Estimating a fiscal reaction function for the South East European countries

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Abstract:
The global economic crisis caused a deterioration in the public finances of the South East European countries. Hence, the fiscal sustainability issue became important not only for developed EU countries (considering the European debt crisis), but also for the SEE region. The paper analyses how primary government balances in South East Europe adjust to increasing government debt and to the economic cycle, by estimating a panel fiscal reaction function. The main goal is to test whether fiscal policy tends to react to a sufficient extent to increasing public debt in order to ensure long-term fiscal sustainability. The empirical results imply a pro-cyclical fiscal policy in the SEE countries. The results also show an initial deterioration of the primary balance after a rise in the debt level, which is not consistent with sustainability of public finances. However, in the medium run primary balance seems to adjust to rising debt.

Keywords: fiscal reaction function, fiscal sustainability, South East European countries.

JEL code: C33, E62, H62, H63.

1. Introduction

The issue of fiscal sustainability is one of the most discussed by economic academics and policy makers in the last few years. The economic crisis and the responding fiscal stimulus proved the importance of fiscal policy during recessions. However, the deterioration of the fiscal stability in many countries (more so in advanced economies) caused great concerns over the long-term fiscal sustainability. This was especially evident in the European Union, particularly in some peripheral countries, which faced difficulties in the financial markets due to rising borrowing costs and diminished credibility. These recent events placed fiscal sustainability in the centre stage of economic discussions.

Fiscal sustainability is most often regarded as the long-term solvency of the government. A government is solvent if it meets its intertemporal budget constraint, i.e. if it is able, within an infinite horizon, to repay its debt with future primary surpluses without an explicit default (IMF, 2003; Celasun, Debrun, Ostry, 2006; Chalk, Hemming, 2000). Fiscal unsustainability implies that current fiscal policies cannot continue forever and a future adjustment will be needed to prevent debt from exploding. Some authors find a lower debt tolerance in less developed countries and show that default can occur at much lower debt levels than in developed countries (see Reinhart, Savastano, Rogoff, 2003).

A common approach for the empirical investigation of fiscal sustainability includes testing whether there exists a systematic (positive) linear relationship between primary surplus and public debt and shows that fiscal policy that contains a strong enough reaction of primary surplus to public debt growth is

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sustainable even in an uncertain world (Bohn, 2005; Chalk, Hemming, 2000; Afonso, Jalles, 2011, 2016) The systematic, that is, average response of the primary balance to past debt is crucial for the fiscal sustainability. If the fiscal authorities react systematically to indebtedness by improving the primary balance in order to maintain public debt sustainable throughout time, then the transversality condition is met and the fiscal policy prevents excess debt accumulation (Bohn, 1998). Its main advantage lies in the direct testing of the link between the primary surplus and the public debt, which does not require any explicit strong assumptions about the interest rates. The public debt evolution depends on whether the concern for debt sustainability dominates the snowball effect or vice versa. This, according to Bohn (1995; 2007), is an error correction mechanism: if the public debt ratio grows, the government should response by increasing the primary balance in order to keep or even reduce the debt ratio and it is a sufficient condition to ensure that the inter-temporal budget constraint is satisfied. Also one needs to account for the influence of other heterogeneous, often transitory influences, allowed with this approach (Mendoza, Ostry, 2007).

The aim of this paper is to analyse how primary government balances adjust to increasing government debt and to the economic cycle. The main goal is to check whether fiscal policy in SEE countries tends to react to a sufficient extent to increasing public debt in order to ensure fiscal sustainability. The paper contributes to the existing literature on fiscal sustainability in SEE by estimating a panel fiscal reaction function, following Bohn (2007) and Afonso and Jalles (2011, 2016). The issue of fiscal sustainability has become important in the countries of the region, since most of them experienced a drastic rise in public debt since 2008, after a period of positive economic performances and favourable fiscal conditions. General government debt grew from an average of 27,9% of GDP in 2007 to an average of 59,7% of GDP in 2015. An additional incentive for the countries to maintain sustainable public finance is the membership or aspirations for membership in the EU and EMU, where the countries are meant to comply with the Maastricht criteria.

