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### **European Mortgage Markets Versus Institutions**

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This study aims to measure the institutional features of residential mortgage markets in the European Union (EU) countries. The institutional features of the mortgage markets include access to credit information, protection of creditor rights, and enforcement of contracts among others, and attributes that define the evolution and functioning of mortgage markets. Differences among these features lead to institutional variations in mortgage markets among countries. In this study, we measure the institutional features along four dimensions (financial, legal, openness and cultural), and compare them to a benchmark. To achieve this, composite indices (overall index and its sub-indices) are developed with the use of a factor analysis. The findings show that the institutional features of the EU mortgage markets are diverse; northern European countries and the United Kingdom (UK) take the lead with respect to the institutional environment of their mortgage markets and have markets with higher institutional quality than the others. That is, these countries have mortgage markets with a more efficient legal framework, more government transparency in policymaking, easier access to financial services and credit information, etc.

#### **Keywords**

Mortgage Markets, European Union, Institutional Environment

**JEL Classification:** D02, D5, E02, F15.

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## 1. Introduction

The housing market elevates mortgage credit markets to a privileged position in the financial markets and the economy in many countries because the housing sector is important for increasing economic growth and employment as well as improving social order, and because most households borrow from the credit markets to obtain a house, which is their greatest financial commitment. Within the mortgage markets of the European Union (EU), the world's most advanced bloc of economic integration, mortgage finance accounts for a significant amount of the business of financial intermediaries. At the end of 2016, the outstanding mortgage debt to gross domestic product (GDP) ratio was 47.1% in the EU-28 (European Mortgage Federation, 2017). Mortgage credit also represents the largest share of total credit, with the mortgage credit to total credit ratio standing at more than 70% in EU member countries (European Banking Authority, 2017). Moreover, mortgage debt continued to grow in the EU despite the 2007–2008 global financial crisis and the eurozone crisis. The growth rate in most years during the period of 1995–2016 was above the economic growth rate.<sup>1</sup>

Since the EU mortgage credit markets are clearly important, it is highly advisable to observe developments in these markets, as such developments can have serious effects on the European economy, potentially triggering a financial crisis, and by extension, affecting even the global economy. This was the case in the 2007–2008 global financial crisis which had its origins in the mortgage markets. Developments in the mortgage markets of the EU member countries showed similar trends pre- and post-global crisis, but there were also marked differences. For example, in real terms, the average annual growth rate of mortgage credit between 2000 and 2007 was 8% in Portugal, 16% in Spain, 18% in Ireland, and 25% in Greece (European Mortgage Federation, 2017). The borrowing rate of home buyers from the credit markets varied from country to country within the EU. The share of individuals in the population borrowing to buy their own house was 35.5% in Portugal, 13.3% in Greece and 59.2% in the Netherlands (Eurostat, 2017). Similarly, differences were evident in default and foreclosure rates on the mortgage loans. In comparison to 2007, the foreclosure rates in Austria (3.52%) and the Netherlands (8.28%) in 2008 were much lower than those in other EU countries, such as Spain (126.1%) and the UK (68.59%) (European Commission, 2011). Many other examples can be cited.

Such differences may be, in part, attributable to the institutional features of the different mortgage markets. We would ideally begin with a clear definition of 'institution' to investigate the effectiveness of this relationship but a single

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<sup>1</sup>In the EU, the growth rate of mortgage debt has remained below that of the economy for only 2008 and 2013 in the period between 1990 and 2016 (European Mortgage Federation, 2017; Eurostat, 2017).

accepted definition is lacking. A definition that is widely cited in the new institutional economics literature is that of North (1990, p.3), according to whom institutions are rules, enforcement characteristics of rules, and the norms of behaviour that structure repeated human interactions. Some of the institutional characteristics of the mortgage markets, among others are: access to credit information, affordability of mortgage services, foreclosure procedures, efficiency of contracts, and protection of the rights of market participants (lenders, borrowers and investors).

