Migration and University Education: An Empirical (Macro) Link

Şule Akkoyunlu*, Gil S. Epstein** and Ira N. Gang***

Abstract (116 words)

Distinguishing between short-run and long-run outcomes we provide new insight into the relationship between education and migration. We examine the specific link between the acquisition of high levels of human capital in the form of university education in Turkey and migration to Germany. We implement bounds testing procedures to ascertain the long-run relationships with the variables of interest in a migration model. Although the bounds testing procedure has advantages compared to other methods, it has not been widely implemented in the migration literature. We find a negative and decreasing non-linear long-run and short-run relationship between home country university education and Turkish migration to Germany over 1970-2015. Over the long run, increased higher education reduces emigration flows.

Short Abstract (53 words)

This paper examines the link between university education and emigration flows in the context of the Turkish migration to Germany between 1970-2015. Using time series data, the we apply a bounds testing procedure and find that increases in higher education are associated with decreasing emigration flows both in the short and long run.

Keywords: Education; Migration; Turkey; Germany

JEL Codes: C22; F22; F63; I25; I26; O15

* Corresponding Author: Coventry University, School of Economics, Finance and Accounting, Gosford Street, CV1 5FB, Coventry, UK. sule.akkoyunlu@gmail.com
** Department of Economics, Bar-Ilan University, Ramat Gan 52900, Israel. RWI, Essen; IZA, Bonn; GLO; CReAM, London. E-mail: gil.epstein@biu.ac.il
*** Department of Economics, Rutgers University, 75 Hamilton St., New Brunswick, NJ 08901-1248, USA. RWI, Essen; IOS, Regensburg; IZA, Bonn; GLO; CReAM, London. Email: gang@economics.rutgers.edu

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1. Introduction

Economics has long highlighted the close link between education and migration: Hicks (1932) pointed to relative wages as a main element of migration, while the standard Mincer (1958) estimation has education as a main factor determining wages. The kinship is a bit complex, with differential returns to skills and education in both the home and host countries influencing migrant decision-making. An increase in access to education in the home country can decrease migration by reducing the desire to study abroad and by raising worker productivity. On the other hand, an increase in access to education in the home country will increase skills and possibly their transferability to a host country labor market. This can increase migration via the brain drain and related phenomena.

It is intriguing empirically to examine the linkages between education and migration. Indeed, migration is itself a form of human capital investment. By migrating, people gain skills, knowledge and experience, which increase the human capital stock in both source and destination countries. Schooling might also encourage people to migrate (Faggian et al., 2007), suggesting that education and migration may be complementary rather than substitute forms of investing in human capital.

Most famously the close connection between education and migration has been highlighted in the brain drain/gain literatures. Study of the brain drain phenomenon makes the case that increased provision and attainment of home country higher education may not yield the expected benefits as the highly educated may emigrate. It highlights the negative impacts of skilled/educated emigration on the home economy (Bhagwati and Hamada (1974); Grubel and Scott (1966)). Bhagwati and Rodriguez (1975) suggest a "safety valve" function for the brain drain, as it can lower the economic and political pressures brought on by unemployed educated workers.

In contrast, the brain gain emphasizes the second-round positive impacts on the source country of international emigration through remittances and enhanced returned migrants' skills (Co, Gang and Yun, 2000). Mountford (1997) furthermore highlights the existence of a "demonstration effect" arguing that emigration of the highly educated, by raising the return to education in the home country, creates positive incentives for investment in human capital. While there may be a negative direct effect on the home country's skill composition through skilled emigration, it will encourage human-capital formation in the long run. Mountford

(1997) finds evidence that skilled emigration is beneficial for the home country – which is also called the 'beneficial brain drain' – as long as the probability of future emigration is low enough (see Stark et al., 1997; Vidal, 1998; Beine et al., 2001). Similarly, Beine et al. (2001, 2008 and 2011) finds that higher emigration rates may have a positive effect on average human-capital levels in the home country; when countries are characterized by low levels of human capital, low income and relatively low emigration rates of skilled workers (not exceeding 20 to 30 per cent), the net effect on the average human-capital level of the remaining population in the home country is positive.

We exploit the ability to distinguish between short-run and long-run outcomes in modern macro-econometrics to provide new insight into the relationship between education and migration. Focusing on education in a macro-econometric framework, we examine the specific link between the acquisition of high levels of human capital in the form of university education in Turkey and migration to Germany. We implement bounds testing procedures to ascertain the long-run relationships with the variables of interest in a migration model. Although the bounds testing procedure has advantages compared to other methods, it has not been widely implemented in the migration literature.

Turkey is a country where the expansion of access to and quality of education had been seriously pursued by policy-makers over the last century and especially over recent decades. For example, compulsory education was expanded to eight years in 1997 and further to 12 years by the 2012-2013 academic year (MEB, 2015). In addition, the number of public and private universities have been increasing since 1980. Fifty new public universities and 36 non-profit universities became active between 2006 and 2011. During the academic year 2001–2002 there were 76 universities, 53 of which were state-run and 23 were non-profit. By academic year 2017-2018, 1.4 million students were enrolled in higher education in Turkey in 206 universities and academic institutions in total: 129 state universities, 72 private foundation universities, five two-year granting institutions, and in addition one special national defense university, and one police academy.[1] The quality of education at Turkey's universities varies greatly; some are regularly visited by the US Accreditation Board for Engineering and Technology and their programs are equivalent to comparable programs in the US, and some

[1]State Planning Organisation (SPO) (2011), Annual Programme, p. 200; https://istatistik.yok.gov.tr; and http://www.yok.gov.tr/web/guest/universitelerimiz.

universities have joint degree programs with foreign universities. Turkey's universities actively participate in international programs such as the Socrates–Erasmus program of the European Commission.

The next section describes Turkish migration to Germany. Section 3 introduces the empirical migration model we test; while the fourth section explains the details of Pesaran *et al.'s* (2001) bounds testing procedure. The fifth section provides the test results and presents the final model; the final section concludes.

2. Background: Turkish Migration to Germany

The direction of migration flows between Germany and Turkey has changed in recent years, with outflows of Turkish nationals from Germany outpacing the inflows of Turkish nationals to Germany, making net migration negative since 2006. This is seen in Figure 1.[2]

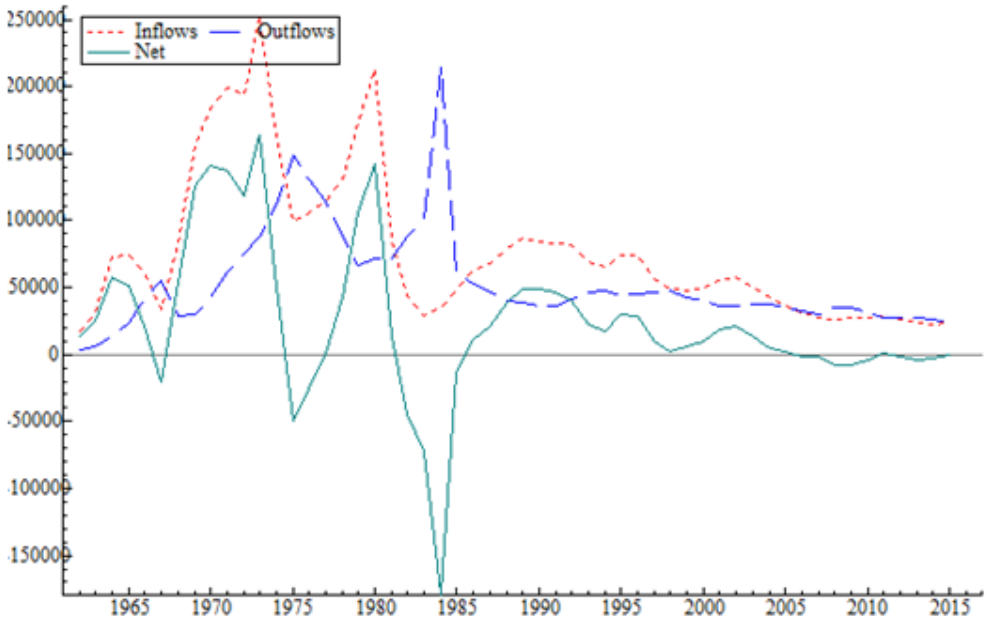

FIG. 1 Inflows, Outflows and Netflows of Turkish Citizens to/from Germany
Source: Statistisches Bundesamt, Wiesbaden, 2017

