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ABSTRACT

This paper examines the degree of capital mobility in the countries of the Caucasus. We employ a simple model developed in the seminal paper by Feldstein and Horioka (1980). First, we estimate the model using conventional time-series econometrics in order to capture the short-run dynamics. Then, we construct a panel of 6 countries of the Caucasus – Azerbaijan, Armenia, Georgia, Kazakhstan, Russia, and Turkey – and obtain the long-run estimates by applying a panel cointegration approach. To that end, we make use of the fully modified ordinary least squares (FMOLS) estimation method for heterogeneous panels, developed by Pedroni (2000). We estimate the long-run saving retention ratio to be quite high, showing that capital mobility in the Caucasus is considerably low. In addition, we also look at the country ratings of the Index of Economic Freedom to compare our results with the official rankings in market openness. We also put our findings in an international context, and confirm that Caucasus is relatively financially restrained. Finally, we discuss the implications of our results for the region's policy-relevant issues such as financial integration, human capital mobility, across-border trading, fiscal and monetary policy, exchange rate volatility, solvency management, responsive consumption smoothing, and recession resistance.

Keywords: Capital mobility, Feldstein-Horioka regression, Caucasus, Saving-investment correlation, Time-series, FMOLS panel cointegration

JEL Classification: F3; F31

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1. Introduction

Capital mobility, especially for the cases of developing countries, is a valuable area of research – particularly from the practical points of view. The degree of capital mobility sheds light on the historical "policy trillemma" – the choice between monetary independence, capital mobility, and exchange rate stability. For concrete practical relevance, capital mobility is important for determining optimal fiscal and monetary policy (Mundell, 1968), managing the exchange rate (Levich, 1985), setting the tax induced by inflation (Easterly *et al.*, 1995), and for numerous other purposes as well.

There are multiple ways in which capital mobility can be estimated. Caprio and Howard (1984), Penati and Dooley (1984), Obstfeld (1986), Calvo, Leiderman, and Reinhart (1992) have suggested a simple method of analyzing the aggregate values of capital flows. Others, such as Haque and Montiel (1991), Faruqee (1991), and Reisen and Yeches (1991), claimed that a good methodology for capital mobility estimation is the uncovered interest parity formula. The chief proposition of this method is that expected returns from domestic and foreign assets are equalized via the inter-border arbitrage.

Another approach, and the one which we will adopt in this paper, is the Feldstein and Horioka (1980) assertion that a good measurement for capital mobility can be the interplay between domestic investment and saving. The logic behind the Feldstein Horioka (FH) model is that for a small open economy, which is very strongly integrated with the international financial markets, the correlation between domestic investment and saving rates will be minimum if not completely zero. That occurs because regardless of how much the population decides to save, investment rates are determined on the global markets and are "imported" home.

More broadly speaking, an economy, for which there exists a perfect co-variation between aggregate investment and saving, does not exhibit signs of capital mobility because the country seems to be investing only the capital which has been accumulated within its own borders. If there is a substantial gap between domestic investment and saving, then the country is allowing capital to flow in from abroad, permitting the accounting mismatch. Of course, in a very long-run, it's fiscally impossible to continue to maintain that gap, since nations must meet the basic solvency constraint. However, over specific periods of time, it's interesting to observe whether certain countries or regions show any significant tendencies towards capital mobility or financial closeness.

In general, the discussion on saving and investment is important in its own right; even if we discard the capital mobility prism. There is little doubt in the conventional belief that domestic saving is an important factor of economic growth. Even the most basic of all economic growth models show that decreasing saving rates have a negative effect on Gross Domestic Product. The theoretical relationship between saving and growth builds on the long-run congruence of the investment and saving rates. Rising domestic saving improves the investment climate, which in turn spurs the financial dynamic and ultimately leads to higher income growth. A natural response, therefore, is to try to estimate the relationship between saving and investment. Not only for the sole purposes of description and observation, but in order to derive important policy-relevant recommendations and implications.

This paper will compute the saving-investment relationship, as a measurement of capital mobility, for six countries of the Caucasus. Those are Azerbaijan, Armenia, Georgia, Russia, Kazakhstan, and Turkey. Although Turkey is sometimes geographically excluded from the Caucasus, its economic ties to the region are substantial enough for us to decide to include it into this analysis. To some extent, the same logic applies to our inclusion of Russia and Kazakhstan. While Azerbaijan, Armenia, and Georgia constitute the Caucasian "core", often referred to as the "Southern Caucasus", we wish to extend the discussion by bringing Russia, Kazakhstan, and Turkey (all with significant economic ties with the region) into the picture.

