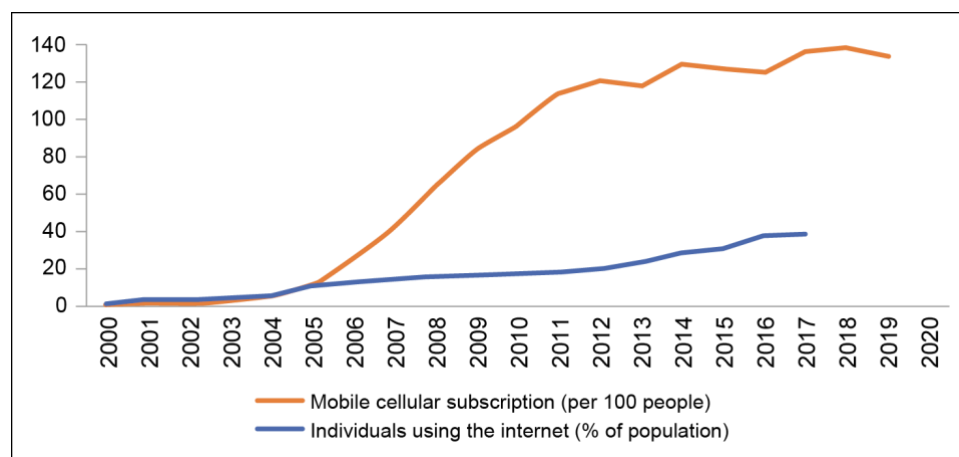
Source: National Bank of the Kyrgyz Republic, <https://www.nbkr.kg/index1.jsp?item=1785&lang=RUS> (accessed 10 January 2022)

⁵ <https://www.kg.undp.org/content/kyrgyzstan/en/home/presscenter/pressreleases/2021/09/migration-research.html>.

The Internet and mobile phones have empowered labor migrants by enabling them to keep updated with information about migration and labor force regulations in destination countries, as well as facilitating instant messaging with families, and the sending of remittances (Thompson 2009; Bacigalupe and Cámara 2012; Molony 2012), which is also observed for Kyrgyz labor migrants in the Russian Federation (Ruget and Usmanalieva 2019).

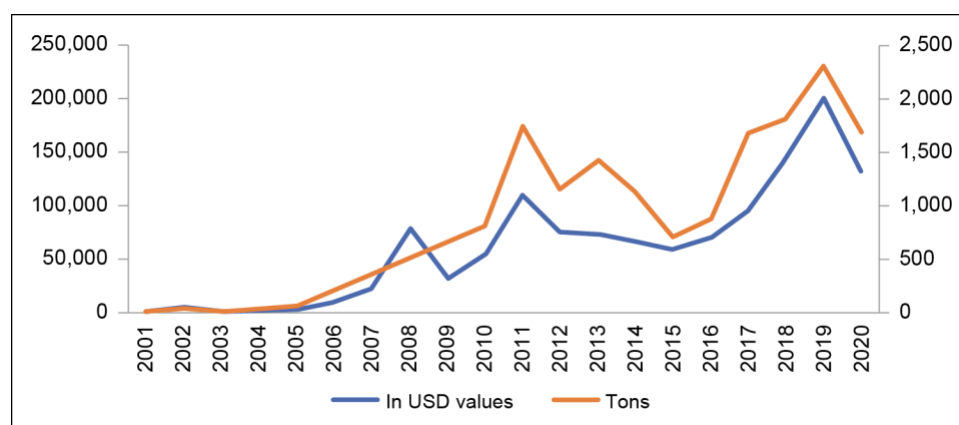
Widespread use of mobile phones and Internet access in the Kyrgyz Republic has significantly increased over the last 15 years. According to World Bank data, mobile cellular subscriptions per 100 people increased from 10 in 2005 to 134 in 2019, whereas in the same period the share of individuals using the Internet increased from 10% to 38% (see Figure 3).

Figure 3: Mobile Cellular Subscriptions and Use of Internet in Kyrgyz Republic



Source: World Bank, World Development Indicators (accessed 27 January 2022).