Turkish migration to Germany can be characterized into eight phases, as laid out in Table 1. The first phase began in the 1960s with arrangements between the two countries over temporary Turkish guest workers. The programs' encouragement of temporary migration was

[2]Since 2006, it was positive only in 2011.

expected to help reduce unemployment in Turkey, contribute to foreign exchange reserves, and through returned migrants, increase skills. However, many guest workers encouraged by their host employers decided to stay in Germany and had their families join them, constituting the second phase of Turkish migration.

The third phase of Turkish migration to Germany occurred with asylum seekers and political refugees during the 1970s and 1980s following political upheaval in Turkey. Return migration took place in the mid-1980s with Germany's *Foreigners Repatriation Incentives Law of 1983.* Around 250,000 Turkish nationals benefited from this scheme covering returnee's relocation costs and paid back accrued social benefits, pensions, etc. Migration from Turkey to Germany has been decreasing since the 1980s with the start of significant return migration. A German migration law adopted in July 2004 made entry conditions more difficult by requiring a basic knowledge of German. Between 2002 and 2013 migration to Germany through family reunification fell from 25,068 to 6,113, increasing in 2015 to 15,888. Asylum applications dropped from 28,327 in 1992 to 1,500 in 2015. Stricter asylum laws in Germany with the reformed constitution (*Grundgesetz*) in 1993 made obtaining asylum more difficult.

TABLE 1
STYLISED PHASES OF TURKISH MIGRATION TO GERMANY SINCE 1961

Phase	Name	Years	Story
1	Labor Recruitment	1961-1973	Turkish "guest workers" were employed through Germany's Central Recruitment Office (*Anwerbebüros der Bundesanstalt für Arbeit*) with the intent to avoid permanent moves to Germany by continuously rotating migrants back and forth between Germany and Turkey. This plan for circular migration was quickly abandoned, as employers wanted to keep the workers who had been trained by their firm and families wanted to stay together. Turkey's aim in participating was to relieve unemployment at home and increase foreign-exchange reserves through remittances. In addition, the Turkish government hoped that Turkish migrants would return with new professional skills and knowledge; they hoped for what later came to be called a "brain gain". Estimates are that 17% of Turkey's skilled labor went abroad during this period.
2	Family Unification	1973-1980s	Germany's labor recruitment policy ended in 1973, though many Turkish workers stayed in Germany. Frequently their spouses, children and other family members joined them. During this period, migrants from Turkey began to enter Germany illegally, or entered legally but overstayed their tourist visa. Often they worked in the informal economy.
3	Asylum Seekers and Refugees	1980s	Political turmoil in Turkey during the late 1970s and the 1980 military coup generated refugee migration. With unrecognized credentials and frequently lacking legal status, asylum seekers and refugees were often not able to find work.
4	Return Migration	1983-1985	Nearly 250,000 Turkish migrants and their families returned to Turkey, taking advantage of the Foreigners Repatriation Incentives Law (Gesetz zur Förderung der Rückkehrbereitschaft von Ausländern) of 1983. A return fund of 10,500DM for unemployed foreign nationals who had worked in Germany at least for two years and 1,500DM for each family member were offered.
5	Second Refugee Wave	1990s	Kurdish refugees and political asylum seekers constituted the second refugee wave.
6	Circular Migration	Early 2000s	A major shift in Turkish migration patterns occurred. Students, highly skilled workers, intracompany transferees and retirees move in both directions.
7	Net Negative Migration Flows	Since 2006	For Germany, outflows of Turkish nationals have outpaced their inflows. A new type of migration – emigration of highly skilled Turks from Germany to Turkey has also occurred. Highly skilled persons of Turkish origin in Germany have been more willing to move to Turkey than low-skilled persons.
8	Post-coup Attempt Crackdown	After 2015	The number of asylum applications after the military coup attempt on 15 July 2016 from Turkey to other countries, as well as to Germany, has increased.

Sources: Abadan-Unat (2011), Alscher et al. (2014), Aydin (2016), Castle and Miller (2009), Sayari (1986).

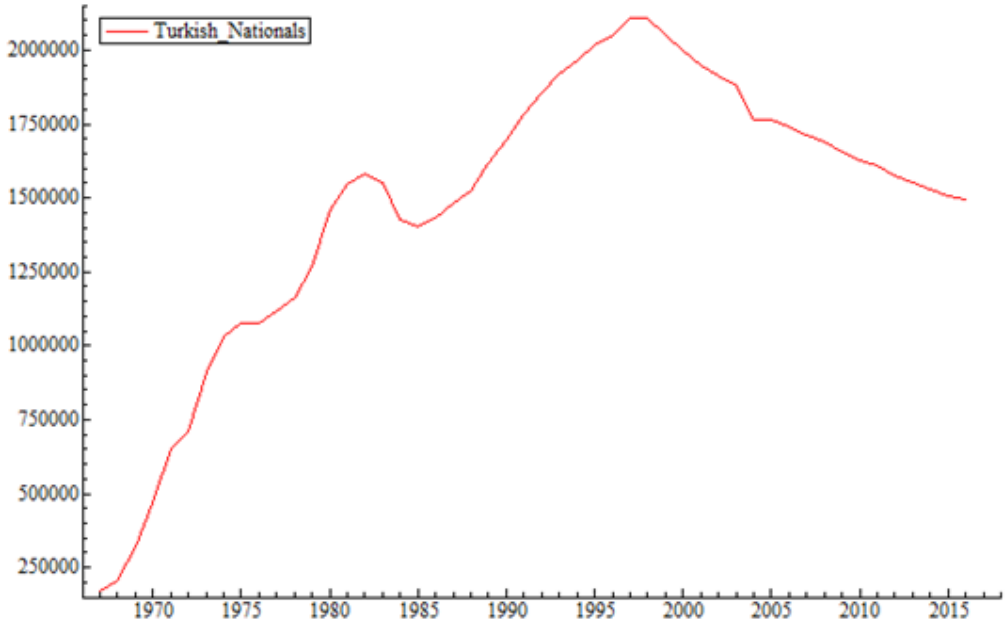

FIG. 2 Turkish Citizens in Germany
Source: Statistisches Bundesamt, Wiesbaden, 2017

There are almost 3 million (2,851,000 in 2015) current and former Turkish citizens residing in Germany, 1.5 million of them kept their Turkish citizenship. 610,000 Turks were born in Germany and 246,000 Turks were dual citizens in 2015.[3] Figure 2 shows the data on Turkish nationals in Germany.[4]

Although Turkish migration from the 1970s had a permanent nature, immigration since 2000 has been temporary and circular. Students, highly skilled workers, and retirees have been travelling in both directions.

[3]Bundesamt für Migration und Flüchtlinge (BAMF) *Migrationbericht, 2015* (Nuremberg: BAMF, 2017),https://www.bamf.de/SharedDocs/Anlagen/DE/Publikationen/Migrationsberichte/migrationsbericht-2015.pdf?__blob=publicationFile.
[4]Statistisches Bundesamt, *Bevölkerung mit Migrationshintergrund – Ergebnisse des Mikrozensus, Fachserie 1 Reihe 2.2. - 2016* (Weisbaden, Germany: Statistisches Bundesam, 2017). https://www.destatis.de/DE/Publikationen/Thematisch/Bevoelkerung/MigrationIntegration/Migrationshintergrund.html.