The remaining of the paper is structured as follows. Section 2 provides a brief literature review. Section 3 describes the data and explains the econometric methods applied in this study. Section 4 reports the time-series and panel cointegration results. Section 5 compares our outcomes with the official rankings of market openness, puts our results in an international context, and discusses various policy-relevant issues. Finally, Section 6 concludes.

2. Literature Review

The Feldstein-Horioka model has been estimated very extensively, using a plethora of various econometric methods, with datasets ranging from OECD countries to the Sub-Saharan states. The model itself is quite straightforward and takes the form of the following regression equation:

$$\frac{I}{Y}_t = \beta_0 + \beta_1 \left(\frac{S}{Y}\right)_t + \varepsilon_t \qquad (1)$$

In which $\frac{I}{Y}$ is the ratio of aggregate domestic investment over GDP, $\frac{S}{Y}$ is ratio of aggregate domestic saving over GDP, ε_t is the error term.

The purpose of the FH regression is to estimate the saving retention ratio - β_1. In an extreme case of complete financial autarky, the coefficient is equal to unity. This scenario implies that all the investment that occurs in the country of discussion comes from domestically accumulated savings, as no capital at all arrives from abroad. In an alternative extreme case of perfect capital mobility, the coefficient would be zero. This case suggests, rather intuitively, that the country is financing its domestic investment operations only with foreign funds. Both extremes are rare, as theory would predict most economies to demonstrate a saving coefficient of between 0 and 1.

Feldstein and Horioka estimated the equation in (1) using long-run averages of cross sectional regressions of investment over saving for the 16 countries of the OECD. They achieved rather puzzling results – very high coefficients for the investment-saving relationship, which effectively signaled low capital mobility in the OECD. These results, with additions from studies on the developing countries, gave birth to a notion of the so-called "Feldstein-Horioka" puzzle – high saving retention ratios for developed nations (indicating low capital mobility) and small coefficients for the developing states (suggesting financial openness and free flow of capital). Economic logic and conventional theory would predict exactly opposite empirical conclusions. This inconsistency was eventually called the "mother of all puzzles" (Obstfeld and Rogoff, 2000).

Some other cross country studies of the FH model include Feldstein (1983), Feldstein and Bachetta (1991), Tesar (1991), Artis and Bayoumi (1992), and Coakley et al. (1995). There exists a striking heterogeneity in the cross-section numbers, with the saving ratios ranging from as low as 0.42 in Obstfeld (1986) and as high as 0.85 in Murphy (1984). Most of the cross-sectional empirical work, especially in the 1980s, was done over the samples of developed economies, such as the OECD states. Results seem to confirm the existence of the Feldstein-Horioka puzzle.

There are quite a few notable time-series estimations of the FH model. Some of those studies include the papers by Miller (1988), Alexakis and Apergis (1992), Tesar (1993), and Afxentiou and Serlitis (1993). The peculiarity of the time-series method is in the ability to estimate directly the FH estimates for individual countries. It's also possible to evaluate the performance of economic regions, or groups of countries, with the implementation of a panel setting. A panel data approach towards FH estimation is a relatively new development in this research stream, although there are several notable studies. Some of them include Amirkhalkhali and Dar (1993), Coakley (1999), Jansen (2000), Kim (2001), Coakley et al. (2004), and Cyrille (2010). The relationship between standard cross section, panel-data, and time-series estimates are described well in Pesaran and Smith (1995).

The most recent advances in econometrics (Pedroni, 1999) enable us both to account for the short-term variation in aggregate saving and to provide a long-run equilibrating equation of the investment-saving relationship. This paper, just as the majority of studies that deal with the panel-data approach to FH estimation, works with panel sets suffering from the heterogeneity of the country components. Pedroni (2000) has proposed the method of Fully Modified Ordinary Least Squares (FMOLS) specifically for the cases with heterogeneous panels. In this paper we have adopted this technique, in addition to our time-series estimation.

The key assumption behind the FMOLS approach is that the standard OLS application produces biased estimates of the saving retention ratio, because both investment and saving suffer from the spurious regression problem. Elimination of this bias is possible by allowing for fixed effects among different panel members to be heterogeneous, while simultaneously permitting the short run dynamics. The within-dimension FMOLS approach has become very popular for its ability to eliminate regressor endogeneity and serial correlation in the residuals, the problem present in most long-run cointegration estimations. The estimates computed this way are also asymptotically unbiased (Pedroni, 2004).

Bahmani-Oskooee and Chakrabarti (2005) have applied the FMOLS technique to their study of a large heterogeneous panel of 126 countries. Bangake and Eggoh (2011) employed Pedroni's FMOLS in their analysis of African countries. Murthy (2009) performed a panel cointegration analysis for Latin American and Carribean countries. Kim et. al (2005) applies the FMOLS panel cointegration technique for 11 Asian economies. For excellent literature reviews on capital mobility and the FH model, consult Coackley et. al. (1998) and Apergis and Tsoumas (2009).