**Figure 4: Kyrgyz Republic Imports of Telephones
(Including for Cellular Networks, etc.)
(in USD Value and Tons RHS)**



Note: Complete title of the goods category: "8517: Telephone sets, incl. telephones for cellular networks or for other wireless networks; other ..."

Source: Trade Map (accessed 25 January 2022).

The use of mobile phones, and particularly smartphones, increased significantly in the Kyrgyz Republic after 2010. This is supported by the evidence of imports of telephones, including those for cellular networks (see Figure 4). In the pre-Covid year of 2019, the value of imports of telephones reached USD200,000, or 2,300 tons. Smartphones and soft applications enabled not only migrants in destination countries but also potential migrants to find helpful information for preparing for labor migration. It also facilitated remittance sending and receiving processes.⁶ According to Harris and Prohorova (2021), among migrants from central Asia in the Russian Federation, more than 90% of those with their own smartphones prefer sending remittances via the Internet (digital remittances), while in recipient countries this rate is above 70%.

3. LITERATURE REVIEW

Literature on migration agrees on the fact that information and communication technologies (ICTs) contribute to solving the issue of incomplete information for potential migrants and impact on their decision to migrate (Wood and King 2001; Hamel 2009). Also, ICTs increase opportunities for working and maintaining family life despite the long distances involved (Kotyrlo 2020). Not only potential migrants but also those in destination countries are active users of the ICT (Bankole, Shirazi, and Brown 2011). Iqbal, Peng, and Hafeez (2020) found that there is a positive relationship between ICT and migration across Belt and Road Initiative countries.

Empirical evidence on the importance of ICT for human mobility suggests that big data accumulated through the usage of the Internet and smartphones can be used to research migration flows (Ponzanesi 2019; Shen 2021; Sandberg et al. 2022). In these studies, the migration determinants have primarily been investigated and models have been constructed to track, map, and predict human mobility (Taylor and Meissner 2020; Sirbu et al. 2021; Napierała et al. 2022; Cai 2022). One of the main advantages of measuring migration with big data is that migration flow can be continuously observed in real time, while migration data conveyed in censuses and household surveys rely on self-reporting by respondents about migration and mobility (Kirchberger 2021). Pajević and Shearmur (2017) investigated how big data can be used for analyzing the geographical trajectories of workers' mobility in urban areas. The authors argued that traditional approaches, like the use of census data, etc., for studying employment locations do not fully capture the locations where economic activity and economic value are created, and they suggested using real-time ICT-driven data, such as geolocation, intensity, and line use data recorded throughout the day, social network posts, and time data to explore worker mobility.

According to Kirchberger (2021), digital trace data from mobile phones can be classified as those that are compiled from the usage of smartphone applications and those that are inferred from call detail record (CDR) data from a mobile phone operator. The latter is widely used in migration studies and allows migration to be defined, in terms of whether it is permanent, temporary, or circular (Batan et al. 2018; Yang et al. 2020; Kirchberger 2021). However, these data are not widely available for low-income countries and depend greatly on the willingness of mobile phone operators to give access to call detail records, while the data compiled from smartphone applications are mostly available and provide the opportunity to carry out investigations across countries. For instance, Spyrtos et al. (2018) estimated the number of expats in 17 EU countries based on the data from Facebook network platforms that are smartphone

⁶ For instance, see <https://kyrgyzstan.un.org/en/131029-future-development-digital> (accessed 31 January 2022).

applications, namely Facebook, Instagram, and Messenger. Google Trends data have been used to estimate a migration gravity model in addition to other economic and demographic migration determinants (Böhme, Gröger, and Stöhr 2020; Golenvaux et al. 2020). Xu et al. (2020) constructed a labor mobility network by collecting data on online résumés from social networks.

Migration Data Issues in Kyrgyz Republic

Even though big data improve the understanding of how and why people move, they have limitations such as the representativeness of data. Digital data drawn from smartphones and their applications, or Internet-based devices, are constrained by those who use digital equipment. For instance, CDR data cannot measure the movements of migrants that do not hold mobile phones, and may exclude from observation migrants in the lowest-income quintile (Kirchberger 2021). Also, countries where Internet access is expensive or where full coverage is not available may yield a biased representation of the population. Another limitation of investigating migration with big data is the fact that in low-income countries, temporary migration cannot be traced with official statistics.