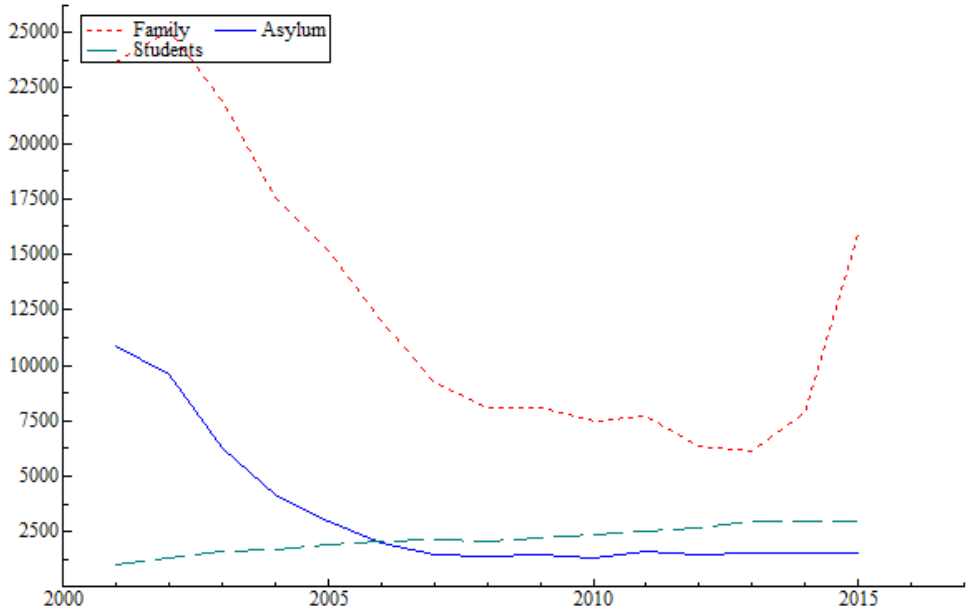

FIG. 3 Annual Flows from Turkey to Germany by Visa Type (Family Reunion, Asylum Applications and the Purpose of Education (2000-2015)
Source: BAMF, Migrationsbericht 2015.

Figure 3 shows that in addition to the recent increase in family reunification, migration flows of Turkish students to Germany has been steadily increasing. Turkish students receiving a visa to study in a German university increased from 747 in 1999 to 2,965 in 2015. The total number of Turkish university students in Germany was 36,530 during the 2015/2016 academic year and Turkish students make up the largest external student group in Germany. Aydin (2016) points out that Turkish nationals who enter Germany with a student or work visa are the most likely to leave. In 2012 one-fifth of emigrants who were on student and work visas returned to Turkey.[5] Figure 3 also shows that asylum applications decreased until 2007 and has been constant. The number of asylum applications after the coup attempt on 15 July 2016 from Turkey to other countries, as well as to Germany, increased.

Aydin (2016) draws attention to media interest[6] in the movement of highly educated Turkish-origin individuals from Germany to Turkey in recent years and relates recent net migration

[5]BAMF, Abwanderung von Türkeistämmigen: Wer verlässt Deutchland and warum? (Nuremberg, BAMF, 2014). https://www.bamf.de/SharedDocs/Anlagen/DE/Publikationen/Beitragsreihe/beitrag-band-6-abwanderung-tuerkeistaemmiger.pdf?__blob=publicationFile

[6]Freia Peters, "Warum gut gebildete Türken Deutschland verlassen, *Die Welt,* October 30, 2010. https://www.welt.de/politik/deutschland/article10636913/Warum-gut-gebildete-Tuerken-Deutschland-verlassen.html Daniel Von Steinvorth, Ethnic Turks Encounter 'Kültürschock', July 02, 2010. http://www.spiegel.de/international/world/leaving-germany-for-turkey-ethnic-turks-encounter-

flows to this emigration. Sezer and Dağlar (2009) conducted a survey on highly educated Turkish-origin individuals and found that more than one-third of those surveyed were willing at some point to move to Turkey. Aydin (2016) also points out that these highly qualified emigrants migrate for job-related reasons and for further education and research. This phase also coincides with the increase in per capita Turkish GDP, suggesting economic prosperity in Turkey encourages return migration. Figure 4 shows that the ratio of per capita German GDP to Turkish GDP has been falling since 2006.

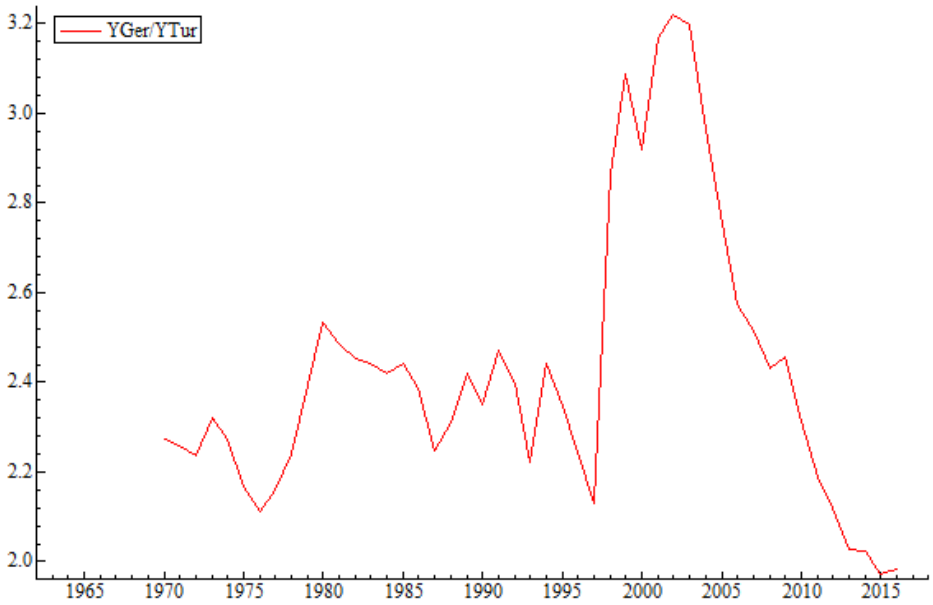

FIG. 4 per capita German GDP to per capita Turkish GDP Ratio in constant USDs.
Source: OECD

3. Key Variables

In the standard Roy model (1951), if rewards for skill are higher in the host relative to the home country, then migrants are positively selected and more educated than non-migrants. This affects economic growth and development as the post-migration skill composition of workers in the home country will be lower than pre-migration. The main idea is that a local individual

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must decide whether or not to invest in herself by obtaining additional education (for example, university education). When making this decision she has to look at education's costs and benefits. On the one hand, additional schooling will enable her to obtain a better job, higher wages and higher status; and, of course, increased consumption and life expectancy. However, she also considers the option to emigrate to a different country with a higher standard of living and higher wages. Thus, when she comes to decide whether or not to invest in additional higher education she must also take into consideration the possibility of emigration.

Strategic planning on the part of workers may also be involved here. In their decision-making calculus potential migrants compare potential lifetime net discounted earnings/incomes at home and in host locations taking into consideration skill prices and the degree to which skills acquired in each country are transferable to other countries' labor markets. Migrants might also acquire skills in a host country and this may depend on the number, types and quality of skills and/or education acquired previously in the home country – more educated migrants may acquire additional skills more easily (see Borjas, 2000). Similarly, Chiswick and Miller (1994) find a positive complementary relationship between pre-immigration schooling, occupational status and post-immigration schooling. Therefore, the acquisition of skills in the home country, and hence the increase in educational attainment in the home country, may increase migration.