The main distinction of this paper is that, to the best of our knowledge, no previous work has been done on the analysis of capital mobility for the Caucasus as a distinct group. While for Turkey, Montiel (1994) has estimated the saving ratio be 0.47, the saving retention coefficients for Azerbaijan, Armenia, Georgia, Kazakhstan, and perhaps even for Russia, will be obtained for the very first time. In general, developing countries should demonstrate some forms of infrastructural imperfections and thus low capital mobility (Murphy & Vasudeva, 2009). We thus are basing our expectations based on this assumption.

This paper aspires to put quantified results on the tables of regional policy makers, as countries of the Caucasus continue with their development strategies. It's extremely desirable that this study will spark a new stream of research on this region, as still very little empirical work has been done on the nations of the Caucasus. In addition, there have not been many applications of panel data econometrics towards this topic, which is flooded with cross-section and time-series papers. Therefore, our application of panel cointegration will provide the much-needed variety in the estimation methodologies that this sphere requires.

3. Econometric Methods and Data

Researchers have long emphasized the easiness of working with a time-series setting in the context of capital mobility (Obstfeld, 1986). Even Feldstein and Horioka themselves emphasized that time-series estimates are important to highlight the short-responses of investment to savings, because they are different from their long-run equilibrating counterparts. One logic behind this differential is that physical investment tends to react to savings with a significant lag, and thus the long-term estimates of panel sets or cross-sections are usually larger than the short-term time-series coefficients.

For the panel cointegration method we base our estimation on the core assumption that investment and saving both possess a unit root. In order to determine that this is indeed the case, we employ the Im-Pesaran-Shin (IPS) panel unit root test as proposed in Im et al. (1997). The IPS test will be constructed on the base of a group mean of the individual member unit root tests. We must estimate the following equations to perform the test:

$$\Delta\left(\frac{I}{Y}\right)_{it} = \mu_{1i} + \lambda_{1i}\left(\frac{I}{Y}\right)_{i,t-1} + \sum_k \theta_{1i,k}\Delta\left(\frac{I}{Y}\right)_{i,t-k} + \delta_{1it} + \varepsilon_{1it} \quad (2A)$$

$$\Delta\left(\frac{S}{Y}\right)_{it} = \mu_{2i} + \lambda_{2i}\left(\frac{S}{Y}\right)_{i,t-1} + \sum_k \theta_{2i,k}\Delta\left(\frac{S}{Y}\right)_{i,t-k} + \delta_{2it} + \varepsilon_{2it} \quad (2B)$$

in which μ_i are the individual fixed effects, λ_i are corrected for inter-temporal serial correlation

The IPS test statistic is computed based on the average of the individual ADF statistics over cross-sections (Fischer, 1932). For more information on testing for unit roots in the time-series context, consult Dickey et. al (1986). The null hypothesis of the test is the presence of a unit root in the series. The following equation is used to estimate the IPS statistic:

$$\bar{t}_j = \frac{1}{N}\sum_i \frac{\hat{\lambda}_{ji}}{\hat{\sigma}_{\hat{\lambda}_{ji}}} \quad (3)$$

In addition to the IPS test, we will perform the alternative panel unit root tests as described in Maddala and Wu (1999). It's believed that the tests by Im et al. have several problems in their method, such as the decline in power of the test when individual trends are included. The MW proposition is a special case of the Fisher test, and is based on the combination of the p-values of the test-statistic for a unit root in each cross-sectional entry. The MW test statistic is distributed as Chi-square with 2N degrees of freedom under the null of cross-sectional independence. This test doesn't depend on different lag length selections in the individual ADF regressions, and is superior to the IPS test. The MW statistic is given by the following:

$$-2\sum_{i=1}^{N}\log(\pi_i) \rightarrow \chi_{2N}^{2} \tag{4}$$

In the next step, once variable stationarity has been tested for, we determine if our variables – investment and saving – are cointegrated. For the panel data set like ours, we perform a panel cointegration test as described in Pedroni (1995). The test takes into account the heterogeneity which is most certainly present in the model, asserting that the vectors of cointegration are not identical. In order to perform the test, we must first estimate the following long-run cointegration relationship:

$$y_{it} = \alpha_i + \delta_i t + \beta_{1i}x_{1,it} + \beta_{2i}x_{2,it} + \cdots + \beta_{Mi}x_{M,it} + \varepsilon_{it} \tag{5}$$

for i=1,…,N ; t=1,…,T ; m=1,…,M; and where α_i – idiosyncratic fixed effect, different across countries; β_i – effect, common to all countries; ε_i – error term

The residuals that are estimated in (5) have the following nature:

$$\hat{\varepsilon}_{it} = \hat{\rho}_i\hat{\varepsilon}_{it-1} + \hat{u}_{it} \tag{6}$$

Pedroni's method presents seven different statistics that test panel data cointegration. Four of them are based on pooling, and are thus named the "Within" dimension, while the last three are based on the "Between" dimension. For both types of tests, the null hypothesis is that series are not cointegrated in the long-run.