However, remittances sent by labor migrants are recorded at a higher frequency. Moreover, literature suggests that worker remittances are a major determinant of labor migration (Fareedy 1984). Therefore, we suggest evaluating whether the online information-seeking behaviors of migrants and those looking for opportunities in the domestic labor market could explain the variations in remittances, alongside other known drivers of remittances. To analyze the explanatory power of Google Search indices on remittance inflow, we first begin by gathering Google Trends data that could be related to migration and remittances. Google is the dominant search engine in the Kyrgyz Republic with a share of almost 90%.⁷ Google Trends (GT) is a publicly accessible Internet-based service that provides a time series of word search volumes for the period starting from 2004 at weekly and monthly frequencies. The search volume is presented as indices, which reach a maximum of 100 at the peak point during the analyzed period.

We started by analyzing migration-related keywords presented in Böhme et al. (2020) by translating these words into the Kyrgyz and Russian languages, the latter being the second most common language spoken in the Kyrgyz Republic. Then we added new keywords that were assumed to be related to migration and remittances in the Kyrgyz Republic (including “blacklist”). Böhme et al. (2020) use the semantic links between words in the Wikipedia encyclopedia related to the overarching topic of migration and use semantic links that analyze the text of English language Wikipedia and identify pairs of keywords that are semantically related.

⁷ For instance, see: <https://gs.statcounter.com/search-engine-market-share/all/kyrgyzstan> (accessed January 28, 2022).

However, for the Kyrgyz language, we do not have such a semantic analysis platform. Therefore, for a better prediction of remittances we attempt to search keywords that may identify the intensity of labor migrants from the Kyrgyz Republic abroad and the Kyrgyz diaspora.⁸ This may not reflect the current labor migration, but it may include those who have moved abroad from the Kyrgyz Republic and obtained citizenship there. To analyze remittances as a consequence of labor migration, it might be better to search words not only in the destination countries, but also in the Kyrgyz Republic but related to the destination country: for instance, “jobs in the Russian Federation,” etc. However, it should be noted that Kyrgyz people generally tend to use informal (social) networks (relatives, etc.) to find jobs abroad, especially in the Russian Federation. Therefore, official use of Google Search to find jobs may not be widespread. However, other words related to the migration process might be employed. For instance, “look for air tickets” may indicate upcoming labor mobility trends. Also, looking for job search activities in the local labor market may indicate follow-up migration trends. Individuals in the local labor market, along with job search words, search main websites for vacancy announcements.⁹

Thus, GT search words in this research were chosen according to their relevance for migration and remittances. As both Kyrgyz and Russian are spoken in the Kyrgyz Republic, words in both languages are searched in GT. The geography of the search is based on the Kyrgyz Republic and on destination countries too.

It should be noted that in this study, for exploring the inflow of remittances, the search keywords used are from the general domain of migration and the labor market. Putting it differently, remittances are considered as a consequence of labor force mobility and the intensity of migrant stocks in destination countries. However, other potential macroeconomic factors affecting remittances are taken into account within the empirical gravity model.

The economic data for empirical modeling are remittances, and the real effective exchange rate for the Kyrgyz Republic has been compiled from the National Bank of the Kyrgyz Republic (NBKR), while GDP data have been gathered from the Interstate Statistical Committee of the Commonwealth of Independent States (CIS). These are monthly data for the period from January 2011 to July 2021. This period is selected to represent periods of salient smartphone use in the Kyrgyz Republic and most Google Search words are available from 2011. Monthly data on remittances are taken from the NBKR data on money transfers by individuals from abroad, which are also given for sending countries. However, almost 97% of money transfers by individuals come from the Russian Federation. However, in our analysis we include four other countries with non-zero values, namely Kazakhstan, Germany, the US, and Great Britain. Therefore, our monthly remittance data consist of money transfers from five countries to the Kyrgyz Republic.