The rest of the paper is structured as follows. Section 2 briefly overviews the empirical literature on fiscal reaction functions as means for testing fiscal sustainability. Section 3 explains the used methodology and data, Section 4 reveals and explains the empirical analysis and results and Section 5 contains the concluding remarks.

2. Overview of the empirical literature

The interest in using fiscal reaction functions for testing the response of primary balance to debt has grown recently, especially since the crisis. Most studies focus on developed countries (Bohn, 1998; 2005; 2007; de Mello, 2008; Afonso, Jalles, 2011, 2016; Fincke, Greiner, 2012). Some studies include both developed and developing or transition economies (IMF, 2003; Mendoza, Ostry, 2007; Baldi, Staehr, 2013; Shijaku, 2017) while a there is a growing body of literature focusing on CEE and SEE countries or other developing countries (Burger et al., 2011; Tanner, Ramos, 2002; Eller, Urvova, 2012; Zdravkovic, Zubovic, Bradic-Martinovic, 2013; Llorca, Redgepagic, 2008; Zoli, 2005; Trenovski, Tashevska, 2015; Andric, Arsic, Nojkovic, 2016; Tashevska and Trenovski, 2017 etc.).

Most of the estimated fiscal reaction functions for the developing countries are based on panel regression models since there are no long series of data for individual countries (IMF, 2003; Mendoza, Ostry, 2007; Eller, Urvova, 2012; Llorca, Redzepagic, 2008). IMF (2003) found that the primary balance response weakens with the growth of the debt ratio and stops at a, that is beyond the 50% of GDP debt level, the fiscal policy in the emerging economies is not consistent with providing sustainability, while in the industrialized countries, there is a strong reaction at high debt levels. Baldi and Staehr (2013) found a stronger response of primary balance in Europe since the crisis, explaining it as a reflection of short-term measures to address the fiscal problems facing the countries. However, they didn't find a strong response in the CEE countries with the possible exception that fiscal policy appears to be counter-cyclical in the post-crisis sample while it was pro-cyclical or a-cyclical in the pre-crisis sample. Mendoza and Ostry (2007) analysed a larger set of emerging and industrialized countries for the period from 1990 to 2005 and confirmed that the sustainability condition was met in the countries with moderate debt levels, but not in the highly indebted countries. They warned against a smaller ability of governments to keep fiscal

solvency above a 50-60% of GDP level. Berti et al. (2016) found that the primary balance reacts positively to increasing public debt among CEECs, while Stoian and Campeanu (2010) got mixed results for the reaction of primary balance to debt for a group of CEE countries. Eller and Urvova (2012) and Zdravkovic, Zubovic and Bradic-Martinovic (2013) found a positive response of primary balance to debt shocks in the CESEE countries. Zdravkovic, Zubovic and Bradic-Martinovic (2013) also found evidence of a non-linear relationship between primary balance and lagged debt, with fiscal fatigue occurrence at 70% threshold and showed that countercyclical response of primary balance is more pronounced in economic downturn. Shijaku (2017) concluded that there was some evidence of sustainability in the candidate and potential EU candidate countries. However, he notes that the pursued fiscal policies do not avoid excessive debt accumulation.

3. Data and methodology

The analysis uses annual data for the period 2000-2016, for nine South East European countries (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Montenegro, Romania, Serbia and Slovenia), with a total number of 153 observations. Three variables are used: General government gross debt (% of GDP) - *debt*, General government primary net lending/borrowing (% of GDP) – *primary balance* and Output gap – *output gap*. The data source for the first two variables, and for real GDP, is the World Economic Outlook Database 2017, from the International Monetary Fund. The output gap was calculated with the Hodrick-Prescott filter, as a percentage deviation of real GDP from its trend.

Figure 1 represents the movements of the two main fiscal variables for the period 2000-2016. The left vertical axis refers to the gross debt, while the right vertical axis refers to the primary balance.

The analysed countries from Southeast Europe are characterised with diversity regarding the level and trends of their government debts and primary balance. What is common is the falling debt level in the pre-crisis period and the rising debt since the outburst of the global economic crisis. There are economies in our sample with high government debt – above 60% of GDP (Albania, Croatia, Montenegro, Serbia, Slovenia), another group with general government debt below 50% of GDP (Bosnia and Herzegovina, Bulgaria,, Macedonia, Romania) and some were significantly affected by the global economic crisis from 2007 (Slovenia marked the largest rise in debt since 2007 – from 23% of GDP to 78% of GDP in 2016). Despite the different paths of primary balances across countries, there is an evident worsening of the balances once the crisis reached the countries.