Will further education help increase her employment and earnings possibilities, and further education, in the destination country? This is not always clear. Many times it is easier to migrate having a lower level of education since it is easier to find a job and obtain additional schooling in the host country. It may well be the case that an individual will decide not to invest in education in their home country and will try to emigrate without education rather than investing in education and then trying to emigrate. Thus we may well see that those emigrating have lower education levels since it enables them to more easily find a job and obtain additional schooling in the host country than those that come with a higher education (see Abdulloev, Epstein and Gang, 2015).

The bottom line here is that it is unclear whether increased schooling of the potential migrant group will end up increasing or decreasing emigration from the home to the host country. The relationship is, in short, ambiguous. It is an empirical question; one we set out to examine in the highly interesting relationship between Turkey and Germany.

Our study examines the annual gross inflow of Turkish migrants to Germany as a share of the home (Turkish) population, M_t. This is the gross directional migration rate, used in investigating factors related to migrant locational choices, for example in Borjas (1987, 1999), Hatton (1995), Clark et al. (2007), Pedersen et al. (2006), Péridy (2006), Epstein and Gang (2006b) and Mayda (2010). Our variables are in log form.[7] We focus on the role university education plays in this process, examining '*share of university graduates*' among the population aged 25 to 44 in Turkey as captured in UNI_t and UNI_t^2, the shares and shares-squared. The squared term captures the possible non-linear relationship between university education and migration.

We account for several other factors in locational decision-making. In Table 2 we define each of the variables and the data sources from which we obtained them. Gross pecuniary migration incentives are reflected in national income differentials. In our case Y_{ft}/Y_{ht} is annual income in the host country (Germany) divided by income in the home country (Turkey), measured as per capita GDP in purchasing-power parity terms. Employment opportunities in Germany, the destination country, will influence the migration decision. Poor economic conditions in Germany reflected in its unemployment rate U_{ft}, lower job opportunities directly. Moreover, German migration policies have become more restrictive during periods of high unemployment in Germany (Mayda and Patel, 2004). Similarly, Turkey's unemployment rate, U_{ht}, represents a simple push factor. The unemployment rates enter the empirical model individually rather than as a difference term, in line with (for example) Borjas (1987, 1999), Hatton (1995), Pedersen et al. (2006), Péridy (2006), Clark et al. (2007) and Mayda (2010).

Several other variables are included to capture investments in economic development. Foreign assistance can help overcome several obstacles to development, such as credit constraints and poor infrastructure. Including the ratio of overseas development aid to Turkey (from all sources) with respect to Turkish gross national income, $(A/GNI)_t$, will allow us to see the relationship of migration and foreign assistance in both the short and long run. The volume of trade between Turkey and Germany tells us something about the financial and informational constraints associated with migration, the level of business linkages between economies and

[7]The log-log model is also preferred by Lundborg (1991), Faini and Venturini (1993) and Pedersen *et. al.* (2008). Dependent and explanatory variables are transformed to logarithms. The parameters of the log-log model have an interpretation as elasticities.

uncertainty. The literature has found the higher the trade volume the more intensive the links (Akkoyunlu, 2009, 2012 and Epstein and Gang, 2006a). These links help shape the migration environment by lowering migration costs (Bauer, Epstein and Gang, 2005, 2007, 2009). We use the share of the trade volume (sum of exports and imports) between the two countries in the total trade volume of Turkey with all its trading partners, T_t. Finally, we want to capture the demonstration or signaling effects of migration that may encourage migration. To do this we include workers' remittances from Germany as a proportion of the Turkish GDP, $(R/Y_h)_t$ Remittances may also be used to finance cost of migration.

TABLE 2
VARIABLE DEFINITIONS AND DATA SOURCES

Note that all variables except dummies are natural logs.

Variable	Definition	Data Source
$\ln M_t$	*Gross directional migration:* log of the gross flow of Turkish migrants to Germany, expressed as a share of the home (Turkish) population	Federal Statistical Office, Germany; Turkish Institute of Statistics
$\ln UNI_t$ *and* $\ln UNI_t^2$	*University graduates*: shares and shares-squared of 'university graduates' among the population aged between 25 and 44 in Turkey	Turkish Institute of Statistics
$\ln(Y_{ft}/Y_{ht})$	*Relative income*: log of annual income in the host country divided by income in the home country, measured as per capita GDP in purchasing-power parity terms	OECD
$\ln U_{ft}$	*Unemployment rate in Germany*	Federal Statistical Office, Germany
$\ln U_{ht}$	*Unemployment rate in Turkey*	Turkish Institute of Statistics
$\ln(A/GNI)_t$	*Aid:* overseas development aid to Turkey-to-Turkish GNI ratio	World Development Indicators, World Bank
$\ln T_t$	*Trade intensity*: proxy for the intensity of economic cooperation between Turkey and Germany, calculated as the log of the share of the trade volume (sum of exports and imports) between the two countries in the total trade volume of Turkey with all its trading partners	Turkish Institute of Statistics
$\ln(R/Y_h)_t$	*Workers' remittances:* log of the ratio between workers' remittances from Germany and the Turkish GDP	workers' remittances were obtained from the balance sheets of the Bundesbank.
$D1983_t$, $D1990_t$ and $D1994_t$	impulse dummies respectively equal to 1 in 1983, 1990 and 1994 and zero otherwise	

Notes: Prior to 1990 the data refers to West Germany; after 1990/1991 to unified Germany (West and East Germany together). Aid data for Germany and Turkey are given as shares of GNI (gross national income). Aid data are only available as a share of GNI in international statistics.

In summary, Turkish migration to Germany is modeled in a standard empirical form (see

Hatton, 1995) as in equation (1):

$$M_t = f(UNI_t, UNI_t^2, Y_{ft}/Y_{ht}, U_{ft}, U_{ht}, (A/GNI)_t, T_t, (R/Y_h)_t) \quad (1)$$

Our empirical analysis of Turkish migration builds on Akkoyunlu (2009, 2010) where she focuses on the influence of trade and capital flows on migration, examining whether trade, aid and remittances work to reduce or increase migration. Our focus here is on the role of university education; so we also include *university education* variables intended to capture the non-linear relationship between education and overall emigration.

The annual data we use covers the period from 1970 to 2015. Figures 5a and 5b show the trends of the model's variables, which indicate that migration share has certain common features with relative income, unemployment rate in Germany, unemployment rate in Turkey, aid, trade intensity, remittances, university education and its square in Turkey. Our visual inspection suggests that these factors move together: falling migration share in the post-1980 period matches closely decreases in relative income, trade intensity, remittances and the square of university education, and increases in German unemployment and university education. However, over the entire period, migration share and university education and its square seem to be highly correlated. Therefore, we expect to see the largest effect on migration share from university education and its square. In fact, we argue that the proper description of the relationship between Turkish university education and migration is given by concurrently examining from the linear and quadratic terms. The salient features of the data and their connection over the entire period recommend using a formal econometric modelling to further reveal and refine these relationships.

FIG. 5a Trends of Model Variables: 1970–2015.
Source: Authors' calculations.