⁸ https://www.rs.undp.org/content/serbia/en/home/blog/2020/mo_e-li-google-pretraga-da-pomogne-u-lociranju-dijaspore-.html.

⁹ https://kaktus.media/doc/439336_kak_nayti_raboty_v_kyrgyzstane._spisok_onlayn_servisov.html.

Table 1: Search Keywords in Google Trends

Searched Words in Google Trends	Translation in English
<i>Search words in countries of destination of migrants (Russian Federation, Kazakhstan, Germany, US, and Great Britain)</i>	
Бишкек (Бишкек Москва, Бишкек Алматы)	"Bishkek" for Germany, US, and Great Britain; for Russian Federation "Bishkek Moscow"; for Kazakhstan "Bishkek Almaty"
Ош	Osh (city in Kyrgyz Republic)
Иссык-Куль	Issyk-Kul (name of lake)
Той	Toi (festive event)
Чингиз Торекулович Айтматов	Chingiz Terekulovich Aitmatov (writer)
Комуз	Komuz (musical instruments of Kyrgyz Republic)
Кумтор	Kumtor (mining company in Kyrgyz Republic)
Кумыс	Kumis (horse milk)
<i>Search words in countries of origin of migrants (Kyrgyz Republic)</i>	
Employment	Employment
Job Kg	Job Kyrgyz Republic
Job	Job
Rabota	Work
Авиабилет	Air Ticket
Авиабилеты	Air Tickets
Бизнес	Business
Билет На Самолет	Plane Ticket
Билет	A Ticket
Бирге Ру	Birge.ru (Website of Kyrgyz migrants)
Вакансии Бишкек	Vacancy Bishkek
Вакансии	Vacancies
Виза	Visa
Выезд	Departure
Гражданин	Citizen
Граница	Border
Жердеш ру	Jerdesh.ru (Website of Kyrgyz migrants)
Жумуш	Work
Ищу Работу	Looking for Work
Лалафо Бишкек Работа	Lalafo (Website name) Bishkek Work
Лалафо Работа	Lalafo (Website name) Work
Опыт	Experience
Паспорт	Passport
Работа в Бишкеке	Work in Bishkek
Работа в Турции	Work in Turkey
Работа дизель	Diesel (Website name) Work
Работа	Work
Резюме	Resume
Родина	Homeland
Самолет	Plane
Черный список	Blacklist
Эмгек	Labor

Table 2: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Observations
Remittance (<i>million US dollars</i>)	36.50689	74.1957	0	274.1805	635
GDP (<i>million US dollars</i>)	607.3482	169.7376	293.3547	1,147.537	635
REER	111.826	4.50384	103.2	124.1	635
GT words for destination					
<i>Bishkek</i>	30.55433	23.14332	0	100	635
<i>Osh</i>	26.01417	25.60784	0	100	635
<i>Toi</i>	42.39213	25.22828	0	100	635
<i>Chingiz Torekulovich Aitmatov</i>	25.82677	22.18893	0	100	635
<i>Komuz</i>	19.27087	25.1099	0	100	635
<i>Kumtor</i>	10.44882	20.77812	0	100	635
<i>Kumis</i>	23.4063	20.55228	0	100	635
<i>Issyk-Kul</i>	23.7748	21.06677	0	100	635
GT words for origin, Kyrgyz Rep.					
<i>Employment</i>	22.51969	21.85154	0	100	635
<i>Job Kg</i>	26.20472	28.21821	0	100	635
<i>Job</i>	36.22047	21.80061	0	100	635
<i>Work</i>	30.74803	23.6146	0	100	635
<i>Air Ticket</i>	28.83465	22.73519	0	100	635
<i>Air Tickets</i>	45.8189	20.85719	0	100	635
<i>Business</i>	37.79528	16.11539	13	100	635
<i>Plane Ticket</i>	20.08661	20.87216	0	100	635
<i>A Ticket</i>	40.71654	21.75099	0	100	635
<i>Birge.ru</i>	18.15748	24.27122	0	100	635
<i>Vacancy Bishkek</i>	46.87402	23.4746	0	100	635
<i>Vacancies</i>	41.45669	12.07152	8	100	635
<i>Visa</i>	41.2126	18.17095	0	100	635
<i>Departure</i>	22.88976	17.49007	0	100	635
<i>Citizen</i>	26.32283	21.04257	0	100	635
<i>Border</i>	20.02362	21.38039	0	100	635
<i>Jerdesh.ru</i>	19.77953	27.75396	0	100	635
<i>Work</i>	34.84252	24.10591	0	100	635
<i>Looking For Work</i>	45.59843	24.98494	0	100	635
<i>Lalafo Bishkek Work</i>	20.59843	27.18649	0	100	635
<i>Lalafo Work</i>	20.93701	25.39677	0	100	635
<i>Experience</i>	25.67717	18.2408	0	100	635
<i>Passport</i>	46.65354	15.92242	14	100	635
<i>Work in Bishkek</i>	49.11024	23.88994	0	100	635
<i>Work in Turkey</i>	21.83465	21.87351	0	100	635
<i>Diesel Work</i>	41.14961	27.03167	0	100	635
<i>Work</i>	56.37008	13.3225	21	100	635
<i>Resume</i>	23.68504	16.75708	5	100	635
<i>Homeland</i>	37.14961	21.28375	0	100	635
<i>Plane</i>	23.75591	12.70492	0	100	635
<i>Blacklist</i>	28.8189	24.22828	0	100	635
<i>Labor</i>	28.88189	21.0481	0	100	635