The institutional environment is much more important for the EU member countries than other countries, because the EU has aimed for the most advanced stage of economic integration, i.e. economic and monetary union, which requires a high degree of harmonisation of the institutional environment. Without this degree of integration, institutional variations could cause differences in the performance of the financial sector, such as the development of the mortgage markets between the EU member countries— affecting the national architecture of mortgage credit markets (bank-based or market-based), access of housing buyers to mortgage loans, risk-taking behaviour of financial intermediaries, rights of market participants, transaction costs, etc. This, in turn, could affect how the integration of these markets progresses. For these reasons, it is important to identify and measure the institutional features of the mortgage markets of the EU.

A literature review reveals the vast amount of work that emphasises the significance of the institutional environment of mortgage markets (Maclennan, Muellbauer and Stephens, 1998; Calza, Monacelli and Stracca, 2013). Yet very few studies have measured the institutional environment with the use of an index method. We have found only two (Wyman, 2003; London Economics, 2005), but no attempt has been made to create a benchmark to measure the institutional quality of the mortgage markets. Thus, the aim of this study is to measure the institutional features of the EU mortgage credit markets and create a benchmark for their institutional quality in order to see whether there is a difference between the EU mortgage markets related to the institutional environment and make an inference about the integration performance of the EU mortgage markets related to their institutional environment and then to compare them to each other. Here, by institutional quality, we simply mean to have good institutions, although there is no consensus on what constitutes as a ‘good institution’. In the case of the finance sector, it could be that a good institution enables the effective running of legal systems and well-functioning financial markets.

In this study, the following hypothesis is tested, namely: ‘the institutional environment in EU mortgage markets is heterogeneous’. To test this hypothesis, an overall index with sub-indices is constructed by applying an

exploratory factor analysis.<sup>2</sup> The results of the study show that there is a difference between the EU-28 countries<sup>3</sup> with regard to the institutional features of the mortgage credit markets. For example, the northern European countries and the UK have institutions with higher quality than the others. That is, their mortgage markets have an institutional environment with more government transparency in policymaking, easier access to financial services and credit information, more judicial independence, more protected property rights, and better market protection of market participants than the others. Thus, the quality of the institutional environment is not homogenous in the mortgage credit markets of the EU.

This study distinguishes itself from previous studies in three ways. First, it differs in the use of a set of indices that represent multiple dimensions of the institutional framework of the mortgage credit markets (i.e., financial, legal, openness and cultural). Second, the study differs by using an alternative indexing method; i.e., scoring, in conjunction with a factor analysis for mortgage markets. Third, the work contrasts with previous studies in the use of secondary data to measure the institutional features of these markets, rather than the use of survey data.

This paper is organised as follows: The literature review is provided in Section 2. Sections 3 and 4 present the research methodology and data description, respectively. Sections 5 and 6 include an empirical analysis and its results, respectively. Section 7 presents the results of a robustness check. Section 8 offers the conclusions and avenues for future research.

## 2. Literature Review

In the current literature, some of the studies that emphasise on the importance of institutions for mortgage markets are descriptive (Maclennan et al., 1998; European Central Bank, 2009) while others are empirical studies at the cross-country or country level. Within the existing empirical literature, much attention has been given to some of the financial features of the mortgage credit markets (e.g., credit information, loan maturity) and/or their legal features (e.g., strength of legal rights, enforcement of rules) (European Central Bank, 2009; Calza, Monacelli and Stracca, 2013) or the effect of the national culture on these markets (e.g. indulgence, power distance) (Gaganis, Hasan and Pasiouras, 2020). In the existing empirical literature, the institutional features of the

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<sup>2</sup> There are two types of factor analysis: exploratory factor analysis and confirmatory factor analysis. Exploratory factor analysis is data driven while confirmatory factor analysis is theory driven (see Hair et al., 2013).