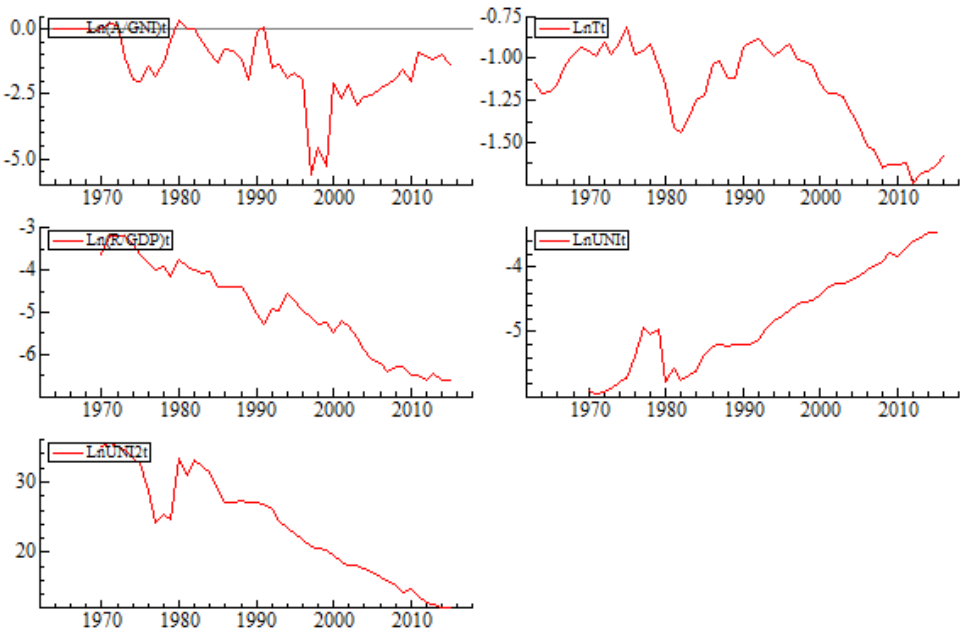

FIG. 5b Trends of Model Variables: 1970–2015.
Source: Authors' calculations.

4. Estimation Procedure

This study employs the bounds testing approach to cointegration, developed by Pesaran *et al.* (2001) to examine the short- and long-run variables related to Turkish migration to Germany. The procedure has several advantages over other methods. First, it allows variables to be integrated of order zero (I(0)), or of order one (I(1)) or mutually cointegrated. Therefore, it does not require pre-testing the variables to determine their order of integration as do other cointegration methods, i.e. the Johansen and Juselius (1990) and Engle and Granger (1987) approaches. Second, the bounds testing procedure is based on the unrestricted error correction model which has better statistical properties than the Johansen-Juselius and the two-step Engle-Granger methods. As pointed out by Banerjee *et al.* (1993); this is because joint estimation of long- and short-run effects with the bounds testing procedure does not push the short-run dynamics into the residual terms. Third, the bounds testing procedure performs better in small samples as in this study, compared to the more popular Full Information Maximum Likelihood Method (Johansen, 1995).

We are working with long time series data and need to estimate short-run and long-run coefficients. "Short-run impact" means the impact of an independent variable on the dependent variable in one up to a few years – we look at the coefficient on the change in the independent variable. "Long-run impact" means the impact of an independent variable on the dependent variable over the entire period – we look at the coefficient of the one period lagged independent variable in levels.

To implement the bounds testing procedure in our context, we assume a vector autoregressive (VAR) model of order *p* relates Turkish migration to Germany as captured by relative income, the overall unemployment rates in Germany and Turkey, the ratio between overseas development assistance to Turkey and GNI, the intensity of economic cooperation between Turkey and Germany, the ratio between workers' remittances from Germany and the Turkish GDP, the number of university graduates divided by population aged 25 and 44, and its square.[8] Our vector autoregressive (VAR) model of order *p* is further reduced to the following conditional error correction model (ECM):[9]

[8]We also used a measure of population aged 15 and 44; the results were almost unchanged.
[9]The graphics, regression output and residual diagnostic tests were all calculated using Oxmetrics 7, (Doornik and Hendry, 2001a, 2001b).

$$
\begin{aligned}
\Delta \ln M_t = {} & \alpha + \theta_0 \ln M_{t-1} + \theta_1 \ln (Y_f / Y_h)_{t-1} + \theta_2 \ln U_{ft-1} + \theta_3 \ln U_{ht-1} + \theta_4 \ln (A/GNI)_{t-1} \\
& + \theta_5 \ln T_{t-1} + \theta_6 \ln (R/Y_h)_{t-1} + \theta_7 \ln UNI_{t-1} + \theta_8 \ln UNI^2_{t-1} \\
& + \sum_{i=1}^{p} \gamma_{1i} \Delta \ln M_{t-i} + \sum_{i=0}^{p} \gamma_{2i} \Delta \ln (Y_f / Y_h)_{t-i} + \sum_{i=0}^{p} \gamma_{3i} \Delta \ln U_{ft-i} + \sum_{i=0}^{p} \gamma_{4i} \Delta \ln U_{ht-i} \\
& + \sum_{i=1}^{p} \gamma_{5i} \Delta \ln (A/GNI)_{t-i} + \sum_{i=0}^{p} \gamma_{6i} \Delta \ln T_{t-i} + \sum_{i=0}^{p} \gamma_{7i} \Delta \ln (R/Y_h)_{t-i} \\
& + \sum_{i=0}^{p} \gamma_{8i} \Delta \ln UNI_{t-i} + \sum_{i=0}^{p} \gamma_{9i} \Delta \ln UNI^2_{t-i} + \omega' D_t + \varepsilon_t
\end{aligned}
\tag{2}
$$

The first part of the right-hand-side – the lagged values of $\ln M_t$, $\ln(Y_f/Y_h)_t$, $\ln U_{ft}$, $\ln U_{ht}$, $\ln(A/GNI)_t$, $\ln T_t$, $\ln(R/Y_h)_t$, $\ln UNI_t$ and $\ln UNI_t^2$ – form a long-run relationship in levels. α and D_t represent the deterministic terms such as constant and dummy variables, respectively. The short-run dynamics are captured by means of lagged values of $\Delta\ln M_t$, and current and lagged values of $\Delta\ln M_t$, $\Delta\ln(Y_f/Y_h)_t$, $\Delta\ln U_{ft}$, $\Delta\ln U_{ht}$, $\Delta\ln(A/GNI)_t$, $\Delta\ln T_t$, $\Delta\ln(R/Y_h)_t$, and $\Delta\ln UNI_t$ and $\Delta\ln UNI_t^2$. The conditional long-run elasticities of Turkish migration to Germany with respect to $\ln(Y_f/Y_h)_t$, $\ln U_{ft}$, $\ln U_{ht}$, $\ln(A/GNI)_t$, $\ln T_t$., $\ln(R/Y_h)_t$ and $\ln UNI_t$ and $\ln UNI_t^2$ are given by $-\theta_1/\theta_0, -\theta_2/\theta_0, -\theta_3/\theta_0, -\theta_4/\theta_0, -\theta_5/\theta_0, -\theta_6/\theta_0, -\theta_7/\theta_0,$ and $-\theta_8/\theta_0,$ respectively (Pesaran et al., 2001).[10] The respective short-run elasticities are the estimated short-run coefficients, i.e., those on the changes in independent variables and the change in independent variables lagged one period.

For our education variables, the share of university graduates in 25-44 year olds and its square, the long-run elasticity is $-\theta_7/\theta_0 - 2(-\theta_8/\theta_0)\ln UNI_t$, calculated at the mean value of $\ln UNI_t$ [11] Below we will value the percentage by which the long-run elasticities change as a result of a one percent change in $\ln UNI_t$**.** The related short-run elasticity is given by the estimated short-run coefficients, $\gamma_{81} + 2(\gamma_{91})\Delta\ln UNI_t$, calculated at the mean value of $\Delta\ln UNI_t$.

The bounds testing procedure utilizes the conventional *F*-test for testing the null hypothesis

[10]To obtain the long-run elasticities the long-run coefficients are normalized by dividing them θ_0, the coefficient on the lagged dependent variable $\ln M_{t-1}$ (Pesaran et al. (2001).