Notes: The GT Index is normalized to a maximum of 100. Google does not disclose absolute values. See, for example, Austin et al. (2021) for details.

4. MODEL SPECIFICATION

To analyze the impact of Google Search indices on remittance inflow to the Kyrgyz Republic from the Russian Federation, Kazakhstan, Germany, the US, and England we have applied the gravity model, where the dependent variable is the remittance and it is regressed by GDP, real exchange rates, and GT words. The augmented gravity model is as follows:

$$X_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 REER_{it} + \beta_3 Gt_{oit} + \beta_4 Gt_{djt} + \delta_t + \varepsilon_{ijt} \quad (2)$$

where,

- i = represents the country of origin – the Kyrgyz Republic;
- j = represents countries that send remittances – the Russian Federation, Kazakhstan, Germany, the US, and England;
- X_{ijt} = is the level of remittance inflow in period t , in million US dollars;
- $\ln GDP_{it}$ = is the level of gross domestic product in the Kyrgyz Republic in period t , in million US dollars;
- $REER_{it}$ = is the real exchange rate;
- GTo = GT words for origin – Kyrgyz Republic
- GTd = GT words for destination countries – the Russian Federation, Kazakhstan, Germany, the US, and England
- δ_t = time-specific fixed effects

The level of GDP in the Kyrgyz Republic is expected to be negatively correlated with the remittance inflow. Hence, the relative growth of income in the Kyrgyz Republic decreases the migration outflow, thereby decreasing the remittance inflow from abroad. For this reason, β_1 is expected to be smaller than zero. The GT words are assumed to significantly impact the remittance inflow into the Kyrgyz Republic, meaning that definite search words may explain the pattern of remittance inflow into the Kyrgyz Republic.

Estimating the log-linearized gravity model in the presence of zero values – in our case these are the zero values for remittance inflow in some months – leads to a loss of information from these observations and a reduction of the sample size. To deal with this issue, Silva and Tenreyro (2006) suggest using the Poisson pseudo-maximum-likelihood (PPML) estimation method. This technique makes it possible to estimate the gravity model in the presence of heteroskedasticity and deal with zeros in data. The interpretation of the results of this model is the same as with ordinary least squares (OLS), and the coefficients are interpreted as elasticity. The estimation in STATA is enabled by the *ppml* command with cluster-robust standard errors (Silva and Tenreyro 2010).

5. EMPIRICAL RESULTS

In Table 3 the results of the impact of Google Trends words on bilateral remittance inflow into the Kyrgyz Republic are presented. All results are presented with cluster-robust standard errors. Gravity models were used initially for GT words searched inside the Kyrgyz Republic, then inside countries of destination, and lastly in the third column the estimation model for all countries is presented.