Having established the presence of an underlying long-run cointegrating equation between the two variables in focus, we will estimate that equation using the method of Fully Modified OLS (FMOLS) as developed in Pedroni (2000). It's a known fact that the standard pooled OLS will suffer from the spurious regression problem if the variables are not stationary in level forms. The FMOLS takes care of this problem, in addition to correcting for serial correlation and the endogeneity of the regressors. First, we consider the following panel regression:

$$y_{it} = \alpha_i + x_{it}\beta + u_{it} \tag{7A}$$

for i=1,…N, t=1,…T; and where y_{it} is a matrix (1,1), β is a vector of slopes, α_i is individual fixed effect, u_{it} - stationary disturbance.

The vector x_{it} is an integrated process of order one, for all *i*, and is defined as follows:

$$x_{it} = x_{it-1} + \varepsilon_{it} \tag{7B}$$

Under the conditions outlined above, the equation in (6) depicts a system of cointegrating regressions. In other words, y_{it} is cointegrated with x_{it}. The FMOLS estimator itself is constructed in a way that the two chief problems associated with standard OLS estimation (endogeneity and serial correlation) are properly corrected for. The estimator is defined as:

$$\hat{\beta}_{FMOLS} = \left(\hat{\beta}_{NT}^{*} - \beta\right) = \left(\sum_{i=1}^{N}\hat{L}_{22i}^{-2}\sum_{i=1}^{T}(x_{it}-\bar{x}_i)^2\right)^{-1}\sum_{i=1}^{N}\hat{L}_{11i}^{-1}\hat{L}_{22i}^{-1}\left(\sum_{t=1}^{T}(x_{it}-\bar{x}_i)\mu_{it}^{*} - T\hat{\gamma}_i\right) \tag{8}$$

where $\hat{\gamma}_i$ is the serial correlation correction term, μ_{it}^{*} is the endogeneity correction

From the FMOLS panel estimator we can derive t-statistics which are asymptotically normally distributed. The null hypothesis for such t-test is H_0: $\beta_i=\beta_0$ for all *i* versus the alternate hypothesis H_a: $\beta i=\beta_a\neq\beta_0$; where β_0 is some value for β under the null hypothesis, and β_a – some alternative value for β which is homogeneous across all the members of the panel. The t-statistic can be constructed using the following equation:

$$t_{\hat{\beta}_{NT}^{*}} = \left(\hat{\beta}_{NT}^{*} - \beta\right)\left(\sum_{i=1}^{N}\hat{L}_{22i}^{-2}\sum_{i=1}^{T}(x_{it}-\bar{x}_i)^2\right)^{-1/2} \tag{9}$$

In this study we are using the yearly data for gross capital formation and gross domestic saving, both as a percentage of GDP. The former is referred to as "investment", while the latter as "saving". The data was obtained from the World Bank. We are using gross and not net saving flows because it's precisely the gross saving which responds to the investment and saving yield differentials. The time period in our study spans from 1996 to 2010. The countries in our sample are the conventionally accepted members of the Caucasus – Azerbaijan, Armenia, Georgia, Russia, Kazakhstan, and Turkey.

4. Results

We begin to present our results by showing the outcome from our standard time-series estimation of the FH model (1). All series were tested for heteroskedasticity with the Breusch-Pagan test[1]; the tests were negative, indicating no need for heteroskedasity-robust standard errors. Table 1 displays our time-series estimates of the saving retention ratio for all the individual countries of the Caucasus as well as for the region as a whole. We note that for Azerbaijan the coefficient is -0.12, a negative number, which suggests an extremely high degree of the mobility of capital. Negative coefficients are not impossible in principle, although rare, and have been recorded in the past for such countries like Costa Rica, Morocco, and Israel (Montiel, 1994).