The analysis in this paper is based on a fiscal reaction function, following Bohn (1995; 2008). The use of primary balance, instead of total budget balance has an advantage because the government controls primary expenditures more easily, while the interest payments are an exogenous category and are determined by past activities of fiscal policy related to borrowing (Angelovska-Bezovska et al., 2011). As in other studies (Bohn, 2007; Ostry et al., 2010; Eller, Urvova, 2012; Afonso, Jalles, 2011; Budina, van Wijnbergen, 2007; Tashevska, Trenovski, 2017) we use cyclically unadjusted balance, because: this helps avoid the disadvantages of the methodology for calculating cyclically adjusted variables related to potential GDP; the cyclically adjusted primary balance can be influenced by temporary factors, not directly related to the cycle, such as onetime operations, creative accounting and classification errors. It should be taken into account that primary balance includes the response of automatic stabilisers, as well as of discretionary policy.

The usual way of assessing the fiscal reaction is by estimating a regression equation where the primary balance is the dependent variable and lagged debt is an independent variable. Sometimes the models contain the output gap as a control variable, which reflects the business cycle and shows whether the government conducts a short term aggregate demand stabilisation policy (Bohn, 1998; Burger et al., 2011; Mendoza, Ostry, 2007; Celasun, Debrun, Ostry, 2006; Afonso, Jalles, 2011; Eller, Urvova, 2012; Medeiros, 2012).

The use of VAR model that captures multiple interactions between the endogenous variables in the models gains importance (Tanner and Ramos, 2002; Afonso and Jalles, 2011; Burger et al., 2011; Shijaku, 2017). When assessing regression equations with the OLS method, the variables need to be stationary and if the model contains non-stationary series, it could provide spurious results. Hence, following Burger et

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al. (2011) and Afonso and Jalles (2011), we employ a VAR framework. We give preference to the vector model also due to the fact that the OLS method omits the feedback effect of primary balance on debt. Namely, this framework does not distinguish between ex-post primary balance adjustments to government obligations (public debt) and ex-ante adjustments of government obligations (public debt) to primary balance (Tanner, Ramos, 2002).