[11]For the derivation of the long- and short-run elasticities with respect to education, see the Notes at the bottom of Table 4.

H_0: $\theta_0 = \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta_6 = \theta_7 = \theta_8 = 0$. Although Pesaran et al. (2001) report the set of asymptotic critical values, simulated with 1,000 bootstraps, we use the critical values reported in Narayan (2005) for a small sample size (46 observations) comparable to our study. Two sets of critical values are used. The first set is *the lower bound*, and is applicable when all regressors are I(0). The second set is *the upper bound*, and is applicable when all regressors are I(1). If the estimated *F*-statistic is less than *the lower bound*, the null hypothesis of no cointegration between Turkish migration to Germany and the variables of interest cannot be rejected. If the estimated *F*-statistic is higher than *the upper bound*, then the null hypothesis of no cointegration is rejected. Finally, if the *F*-statistic falls within the critical bounds, the order of integration of the variables needs to be established in order to obtain conclusive inferences.

5. Estimations

5.1. Test Results

Given the limited number of observations (46) and the variables to be estimated in Equation (2), the lag length is restricted to one, that is $p=1$. Moreover, the LaGrange Multiplier (LM) statistic testing for remaining autocorrelation of order 1, 2, 4 and up to 6 in regression residuals shows that there is no evidence of remaining autocorrelation in the regression residuals when $p=1$; so p=1 is accepted. The last column of Table 3 reports the estimated *F*-test statistic for the joint null hypothesis H_0: $\theta_0 = \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta_6 = \theta_7 = \theta_8 = 0$ using the finite-sample critical values calculated in Narayan (2005) for $T=45$ corresponding to case III (unrestricted constant and no linear deterministic trend) in Pesaran *et al.* (2001). Thus, the result of the bound testing approach for cointegration shows that no long-run relationship between Turkish migration to Germany and the variables of interest can be decisively rejected for $p=1$ at the 1% significance level. This tells us that Turkish migration to Germany and our variables of interest are related.

TABLE 3
RESULTS OF THE LM TEST STATISTICS AND THE BOUNDS TESTING PROCEDURE

P	AR(1)	AR(2)	AR(4)	AR(6)	*F-test - H_0: $\theta_0 = \theta_1 = \theta_2 = \theta_3$ $\theta_4 = \theta_5 = \theta_6 = \theta_7 = \theta_8 = 0$*
1	0.8189	0.2790	0.2141	0.3104	44.929***

Notes: *p* is the lag order of the underlying VAR model for the conditional ECM of Equation (2). AR(1), AR(2), AR(4), and AR(6) are the *p*-values of the Lagrange Multiplier (LM) test statistics for testing for residual autocorrelation of orders up to one, two, four, and six, respectively. The last column gives the *F*-test statistic for the null hypothesis H_0: $\theta_0 = \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta_6 = \theta_7 = \theta_8 = 0$ using the finite-sample critical values simulated in Narayan (2005, p. 1988) for $T=45$ corresponding to case III – with unrestricted constant and no linear deterministic trends. In other words, entries in Table 3 are probabilities and tell us, for example, that the null hypothesis of no serial correlation is accepted at 82% for AR(1). *** indicates that the null hypothesis can be rejected at the 1% significance level.

Having established the existence of a long-run relationship between Turkish migration to Germany and our variables of interest, we move to establish our estimating equation. We start with an error-correction model corresponding to $p=1$ (the change in variables, including the change in the dependent variable, are lagged one period) and delete the insignificant augmentation lags. We arrive at the following parsimonious conditional error-correction equation based on equation (2) and bounds testing procedures:

$$\begin{aligned}\Delta \ln M_t = {} & \alpha + \theta_0 \ln M_{t-1} + \theta_1 \ln(Y_f/Y_h)_{t-1} + \theta_2 \ln U_{ft-1} + \theta_3 \ln U_{ht-1} + \theta_4 \ln(A/GNI)_{t-1} \\ & + \theta_5 \ln T_{t-1} + \theta_6 \ln(R/Y_h)_{t-1} + \theta_7 \ln UNI_{t-1} + \theta_8 \ln UNI_{t-1}^2 \\ & + \gamma_{11} \Delta \ln M_{t-1} + \gamma_{21} \Delta \ln(Y_f/Y_h)_t + \gamma_{31} \Delta \ln(Y_f/Y_h)_{t-1} + \gamma_{41} \Delta\Delta \ln U_{ft} + \gamma_{51} \Delta\Delta \ln U_{ht} \\ & + \gamma_{61} \Delta\Delta \ln(A/GNI)_t + \gamma_{71} \Delta \ln T_{t-1} + \gamma_{81} \Delta\Delta \ln(R/Y_h)_t + \gamma_{91} \Delta \ln UNI_{t-1} \\ & + \gamma_{101} \Delta \ln UNI_{t-1}^2 + \omega_{1983}\ D1983 + \omega_{1990}\ D1990 + \omega_{1994}\ D1994\end{aligned} \tag{3}$$

where γ_{11}, γ_{21}, γ_{31}, γ_{41}, γ_{51}, γ_{61}, γ_{71}, γ_{81}, γ_{91}, and γ_{101} are short-run elasticities.

5.2. Estimation Results – Coefficients and Elasticities

Table 4 provides the coefficient and elasticity estimates for equation (3).

TABLE 4
TURKISH MIGRATION TO GERMANY
Coefficient and Elasticity Estimates, Equation (3)
(dependent variable = $\Delta \ln M_t$)

Variables	Coefficient	Coefficient Estimates	Standard Errors	Elasticity formulation	Migration elasticity estimates
Constant	α	-8.63***	1.24		
Long-run Effects					
$\ln M_{t-1}$	θ_0	-0.920***	0.055		
$\ln(Y_f/Y_h)_{t-1}$	θ_1	-0.052	0.080	$-\theta_1/\theta_0$	-0.06
$\ln U_{ft-1}$	θ_2	-0.579***	0.051	$-\theta_2/\theta_0$,	-0.63
$\ln U_{ht-1}$	θ_3	0.605***	0.089	$-\theta_3/\theta_0$	0.66
$\ln(A/GNI)_{t-1}$	θ_4	0.070***	0.010	$-\theta_4/\theta_0$	0.08
$\ln T_{t-1}$	θ_5	0.097	0.108	$-\theta_5/\theta_0$	1.05
$\ln(R/Y_h)_{t-1}$	θ_6	0.354***	0.037	$-\theta_6/\theta_0$	0.39
$\ln UNI_{t-1}$	θ_7	-2.395***	0.486	$-\theta_7/\theta_0$	0.1718848 at the mean of $\ln UNI_t$
$\ln UNI_{t-1}^2$	θ_8	-0.265***	0.051	$-2(-\theta_8/\theta_0)\ln UNI_t$	
	See notes below for the migration elasticity calculation with respect to the population share of university graduates. If the mean of $\ln UNI_t$ increases by 1%, the migration elasticity falls by 16.13%.				
Short-run Effects					
$\Delta \ln M_{t-1}$	γ_{11}	0.557***	0.040	In the short run, the coefficient estimates are the estimated elasticities.	
$\Delta \ln(Y_f/Y_h)_t$	γ_{21}	0.724***	0.136		
$\Delta \ln(Y_f/Y_h)_{t-1}$	γ_{31}	0.342***	0.118		
$\Delta\Delta \ln U_{ft}$	γ_{41}	-0.540***	0.056		
$\Delta\Delta \ln U_{ht}$	γ_{51}	0.358***	0.072		
$\Delta\Delta \ln(A/GNI)_t$	γ_{61}	0.028***	0.009		
$\Delta \ln T_{t-1}$	γ_{71}	-0.548***	0.119		
$\Delta\Delta \ln(R/Y_h)_t$	γ_{81}	0.206***	0.030		
$\Delta \ln UNI_{t-1}$	γ_{91}	-0.190***	0.067	$\gamma_{91} + 2(\gamma_{101})\Delta \ln UNI_t$	-0.228122304 at the mean of $\ln UNI_t$
$\Delta \ln UNI_{t-1}^2$	γ_{101}	-0.352***	0.096		
	See notes below for the migration elasticity calculation with respect to the population share of university graduates. If the mean of $\ln UNI_t$ increases by 1%, the migration elasticity falls by 0.46%.				
Impact Dummies					
$D1983_t$	ω_{1983}	-0.153***	0.051		
$D1990_t$	ω_{1990}	0.152***	0.048		
$D1994_t$	ω_{1994}	-0.225***	0.050		

Statistics: [probabilities in brackets] R^2=0.988; F(22,20) = 76.38[0.000], T = 44; *** indicates that the null hypothesis can be rejected at the 1% significance level. Source: Authors' calculations.