<sup>3</sup> Our sample covers all the EU countries including the UK due to the period considered in the empirical analysis. At the time, negotiations around Brexit, which is the withdrawal of the UK from the EU, had only just started and hence the UK was still a member of the EU.

mortgage markets are included in the model while examining the development of the mortgage markets or the determinants of mortgage credit (Warnock and Warnock, 2008; Gaganis, Hasan and Pasiouras, 2020). However, few have measured the institutional features of these markets by constructing an index (Wyman, 2003; London Economics, 2005).

Since our aim is to measure the institutional features of the mortgage markets by using an indexing method, we only focus on related empirical studies in the current literature. Indices have proven useful in benchmarking performance in many areas, such as the economy, society and environment (OECD and JRC European Commission, 2008). Due to this, a large number of indices have been developed for real estate markets at either the country or regional level (Lieser and Groh, 2011, OECD, 2018). However, despite the many indices for the housing and commercial real estate markets, there are very few produced for the mortgage markets.

The mortgage market indices date back to those developed for the United States (US) mortgage markets by the Mortgage Bankers Association (MBA). The MBA has been publishing these market indices on a weekly basis since 1990. They are constructed as composite indices and based on questionnaires. Data are grouped according to market dimensions such as purpose of the loan, type of loan and type of product, after which seven indices are produced (market, purchase, refinance, conventional, government, fixed rate mortgage [FRM] and adjustable mortgage [ARM] indices). These indices cover over 75% of the mortgage loan applications for purchases of single-family homes in the US.

Wyman (2003) and London Economics (2005) evaluate the integration of the EU mortgage markets. They consider four criteria (credit risk tolerance, product range, ease of the distribution process, and availability of information and advice), with which Wyman (2003) creates a ‘completeness index’ according to survey data that cover eight EU member countries.<sup>4</sup> A product availability index has been developed for 15 member countries of the EU by London Economics (2005). The index only measures the availability of mortgage products.<sup>5</sup> In contrast to Wyman (2003), this index adopts a supply perspective rather than a demand perspective. Nonetheless, its findings approximately concur with those of the index in Wyman (2003).

These indices are all composite indices. Also, they are all based on surveys, which are directly related to sample bias and measurement errors, as well as the degree of representation of the indicators. To date, no index covers the multidimensional institutional features of the mortgage markets.

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<sup>4</sup> Denmark, France, Germany, Italy, the Netherlands, Portugal, Spain and the UK.

<sup>5</sup> Borrowers are classified as young and older households (either under or over 30), low-equity borrowers (LTV >90%), self-certified income borrowers, previously bankrupt borrowers, credit-impaired borrowers and self-employed borrowers, while products are classified as second mortgages and buy-to-let mortgages.

### 3. Research Methodology

This study focuses on the institutional features of the mortgage credit markets in order to test the hypothesis - the institutional environment in EU mortgage markets is heterogeneous – where the sample comprises the 28 EU member countries.

To achieve this, first, the institutional features of the mortgage credit markets are measured by using a composite index method. Thereby, a benchmark is created for these markets by constructing an overall index and sub-indices. Considering that institutions that do not show significant change over time qualify as a latent factor, we argue that the institutional environment across the EU-28 can be described across multiple dimensions instead of one-size-fits all indicators. Therefore, to obtain a benchmark for the institutional characteristics of the credit markets, the index is calculated as a composite index, which is a mathematical combination of a set of individual variables (Mazziotta and Pareto, 2013).

In spite of the criticism,<sup>6</sup> composite indices are frequently used to compare country performance and increasingly accepted as a tool useful for policy analyses (OECD and JRC, 2008; Hair et al., 2013). Their popularity is attributable to two factors. First, interpreting composite indices is easier than identifying common trends across many separate indicators. Second, the rankings derived from them can put pressure on governments to question their policies. The World Competitiveness Index (World Economic Forum) and the PISA index (Organisation for Economic Co-operation and Development (OECD)) are some examples of composite indices that potentially have strong effects on policies worldwide.