Figure 1 General government gross debt (% GDP) and general government primary balance (% GDP)
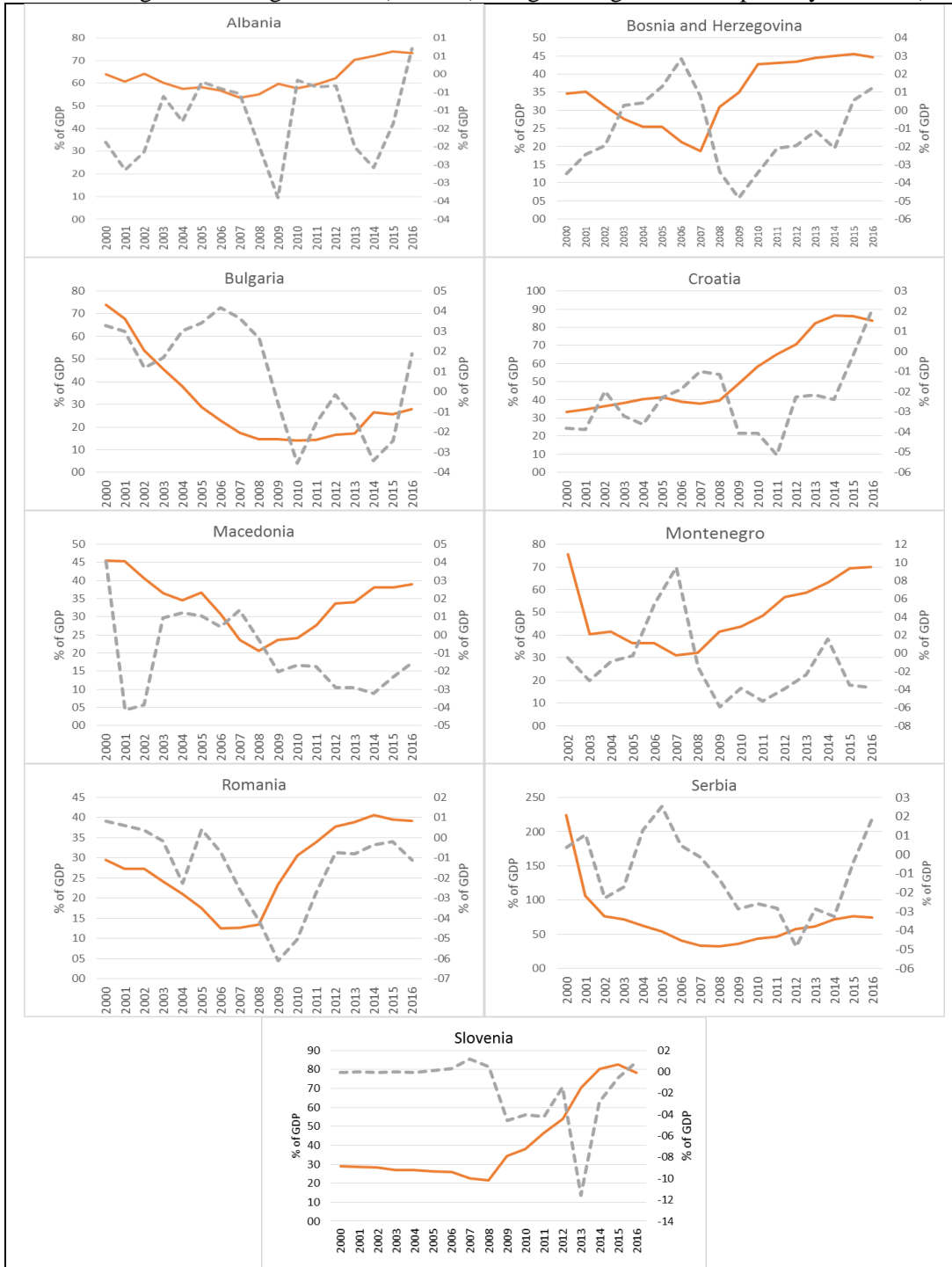
Note: ——— General government gross debt; General government primary balance.

As in other studies focused on developing countries, we use a panel model since there are no long series of data for individual countries (Mendoza, Ostry, 2007; Eller, Urvova, 2012; Llorca, Redzepagic, 2008). The designated method for analysis is panel VAR. Panel VARs have the same structure as VAR models, in the sense that all variables are assumed to be endogenous and interdependent, but a cross sectional dimension is added. So, the Y_t is a stacked version of y_{it}, the vector of G variables for each unit $i = 1, \ldots, N$, i.e., $Y_t = [y'_{1t}, y'_{2t}, \ldots, y'_{N1t}]'$. The index i is generic and in our analysis indicates countires. The panel VAR is

$$y_{it} = A_{0i}(t) + A_i(l)Y_{1t-1} + u_{1t} \quad i = 1, \ldots, N \quad t = 1, \ldots, T$$

Where u_{1t} is a $G \times 1$ vector of random disturbances and, $A_{0i}(t)$ and A_i may depend on the unit (Canova, Ciccarelli, 2013).

4. Empirical analysis
Initially, panel unit root tests are applied to the data. The results are presented in table 1.

Table 1 Panel unit root tests (Authors' calculations)

	p-values (level)			p-values (first differences)		
	Debt	Primary balance	Output gap	Debt	Primary balance	Output gap
Levin, Lin & Chu test						
Individual intercept	0.2241	0.0057	0.0746	0.0000	0.0000	0.0009
Individual intercept and trend	0.0600	0.0764	0.5312	0.0000	0.0000	0.0457
None	0.5422	0.0000	0.0000	0.0000	0.0000	0.0000
Im, Pesaran and Shin W-statistic						
Individual intercept	0.3611	0.0085	0.0248	0.0002	0.0000	0.0040
Individual intercept and trend	0.5013	0.1530	0.6117	0.0001	0.0050	0.3226

Figure 2 Impulse response functions of panel VAR (Authors' calculations)