Armenia and Georgia show big similarities in their estimates, with the coefficients being 0.53 and 0.59 respectively. Kazakhstan's coefficient is slightly lower – 0.48, followed by the more mobile Turkey (0.40) and Finally Russia (0.19) and Azerbaijan (-0.12). For Caucasus as a whole, the saving retention ratio is 0.31, which suggests that capital mobility, despite imperfect, is still better than what we would expect from a predominantly developing region. We also highlight the fact that the coefficients for Azerbaijan, Russia, and Turkey are not statistically significant, while for the remaining countries as well as for the Caucasus the values are strongly significant at the 1% significance level.

As we had mentioned before, the time-series estimates are often lower than the long-run static equilibriums that are derived from panel data analysis. We don't speculate that the time-series values are downward biased or incorrect altogether. It's possible though that the conclusion that the capital flow system in the Caucasus is more than relatively mobile, which we deduce from a relatively low saving retention ratio (0.31), is premature. For this very reason we will present the results from our panel data study first, and then conclude on the degree of capital mobility in this region through a prism of two different, but not conflicting, estimation methodologies.

Before reporting the results from our panel set-up, we show some preliminary tests. Table 2 reports the outcomes of the panel unit root test. As described in section 3 on econometric methods, we have performed the IPS and the ADF-Fisher & PP-Fisher unit root tests. All three methods uniformly don't reject the null hypothesis of unit root in levels, but reject it in first differences. This shows, just as we expected, that investment and saving are non-stationary. Regressions with such variables produce a spuriousness problem, and we need to account for this. Our panel data estimation via FMOLS will take care of this problem.

Having established the non-stationary nature of investment and saving, we try to determine whether our two variables are cointegrated, i.e. form a single long-run equilibrating equation. Table 3 has the results from the Pedroni's panel cointegration test. All seven statistics are presented. Small sample sizes, like in our case, usually make the rejection of the null of cointegration more difficult (Montiel, 1994). Based on the results of the inferentially more powerful ADF statistics of both the within- and the between-dimension groups, which reject the null of no cointegration at the 1% confidence interval, we can now estimate the long-run cointegrating equation using FMOLS.

Table 4 presents the results from the FMOLS estimation of equation (8). We also provide results of the t-test based on formula (9) The table reports just the individual country figures. We allowed for 1 lag in our individual country set-up. Peculiarly, the panel estimate (-0.19) for Azerbaijan is very close to that derived from the time-series method (-0.12). The coefficients for Russia and Turkey are also quite similar to our prior findings. Interestingly, for Armenia, Georgia, and Kazakhstan the coefficients are basically equal to unity. In fact, they are larger than one. The implication of severe capital constraints in these countries is therefore rather obvious. The estimates for Armenia and Georgia are not statistically significant though. For the rest of countries, however, the coefficients are significant, either at the 5% or at the 1% levels.

Table 5 delivers the FMOLS estimates of the cointegrating equation (8) for aggregated panels. For these panels we have selected 2 lags. We find that the long-run equilibrium estimate for Caucasus as a whole is 0.78. This result is in

[1] Test results are omitted for brevity and available upon request

contrast with the time-series value of 0.32. We also decompose the global panel into several sub-panels. The saving retention ratio for the South Caucasus (SC), which includes only Azerbaijan, Armenia, and Georgia, is not substantially different from the global panel: 0.76 vs. 0.78. Then we selectively add Russia, Kazakhstan, and Turkey into a panel with the SC, and the estimates change to 0.66, 0.99, and 0.66 respectively. Evidently, Russia and Turkey have an about equal marginal contribution towards improving capital mobility in the SC. Kazakhstan, on the other hand, effectively transforms the SC into a financial autarky. Overall, we believe that such decomposed representation can provide a policy-friendly picture on how the region performs on this test of financial openness.

5. Discussion

From the first sight, results of our panel data and of the time-series approach contradict each other, because our time-series numbers are almost systematically lower. This applies especially to the individual country estimates for Georgia, Armenia, and Kazakhstan. For the region as a whole the numbers differ quite significantly as well. However, we should take into account the conventionally accepted fact that time-series estimates are almost always systematically lower than their panel counterparts (Feldstein and Horioka, 1980). Keeping this assumption in mind, the contradiction is not fatal. In fact, it turns out, our differential is basically in parallel with what previous research would predict. In addition, the larger long-run FMOLS coefficient and the smaller time-series estimate hint at the existence of a powerful long-run solvency constraint, which does not carry as much weight in the short-run. Given the non-stationary nature of both variables and the presence of endogeneity in our model set-up, we would personally prefer and recommend the panel-data estimates over the times-series ones.