Notes: The long-run elasticity of migration with respect to university education, when the mean value of $\ln UNI_t$ = -4.8123 is $-\theta_7/\theta_0 - 2(-\theta_8/\theta_0)\ln UNI_t$ = – 2.6 - (2)(0.288)(- 4.8123) = 0.1718848. If $\ln UNI_t$= -4.764177 (=1% increase from the mean value of $\ln UNI_t$), the long-run elasticity is –2.6 – (2)(0.288)(-4.764177) = 0.144166. When $\ln UNI_t$ increases 1% from its mean value the long-run elasticity decreases by 16.13% (from 0.1718848 to 0.144166). The short-run elasticity of migration with respect to university education, when the mean value of $\Delta \ln UNI_t$=0.054151 is $\gamma_{91} + 2(\gamma_{101})\Delta \ln UNI_t$ = –0.19 – (2)(0.352)(0.054151) = -0.228122304. If $\Delta \ln UNI_t$ = 0.0546925 (=1% increase from the mean value of $\Delta \ln UNI_t$) the short-run elasticity is –0.19 – (2)(0.352)(0.0546925) = - 0.22917337. When $\Delta \ln UNI_t$ increases 1% from its mean value the short-run elasticity decreases by 0.46% (from -0.228122304 to -0.22917337).

All the diagnostic tests for equation (3) are satisfactory, such as tests for residual autocorrelation, residual ARCH effects, residual normality and the RESET test for functional form.[12] This parsimonious model explains the Turkish migration to Germany quite well over the period under investigation. Our results are further supported by the close match between actual and fitted values shown in the top left panel of Figure 6; the corresponding cross-plot is shown in the right top panel. The estimated regression residuals do not show signs of misspecification in the left bottom panel of Figure 6. The autocorrelation function up to ninth order which is displayed in the bottom right panel takes small values that, moreover, change signs.

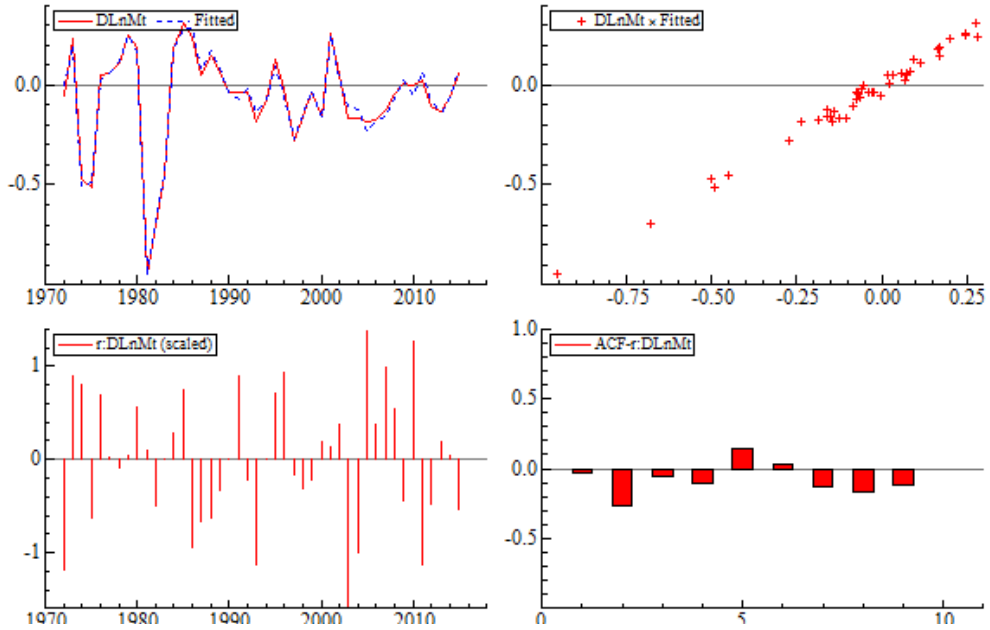

FIG. 6 Actual and fitted values; Cross-plot of actual and fitted values; Regression residuals (r:DlnMt); Autocorrelation function of regression residuals (ACF-r:DlnMt), Equation (3).
Source: Authors' calculations.

[12]The final model (3) has 44 observations and 23 parameters, therefore 21 degrees of freedom in estimation, however, sample size is only one of the factors determining how much information there is in the sample, see Campos and Ericsson (1999). Figures 5a and 5b show that the variability of the data, and hence the informational content of the data is very high. In addition, the large *t*-ratios in Equation (3) suggest that over-parameterization is not an issue in our case, due to the nature of our data.

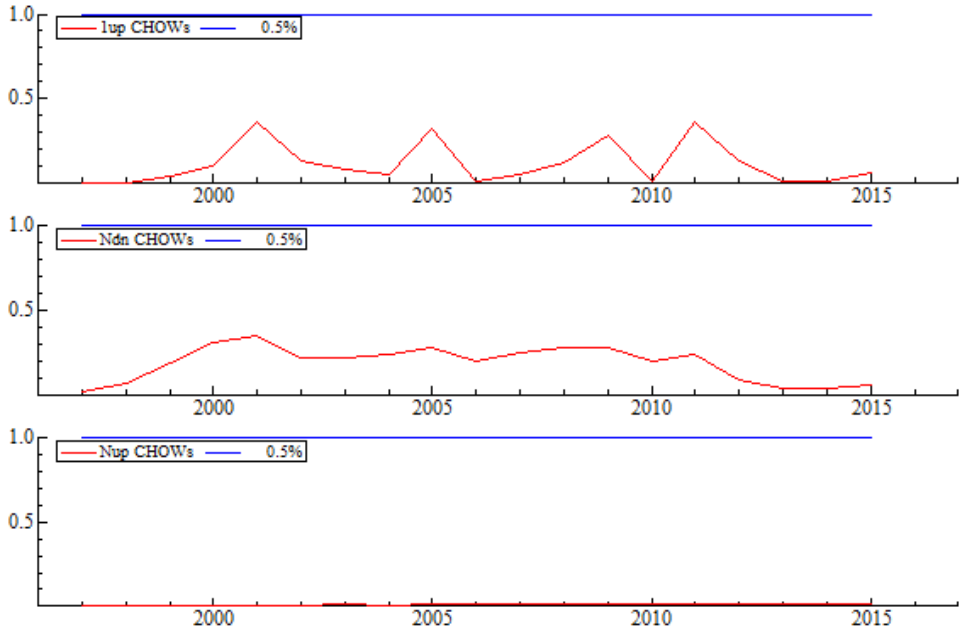

FIG. 7 Recursive stability 1-step; breakpoint; and forecast Chow test statistics scaled by their respective 1% critical values, Equation (3).
Source: Authors' calculations.