Response to Cholesky One S.D. Innovations ± 2 S.E.
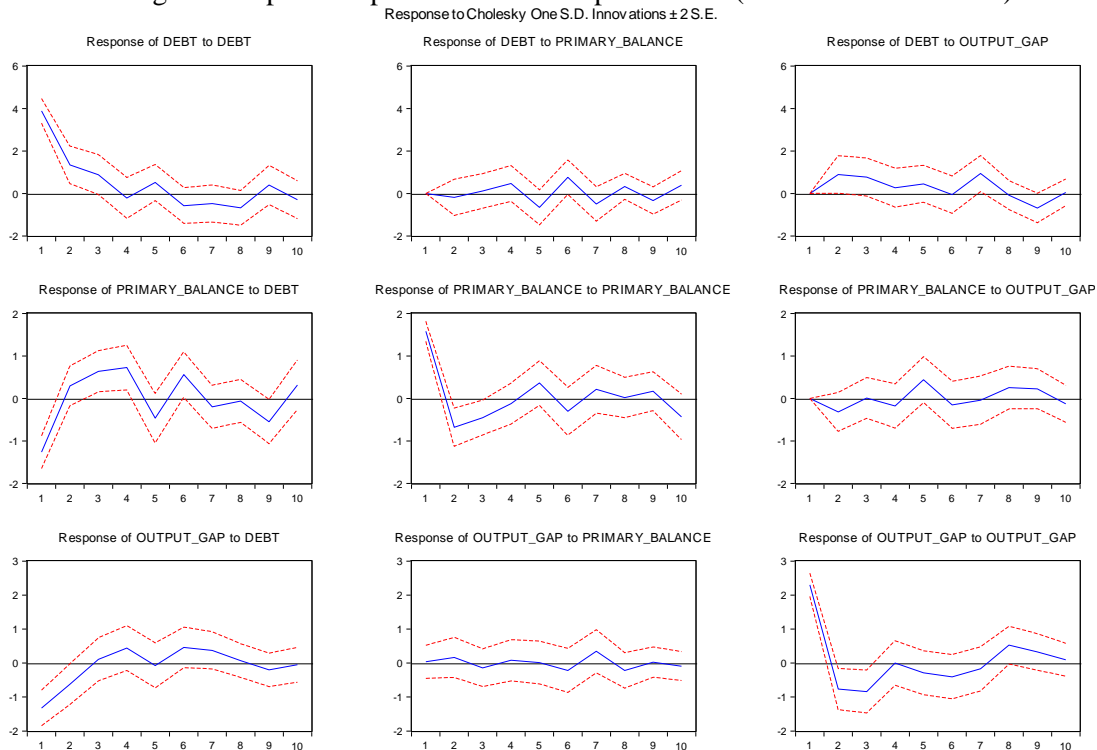
Non-stationarity is present in the series. The series are stationary in first differences and the panel VAR is estimated with the first-differenced variables and with 6 time lags (lag length criteria showed that the LR statistic and Hannan-Quinn information criteria select 6 time lags, while the Final prediction Error and the Akaike information criteria select 8 time lags). The analysis was performed in both ways, and the results were very similar. The authors' decision was to continue the analysis with 6 time lags. The results from the panel VAR in form of impulse response functions are presented in figure 2.

The response of government debt to primary balance appears to be insignificant, which does not confirm that SEE countries' debt falls when the primary budget balance seems to improve. Regarding the reaction of debt to the economic cycle, the initial positive response indicates a pro-cyclical behaviour of fiscal policy in these countries in the first couple of years. This finding seems to contribute to the previous, also confirmed with the negative response of primary balance to output gap shocks. Even when the output gap is positive and the economy is improving, the initial debt increase puts additional burden on the future debt servicing. The negative implications of the public debt increase on economic activity are confirmed with the negative response of output gap to debt shocks in the first two years. The response of primary balance to debt is significant and negative in the first year, while in the second, third and fourth year the response becomes positive, and remains significant. Fiscal authorities increase the budget deficits in spite of the higher debts levels in the short run, which means that they do not take into account the level of indebtedness and this is not consistent with the fiscal sustainability. However, in the medium run, the SEE countries improve their primary balance implying that fiscal authorities seem to undertake measures to counteract the rising level of debt.