Considering that in both time-series and panel-data settings Azerbaijan had a very low score on saving retention (≈-0.19), the country is not under any noticeable burden of long-run solvency. One underlying factor here could be the substantial flow of capital from abroad that has occurred in Azerbaijan during its oil-boom years of 2004-2008[1]. Another reason can lie in the management of Azerbaijan's natural resources, and particularly in the formation of the Azerbaijan State Oil Fund. The Fund is essentially viewed as a buffer against imbalances, a mechanism which functions like a fiscal "insurance policy". It's not clear if Kazakhstan and Russia, also significant oil exporters, have institutions of similar caliber. And it's not perfectly certain if the Oil Fund argument can be appropriately applied to Azerbaijan's extremely low saving retention ratio. However, it's still possible that Azerbaijani policy makers are accepting short-run overrun of investment over domestic saving, partly because the gap can be filled at any time with the finances stored in the Oil Fund.

For Armenia and Georgia, and presumably for the rest of countries of the Caucasus as well, factors such as foreign aid are not included into their fiscal calculations. This matters because we predict that it's impractical to think of no capital mobility at all in Georgia or even Armenia, which was suggested by the larger-than-unity panel-data FH coefficients. Especially when we consider that Georgia typically ranks as a relatively open, free-market economy. It's quite possible that foreign finances do indeed flow into Tbilisi, but are recorded in such way that they are not included into the components of the official "gross capital formation" and "gross national saving": the prime variables of this paper. The same logic, we repeat, can be applied to the rest of the region. Meanwhile, the conventional solvency constraint argument can also be applied to explain the extremely poor financial openness in Armenia, Georgia, and also Kazakhstan.

For Turkey the estimate of capital mobility is very similar to that derived in Montiel (1994). With regards to Russia and Kazakhstan, we are not aware of any prior saving retention estimations for these countries. It's possible, however, that some researchers had included them in panel-data analyses of some particular forms of income groups or regional studies. For Azerbaijan, Armenia, and Georgia, as far as we are aware, the results are primary – without

1 Interestingly, even despite the investment explosion that took place in Azerbaijan in the past 7 years or so, the current account of the country has remained in the positive. Typically though, investment booms tend to be associated with strong current account deficits (Baxter and Crucini, 1993).

empirical precedent and thus with no possibility of comparison of either outcome or method. Thus, we are only able to compare the overall region – the Caucasus – with other notable clusters of economies. Table 5 puts the results of this paper in an international perspective. The comparison table makes it clear that Caucasus has a considerably low degree of capital mobility in an international context.

We now present the ranking of Caucasian states in market openness according to the Heritage Foundation's Index of Economic Freedom (IEF)[1]. From Table 7 we see that Turkey, having ranked 3rd for both criteria, is a relatively flexible economy with respect to capital mobility and is moderately open in overall market terms. Azerbaijan has the greatest degree of capital mobility based on our time-series and panel cointegration results, and yet placed just 4th in market openness among all the Caucasian countries. Armenia, the supposedly closed economy in terms of capital flow, is ranked 1st for its average score in trade, investment, and financial freedoms. Russia, a country with a considerably low saving retention coefficient, is the worst Caucasian economy in market openness.

Because of the apparent disparity in our capital mobility coefficients and the Heritage's market openness ranking, there are three, in our opinion, possible paths for how this discussion can develop. First, we can question the results and the methods presented in this paper. This could be done on at least two levels: the data sets of some of the countries in this panel are of poor quality, and the methodology and/or assumptions of this paper might be imperfect. Second, we can instead question the relevance of the Heritage's ranking by arguing for it being an imprecise "proxy" for comparison with saving-investment ratios. Third, we can accept the conclusions of our research and of the IEF ranking as not mutually exclusive. In other words, it's possible for a country to be very free and open with regards to trade, investment, and financial movement, but still exhibit high FH coefficients. Moreover, the FH model is just one of the several approaches towards capital mobility estimation, and its conclusions are not completely definitive. This path of reasoning appears to be in line with the general informal consensus among the researchers.

Based on the results of our study we can draw some important policy-relevant inferences and conclusions. First, it's rather obvious that our substantially high saving-investment correlation reflects a low degree of financial openness in the Caucasus and its poor integration with the world's capital markets (Sarno and Taylor, 1996). This, in fact, is the original cornerstone logic of the whole FH research stream.

Second, our results shed some empirical light on the age-old discussion of the impossible policy triangle. Recent research has shown that most emerging market economies are showing signs of convergence towards a "middle ground" of semi-fixed exchange rate, somewhat restricted capital flows, and strong although incomplete monetary independence (Aizenman & Ito, 2012). Low capital mobility in the Caucasus, as evidenced by our high saving-investment relationship of 0.78, suggests that governments in this region have their hands untied with respect to both monetary independence and exchange rate management. Without capital flexibility, policy-makers in the Caucasus are believed to be following a fixed or at least a semi-fixed exchange rate regime. It also follows that Caucasian states enjoy the privileges of considerably independent monetary policy-making.