Finally, Figure 7 shows the values of the one-step, breakpoint, and forecast Chow test statistics scaled by their respective 1% critical values (Doornik and Hendry, 2001b). These tests show no signs of model instability.

5.3. University Graduates

Looking at the results displayed in Table 4, it is clear that university education plays an important and significant role in the flow of Turkish migrants to Germany. In both the long run and the short run, our measure, the share of 'university graduates' among the population aged 25-44 in Turkey, affects gross directional migration of Turkish migrants to Germany, expressed as a share of population aged 25-44. In the long run, the *university education* variables have the largest effect compare to the other variables. We see this clearly when looking at the conditional long-run elasticities of Turkish migration to Germany with respect to university graduates: a one percent increase in university graduates as a share of population aged 25-44 from its mean value decreases the migration elasticity by 16.13 percent, a quite large effect. And since an increase in university graduates decreases migration at a decreasing rate in the long run, the extent of the negative impact of university education on migration from Turkey to Germany decreases as education increases.

In the short run, 'university graduates' is also an important estimate in the migration flows equation: a one percent increase in the change in university graduates from its mean value will decrease the migration elasticity by 0.46 percentage points. University graduates in the short run is again an important determinant of Turkish migration. The negative non-linear impact of university education on the migration flow implies that the extent of the negative impact of university education becomes more pronounced as university education increases in Turkey, so that easy access and an increase in the quality of education in Turkey deter migration in the short run as well, though the effect is much smaller in the short run.

5.4. Other Results

Looking at the coefficient estimates and elasticities in both the long- and short run for our other variables of interest provides some useful insights. It is clear from Table 4 that in both the long run and short run the response of migration to these other variables is, except in one case, inelastic. Within this context there are interesting differences. Some of the long-run elements, that is, unemployment rate in Turkey, trade intensity, workers' remittances and aid, contribute positively and significantly to migration from Turkey to Germany, while the unemployment rate in Germany contributes negatively and significantly to migration from Turkey to Germany. Unemployment rates in Germany and in Turkey have expected signs with significant impacts in the long- and short run. A high unemployment rate in Turkey generates pressure to migrate. The availability of jobs in Germany and in Turkey matters in the short run. Somewhat unexpectedly, income differentials do not have long-run impacts. However, in the short run income differentials are the most important determinant of migration inflows. A one percent increase in the change in income differentials between Germany and Turkey increases change in the gross migration inflows as a share of population by 0.72 percentage points.

Economic assistance to Turkey encourages emigration in the long run as well as in the short run. A story here is that an increase in income or improvement in infrastructure due to foreign aid reduces migration costs by making migration accessible to unskilled migrants with low incomes and low access to credit markets. Remittances have a positive effect on migration in the short run as well as in the long run, supporting the hypothesis that remittances fuel migration – remittances to an economy are the harbinger of migration.[13] Expected and

[13]See also Akkoyunlu et al. (2013).

permanent income effects, liquidity constraints, demonstration,[14] signaling, portfolio revision and other considerations raise the possibility that an economy that receives more remittances will generate more migration.

Trade intensity has a large and significant impact: a one percent increase in trade intensity increases gross migration inflows as a share of population by 1.05 percentage points in the long run. Trade intensity, while in the long run encouraging migration, has a negative effect in the short run. Trade is not only the exchange of goods, but also promotes competition and investment in education and infrastructure, thereby creating an opportunity to exploit economies of scale and knowledge transfer, technology and ideas. In the short run, by creating job opportunities at home these dynamic effects of trade deter migration flows.

In equation (3), $D1983_t$ denotes an impulse dummy that is equal to one in 1983 and zero otherwise; similarly, $D1990_t$ and $D1994_t$ denote impulse dummies that are equal to one in 1990 and 1994 and zero otherwise. Outliers in 1983, 1990 and 1994 are captured as those residuals exceeding the regression standard error by a factor of two or more in equation (2). The dummies in 1983, 1990 and 1994 are telling us that an increase in migration in these years cannot be explained by our variables of interest. The significant coefficient for 1983 may reflect the increase in number of public universities in Turkey from the early 1980s, and the impact of the *German Foreigners Repatriation Law* which encouraged return migration of Turkish workers and their families. 1994 might reflect the increase in number of private universities in Turkey from the early 1990s. The significant coefficient for 1990 might reflect an easing of the financial costs of migration, as income increased with Turkey's capital account liberalization during the early 1990s. Also a second refugee wave from Turkey started in the early 1990s.

5.5. Robustness

In addition to our bounds testing procedure above, we explored the robustness of our results in other ways. We dropped independent variables such as income differentials, unemployment rate in Germany, unemployment rate in Turkey, aid, trade intensity and remittances one by one in order to see whether university education variable is sensitive to inclusion of some independent variables. However, the results did not change, and university education variable

[14]Arnold (1992) also argues that spending remittances mainly on consumer expenditures changes the expenditure patterns of the migrant households and creates a 'demonstration effect' for non-remittance-receiving households.

stays robust, and significant. This is a standard robustness check in time series econometrics, Studenmund (2017). Furthermore, we estimated our model for Primary School, Secondary, High School, and Technical High School, but we did not find sizable or significant effects using these education variables. Only university education produces significant and robust results.

6. Conclusions

The skill composition of home and host countries partly depends on immigration and emigration. We investigate the relationship between university education and migration within a general model of Turkish migration to Germany. Our results show that education and migration are indeed intertwined, and the relationship is non-linear in both the long run and the short run. In both the short run and the long run, as the proportion of Turks obtaining university degrees' increases, migration to Germany decreases at a decreasing rate. Both the long-run and short-run effects are negative and non-linear.

We proceeded by first developing and testing an empirical model of Turkish migration to Germany for the 1970–2015 period using the bounds testing procedure. We find a long-run relationship between gross migration inflows into Germany from Turkey and the relative income ratio between Germany and Turkey, unemployment rates in Germany and Turkey, aid to Turkey, trade intensity, remittances by Turkish migrants to Germany as a ratio of Turkish GDP, and university graduates and the square of university graduates. Based on the results of the bounds testing procedure, a parsimonious conditional error-correction model is developed.

Migration is a dynamic process and the decision to migrate is related to the acquisition of university education. However, we do not observe a brain-drain type phenomenon; rather, here university schooling reduces migration. University graduates in the population are significant and important in explaining migration flows from Turkey to Germany. In the long run as well as in the short run, university education and migration have a negative non-linear relationship. As university graduates increased in Turkey as a share of the population, migration flows to Germany decreased at a decreasing rate. An increase in access to university degree in Turkey deters migration.

Income was a strong force driving Turkish workers to Germany in their short-run decision-making; over the long run it was not important. Perhaps Turkish migrants thought they could do better in Germany rather than staying and having a regular job in Turkey. However, this

changed once opportunities arose and having a university degree became more feasible. Up to certain point working in Germany was fine, but when they were able, they preferred to work as, for example, an engineer in Turkey. Our results tell us that when confronting perceived excessive immigration or a refugee crisis, the best strategy if feasible is to improve home country conditions and opportunities. Only then willingness to migrate will fall.

Over the long run income differentials do not matter for Turkish migration but unemployment in Germany and in Turkey along with other variables, especially having a university degree, matters. Our results indicate that Turkish migrants went to Germany because they lacked opportunities in Turkey in terms of education and employment and they thought they could make greater use of their capabilities in Germany. As an increased share of Turkey's population achieved a university education, out-migration to Germany slowed. The share having a university degree has a generally negative, declining, and significant nonlinear relationship with emigration flows both in the long run (over the entire period) and in short run (during a few years). Not surprisingly, this effect is much stronger in the long run than in the short run.

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