5. Conclusions

The paper analyses how the general government primary balance in the South East European countries adjusts to increasing general government debt and to the economic cycle. The results of the empirical analysis imply a pro-cyclical fiscal policy in the SEE countries in the initial period. The response of government debt to primary balance appears to be statistically insignificant, while the initial positive response of debt to the economic cycle confirms the pro-cyclicality of fiscal policy in these countries in the short run. Even when the output gap is positive and the economy is improving, the debt continues to increase. This puts additional fiscal burden regarding the future servicing of the public debt. On the other hand the analysis implies negative implications of the public debt increase on economic activity proved by the negative response of output gap to debt shocks in the first two years.

Regarding the fiscal sustainability issue, the results show that initially, a rise in the debt level, instead of being accompanied by an improvement of the primary balance in order to ensure fiscal sustainability, is followed by a deterioration of the primary balance. Other studies found similar results for these countries. It is encouraging, however, that in the medium run, the primary balance adjusts to the rise in indebtedness in the expected manner, suggesting that the fiscal authorities do seem to take action for maintaining sustainable public finance. This indicates that this countries still partially follow the lessons and the basic recommendation that emerged from the Global economic crisis that in good times the countries should build fiscal buffers and reduce the fiscal burden of debt in order to be able to react in times of crisis.

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Factors in the diffusion of Islamic mathematics in the Mediterranean

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Abstract:
Introduction. The Islamic Empire witnessed a Golden Age in mathematics from the 9th to 15th centuries. Some features of this development are noted here. Purpose and Objective of the Research. We focus on the importance of: 1) commerce in the scientific development of the Islamic Mediterranean, 2) Islamic translation centers (Baghdad, Cordoba, Toledo), and 3) heighted literacy in spreading the powerful Islamic Mathematics between Islamic, Jewish and Christian communities. Methods. We use manual and electronic archival approaches in this descriptive study, especially the electronic Mediterranean Seminar. Main Conclusions. The Islamic economic unit that linked the maritime Mediterranean and Indian Oceans shipped books rapidly, once the translation centers were operational in Spain and Iraq. A plethora of major figures in the development of mathematical theory, from Euclid to Al-Khwarizmi to Omar Khayyam, had their work translated. Over 1,000 books in mathematical sciences were translated during this process, which revolutionized science.

Keywords: literacy, numeracy, statistical descriptive analysis methods, translation centers.

JEL code: N30, N70, O33, O35.

1. Introduction

In an earlier paper (Molgaard, Foss 2016) we examined evidence for the diffusion of the Indo-Arabic numeral system, including zero, from Arabic speaking areas of the southern Mediterranean basin to the northern Mediterranean basin in approximately 700 AD to 900 AD. We concluded that there were several points of possible diffusion, including Norman Sicily while in association with the Fatamids of Egypt, and the great learning center of Cordoba in southern Spain. The importance of merchant schools in Italy and Croatia in spreading knowledge of the Indo-Arabic numeral system more widely in western society was also noted, given that the Adriatic culture area was under the influence of Venice and Pisa directly and Byzantium indirectly and was relatively highly literate for the time.

We wish to expand our argument about the various factors facilitating the spread of the Indo-Arabic system of counting. In particular, we wish to focus on the following concepts: 1) the importance of commerce and value placed on merchants per se in the world view and theology of the ancient Roman provincial capital of Cordoba located in the province of Baetica, Spain, and of the translation and scientific center of Islamic Bagdad, 2) the extensive commercial links from Baghdad to Cordoba and other Spanish centers of translation and learning during the classical Islamic period, and 3) the importance of the book trade between Islamic, Christian and Jewish communities within these commercial links in enhancing the diffusion of Islamic mathematics throughout western Europe in the period up to 1500 C.E.

Our hypothesis is that commerce, spiritual practices, and numeracy served together in a synergistic fashion to propel the diffusion of Islamic mathematics throughout the Mediterranean and Europe as a whole during this period.

2. Background

The unprecedented Islamic economic unit that linked the maritime trade of the Mediterranean and Indian Oceans was capable of moving scientific books as well as other new ideas and techniques of agriculture, engineering, banking and finance, double-entry book-keeping, etc. Much of this trade between and among the Far East and the Mediterranean centered on the main sea route to Ceylon from ports on the Red Sea