Third, Barro et. al (1995) have suggested that the relationship between aggregate domestic saving and investment does not necessarily relate to the financial or even physical capital. Instead, they argue, the saving retention ratio demonstrates the degree of human capital mobility. Using modified Ramsey growth models, they have shown that high correlation between saving and investment suggests that human capital is inflexible and its across-border penetration is jeopardized. Effectively this means that, assuming that Barro's analysis is correct, human capital mobility is very low in the Caucasus.

Fourth, the high saving-investment correlation can reflect a home-country bias in portfolio selection (Feldstein, 1994). There is a variety of potential risks that could refrain domestic investors from purchasing financial assets from abroad. The most prominent of them are political and currency risks. Due to these and any other preventative

1 The Index is readily available in HTML and book formats from the IEF's website: http://www.heritage.org/index/

obstacles, investors hold a disproportionally high share of domestic securities, thus forgoing international portfolio diversification in favor of the apparently less risky domestic holdings. When applied to the case of Caucasus, the home-bias argument suggests that this region presents quite substantial political and/or currency risks for purchasing financial assets overseas.

Fifth, national governments, typically, have two substantial policy tools at their disposal – monetary and fiscal. A policy design targeted specifically at either investment or saving could affect the interplay between the two aggregates in an unexpected way. In other words, the relationship would suffer from a peculiar form of an omitted variable bias, i.e. government policy, which would distort an otherwise market-established equilibrium (Summers, 1988). Thus the endogeneity in domestic savings and/or investment, which are correlated with the policy response variable sitting in the error term. It's therefore possible that with the right policy mix, the saving retention ratio would stay high regardless of the dynamics in the financial environment (Bayoumi, 1990). In the case of Caucasus, given the high FH coefficient of 0.78, we suggest the possibility that national governments design specific policies that target their respective domestic current accounts. Current account targeting, in turn, leads to a disproportionally high saving retention ratio.

Sixth, the saving-investment correlation may be an even better indicator for solvency management. For any economy, exposure to the international capital markets presumably implies some form of a long-run solvency constraint. The degree to which countries respect this constraint in the short-run depends on their policy design, deficit buffers and financial infrastructure, across-border trading risks, portfolio preferences, etc. A high saving-investment relationship could therefore be a signal for a strong solvency imposition (Coakley et al., 1996). We believe that solvency pressures can be among the best explanations for the high saving retention ratio that is observed in the Caucasus.

Seventh, previous research has suggested that high currency volatility may be the underlying source of large saving-investment correlations (Frankel, 1992). On the other hand, common currency settings or some forms of a currency peg carry downward pressing effects on the saving retention coefficient. Therefore, for the case of Caucasus, we can argue that the region as a whole has quite a significant degree of exchange rate variability. Azerbaijan, Russia, and Turkey – according to our findings – do not display much exchange rate fluctuation based on their low FH coefficients. Meanwhile, Armenia, Georgia, and Russia are much more volatiles on these terms.

Eighth, a two-country general equilibrium model of Tesar (1993) with utility maximizing agents, two types of goods (traded and non-traded), and two types of exogenous shocks to non-traded goods (investment and productivity), shows that economic agents change their preference for traded and non-traded goods in response to some sudden exogenous shock. High saving-investment correlations, like in the case of Caucasus, can reflect a poor degree of consumption smoothing in response to exogenous productivity shocks. Considering the prevalence of the non-traded sector of the energy exporting economies of Azerbaijan, Russia, and Kazakhstan, the question of consumption smoothing might prove to be worth further research and exploration.

Finally, Kaplan and Kalyoncu (2011) claim that capital mobility and the saving-investment relationship can reflect a country's crisis stabilization mechanisms. High levels of capital mobility can signal large exposures to foreign incoming capital, which stabilizes the economy during economic slumps. Low mobility, on the other hand, mirrors a restriction on the free movement of capital that has allowed the country to withstand the negative foreign shocks and "isolate" itself from the crisis occurring elsewhere. For the Caucasus, with its very large saving retention ratio, we can conclude that financial closeness and capital inflexibility has not been too detrimental for the region with respect to surviving through the 2008 Global Financial Crisis.