Two salient relationships emerge from these results. Firstly, it is clear that a decline of GDP in the country of origin is associated with amplified remittance inflow increases, showing that in adverse economic cycles at home, migrants are more likely to remit, which is consistent with mutual assurance and spatial hedging theories of migration (see, for example, Lueth and Ruiz-Arranz 2007; Mustafa and Ali, 2018).

Secondly, the evidence shows that exchange rate depreciation in the migrants' home country (Kyrgyz Republic) is significantly associated with lower remittance inflows. This suggests a prudential motive on the part of sending migrants, who recognize the increased home country purchasing power of their income. In other words, a smaller transfer of earned currency (e.g., US dollars or rubles) is needed by their beneficiaries at home to buy the same basket of goods/services (Poghosyan and Blancher 2020).

Apart from these variables, for the available GT words examined in this study, the results do not indicate systematic impacts on Kyrgyz remittance inflows (1 column), and less likely to determine the remittance inflow. Hence, the overall R^2 is quite low, indicating that most of these search words do not significantly explain the variation in remittances. However, the results on several individual search words are interesting. Thus, words that are closely related to job search in general and air tickets in particular ("air ticket," "a ticket," "looking for work," "border," "Jerdesh.ru," "work in Turkey") have a positive correlation with the magnitude of remittance inflows. These words may signal individuals' limited opportunity for employment in the local labor market and their intentions to search for jobs abroad.

GT words that are searched in migrant destination countries significantly explain the remittance variation (R -square = 0.78). This shows that Google Trends searches by migrants living within destination countries (remittance senders) help explain the flow of remittances back home. These fixed (origin) effects are weaker (below average or negative) for larger home cities related to the search for Bishkek or for Bishkek to Moscow (or Almaty), probably indicating that individuals from some origin provinces are more experienced migrants and less likely to consult the Internet.

Therefore, it can be argued that the online information-seeking behaviors of migrants in countries of destination have a relatively strong statistical association with migration decisions, including remittance activity, alongside other known macroeconomic remittance drivers, such as GDP and REER. It should be emphasized that all these search words are merely informational proxies, consulted by Internet users to inform themselves about underlying economic fundamentals that motivate their labor market search and remittance decisions.

Table 3: Impact of Google Trends Words on Remittance

	(1)	(2)	(3)
<i>GDP</i>	0.0021*** (0.0007)	-0.0015*** (0.0006)	-0.0052*** (0.0015)
<i>REER</i>	-0.0352*** (0.0089)	-0.0809*** (0.0128)	-0.1181*** (0.0406)
GT words for origin			
<i>Employment</i>	0.0006 (0.0018)		
<i>Job Kg</i>	-0.0087*** (0.0028)		0.0535*** (0.0138)
<i>Job</i>	-0.0005 (0.0042)		
<i>Work</i>	-0.0007 (0.0016)		

continued on next page

Table 3 continued

	(1)	(2)	(3)
<i>Air Ticket</i>	0.0023** (0.0011)		−0.0370*** (0.0109)
<i>Air Tickets</i>	0.0003 (0.0016)		
<i>Business</i>	−0.0076*** (0.0020)		
<i>Plane Ticket</i>	−0.0025 (0.0019)		0.0156*** (0.0056)
<i>A Ticket</i>	0.0090** (0.0041)		
<i>Birge.ru</i>	−0.0025 (0.0020)		
<i>Vacancy Bishkek</i>	−0.0027 (0.0062)		
<i>Vacancies</i>	−0.0073** (0.0029)		−0.0294*** (0.0109)
<i>Visa</i>	−0.0000 (0.0010)		
<i>Departure</i>	−0.0015 (0.0056)		
<i>Citizen</i>	0.0063 (0.0046)		
<i>Border</i>	0.0048** (0.0020)		
<i>Jerdes.ru</i>	0.0077*** (0.0021)		−0.0212*** (0.0055)
<i>Work</i>	−0.0016 (0.0062)		
<i>Looking For Work</i>	0.0065*** (0.0022)		
<i>Lalafo Bishkek Work</i>	0.0030 (0.0024)		
<i>Lalafo Work</i>	−0.0048** (0.0024)		
<i>Experience</i>	0.0038** (0.0017)		
<i>Passport</i>	0.0066 (0.0044)		
<i>Work in Bishkek</i>	0.0143 (0.0089)		
<i>Work in Turkey</i>	0.0036*** (0.0005)		
<i>Diesel Work</i>	−0.0001 (0.0015)		
<i>Work</i>	−0.0077 (0.0090)		
<i>Resume</i>	−0.0012 (0.0066)		
<i>Homeland</i>	0.0017 (0.0041)		0.0185** (0.0077)
<i>Plane</i>	−0.0039 (0.0043)		
<i>Blacklist</i>	−0.0009 (0.0009)		
<i>Labor</i>	−0.0150 (0.0095)		

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Table 3 continued

	GT Words in Origin	GT Words in Destination	Total
GT words for destination			
<i>Bishkek Mosow</i>		−0.0242** (0.0115)	−0.0256** (0.0118)
<i>Osh</i>		0.0599*** (0.0182)	0.0606*** (0.0185)
<i>Toi</i>		0.0403*** (0.0115)	0.0421*** (0.0122)
<i>Chingiz Torekulovich Aitmatov</i>		0.0204*** (0.0045)	0.0192*** (0.0046)
<i>Komuz</i>		0.0267*** (0.0069)	0.0285*** (0.0072)
<i>Kumtor</i>		−0.0074*** (0.0025)	−0.0090*** (0.0028)
<i>Kumis</i>		−0.0491*** (0.0157)	−0.0507*** (0.0154)
<i>Issyk-Kul</i>		0.0259** (0.0120)	0.0247** (0.0121)
<i>Constant</i>	6.2762*** (1.2684)	7.3250*** (2.6926)	13.8313*** (5.0329)
<i>Month</i>	+	+	+
Log likelihood	−34,478.01	−8,667.644	−8,399.845
R ²	0.0236	0.7785	0.7909
N	614	631	629

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$.

6. CONCLUSIONS

This study examined the efficacy of using the Google Trends Index (GTI) to explain remittance patterns in the Kyrgyz Republic. A hybrid gravity model was combined with the frequency of use of selected Internet search keywords in destination countries and the Kyrgyz Republic. Based on data availability, the remittance inflows from six destination countries were selected for the empirical modeling. Estimation results indicate that searched words in destination countries have more statistically significant impacts on remittances than those words searched in the Kyrgyz Republic, suggesting that remittance supply-side decisions are more search dependent. However, outbound search, using words in the Kyrgyz Republic that reflect job and air ticket seeking, are important in explaining remittances too. These results indicate that GTI can elucidate not only migration departure decisions by the labor force but remittance flows as well. These correlations on both sides of the migration process reveal how ICT infrastructure facilitates migrant job creation and income transfers for sending households, both of which are potent catalysts of poverty reduction and growth in the Kyrgyz Republic and other developing countries.

Along with these findings and in line with earlier literature, we note from our new data that the use of smartphones, Internet access, and digital skills generally may vary across income, education, and age cohorts. These aspects are not controlled in our empirical approach but could assist future research on the potential of ICT to extend labor market benefits more inclusively.

Despite the limitations of sampling this new data resource, several policy implications can be derived from our empirical findings. First, labor outflow since the early 2000s has significantly increased the stock of Kyrgyz migrants abroad. This process makes it essential that government policy become more proactive in four new policy areas:

- 1) Facilitating repatriation of remittances, and
- 2) Channeling them into productive domestic investment.
- 3) Taking account of evidence in more experienced sending economies (Yoshino et al 2020, among others), it is also important for Kyrgyz leaders to consider longer-term policies aimed at repatriating these workers, enhancing their skills, and generally improving the domestic investment climate to attract higher and more diverse steady-state levels of FDI;
- 4) Finally, recognizing the international potential of information technologies to facilitate these pro-growth dynamics should redouble domestic commitments to ICT and the information economy generally to support domestic education and skills development, improving productivity and market access for Kyrgyz workers and enterprises across the domestic economy and globally.

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