6. Conclusion

This paper has applied the traditional time-series approach and a recently developed technique in heterogeneous panel cointegration in the analysis of saving and investment dynamics for the countries of the Caucasus. This paper has found a substantial positive relationship between aggregate savings and investment. Our results provide strong empirical evidence for the lack of capital mobility in the Caucasus. Putting the numbers in an international context gives even more support to our proposition. Our findings imply that the region of Caucasus is integrated poorly with the global financial markets; policy-makers possess monetary independence and conduct fixed or semi-fixed monetary policy; mobility of human capital is quite low; there exists a substantial home-country portfolio formation bias due to high political and currency risks of holding overseas financial assets; national governments design current account targeting policies that indirectly affect the saving-investment interplay; financial markets impose a strong long-run solvency constraint; exchange rate volatility is in general considerably high; the consumption smoothing reaction to exogenous production shocks is poor; capital immobility has helped the region go through the recent recession relatively undamaged.

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Appendix

Table 1
Time series estimates

Country	Coefficient	Std. Error	t-Statistic	p-Value
Azerbaijan	-0.119575	0.160852	-0.743384	0.4705
Armenia	0.532198	0.091666	5.805824	0.0001
Georgia	0.589627	0.116123	5.077589	0.0002
Russia	0.190043	0.180658	1.051951	0.3120
Kazakhstan	0.475551	0.101393	4.690166	0.0004
Turkey	0.404500	0.343550	1.177413	0.2601
Caucasus	0.316076	0.092197	3.428266	0.0045

Table 2
Panel unit root tests

Variable	IPS		ADF		PP	
	Statistic	p-Value	Statistic	p-Value	Statistic	p-Value
Investment	-1.65252	0.0492*	19.9404	0.0682**	13.7003	0.3203**
D(Investment)	-2.97461	0.0015^	30.8711^	0.0021^	40.1900^	0.0001^
Saving	-0.62890	0.2647**	14.0696	0.2963**	8.19991**	0.7693**
D(Saving)	-3.55525	0.0002^	35.0200^	0.0005^	49.9657^	0.0000^

*- Can't reject the null hypothesis of unit root process in stationary form at the 1% significance level
**-Can't reject the null hypothesis of unit root process in stationary form at the 5% significance level
^- Rejects the null hypothesis of unit root process in first-differences at the 1% significance level

Table 3
Panel cointegration test

Test Statistic	Statistic	p-Value
Within Dimension		
Panel v-Statistic	1.110013	0.1335
Panel rho-Statistic	-0.274966	0.3917
Panel PP-Statistic	-0.450769	0.3261
Panel ADF-Statistic	-3.390061	0.0003**
Between Dimension		
Group rho-Statistic	0.363219	0.6418
Group PP-Statistic	-0.941604	0.1732
Group ADF-Statistic	-2.731586	0.0032**

**- Rejects the null hypothesis of no cointegration at the 1% significance level

Table 4
Fully Modified Ordinary Least Squares (FMOLS) estimates for individual countries

Country	Estimate	t-Statistic
Azerbaijan	-0.19	-2.16*
Armenia	1.25	0.86
Georgia	1.17	0.62
Russia	0.21	-1.79*
Kazakhstan	1.61	2.04*
Turkey	0.32	-2.60**

*- Rejects the null hypothesis of zero coefficient estimate at the 5% significance level
**- Rejects the null hypothesis of zero coefficient estimate at the 1% significance level

Table 5
Fully Modified Ordinary Least Squares (FMOLS) estimates for panels

Panel	Estimate	t-Statistic
South Caucasus (SC)	0.76	-0.16**
SC Plus Russia	0.66	-0.87**
SC Plus Kazakhstan	0.99	0.90**
SC Plus Turkey	0.66	-1.31**
Caucasus	0.78	-0.83**

**- Rejects the null hypothesis of zero coefficient estimate at the 1% significance level

Table 6
International Comparison of Capital Mobility Estimates

Region	Estimate	Method	Source
Caucasus	0.78	FMOLS	Jamilov (2012)
OECD	0.69	MLE and Time-Series	Coakley (1994) and Kim (2001)
LDCs	0.44	Time-Series	Coakley (1999)
Asia	0.39	FMOLS	Kim et. al (2005)
Africa	0.38	FMOLS	Bangake and Eggoh (2011)
Low-Income	0.58	FMOLS	Bahmani-Oskooee and Chakrabarti (2005)
Middle-Income	0.54	FMOLS	Bahmani-Oskooee and Chakrabarti (2005)

Table 7
2012 Index of Economic Freedom

Country	Trade Freedom	Investment Freedom	Financial Freedom	Average Score and Openness Rank	Capital Mobility Rank*
Azerbaijan	77.2	55	40	57.4 (4)	1
Armenia	85.4	75	70	76.8 (1)	5
Georgia	89.2	70	60	73.0 (2)	4
Russia	68.2	25	40	44.4 (6)	2
Kazakhstan	79.6	30	50	53.2 (5)	6
Turkey	85.4	70	60	71.8 (3)	3

*- Higher rank indicates a smaller saving retention coefficient obtained in Section 4