To construct the indices, we apply an exploratory factor analysis, which is a reduction technique (Hair, et al., 2013). According to Tucker and Lewis (1973), this technique can be very useful for investigating the latent characteristics that explain for the essential connections between observed phenomena. In addition, this method is one of the most frequently used techniques in the literature in the preparation of composite indices (OECD and JRC European Commission, 2008; König and Ohr, 2013). To produce the indices, we follow the approaches in Noorbakhsh (1998) and Nicoletti, Scarpetta and Boylaud, (2000), in which the sub-indicators with the highest factor loadings are grouped as intermediate composite indicators. To determine the individual variables that would be included in our composite index, we build on the new institutional economics, law and finance, efficient markets and financial liberalisation

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<sup>6</sup> They are sometimes accused of being unreliable because of the complexity of their configurations as well as the differences in the underlying variables (Mubareka et al., 2011; Mazziotta and Pareto, 2013).

theories to advance our understanding of the institutional quality and determine the individual variables that would be included in our index.

First, the new institutional economics and the law and finance theories are considered. The former considers the economy as an institutionalised process. North (1990), one of the pioneers of this theory, combines Coase's theorem of transaction costs and human behaviour, in which the economic actor is receptive to ideology and insights. He suggests that institutions include formal institutions (rules and laws), informal institutions (habits and customs) and their enforcement in the economy. The law and finance theory is based on the new institutional economics theory. This theory focuses on the legal origins and effect of legal systems on financial development. An important aim of the law and finance theory is to identify the conditions under which different institutional choices are optimal for protecting property rights. According to this theory, financial development has been historically determined by the evolution of legal traditions as well as the national culture (Porta *et al.*, 1998; Schiehl and Martins, 2016). Therefore, legal institutional features and their enforcement as well as cultural features are chosen to measure the institutional environment in the mortgage markets, such as the efficiency of the legal framework, enforcing contracts, habits and customs, etc.

Subsequently, bearing in mind the goal of creating a benchmark for the mortgage credit markets, other features of these markets are selected according to the efficient market and financial liberalisation theories (McKinnon, 1973; Williamson and Mahar, 1998).

The efficient market theory states that in an efficient market, the market prices fully reflect the availability of information, and the market participants (i.e. investors, lenders and borrowers) often perform better in the market (Fama, 1970; Tobin, 1984). Then, it is expected that increasing the efficiency of the market contributes to the development of these markets. Thus, the study chooses the features of efficient credit markets, such as accessibility of credit information and the strength of financial intermediaries. According to the financial liberalisation theory, the elimination of direct or physical controls imposed by governments can be achieved by increasing the volume of non-domestic transactions in the economy. With increasing financial liberalisation, domestic financial markets become more interconnected with international markets which contributes to the development of the financial sector (Mishkin and Eakins, 2016). Thus, we select institutional features that show the openness of the credit markets, such as investment freedom and trading cross-border. For efficient and well-functioning credit markets, transparency also matters to all participants in the financial markets because it contributes to an increase in the accessibility of market information. We therefore consider the corruption indicator as another feature of the institutional environment in these markets.

At the end of the analysis, an overall index and four sub-indices are produced. The overall index is referred to as the Institutional Index. Taking into account the sets of institutional features, the sub-indices are labelled as follows: financial, legal, openness, and cultural sub-indices.<sup>7</sup> These indices reveal the quality of the institutional environment of the mortgage credit markets with respect to these four dimensions. They therefore enable us to evaluate the institutional environment of the EU mortgage credit markets from different angles and compare these markets with respect to institutional quality. In addition, the findings from these indices may allow us to see whether the EU mortgage markets are homogenous and thus, to make inferences about the convergence of these markets.

#### 4. Data Description

The institutional variables cannot be measured directly because they lack dynamics (Djankov, McLiesh and Shleifer, 2007). Most of the institutional variables are based on qualitative indices like in this study. With the exception of the cultural variable, data are collected from internationally recognised organisations: the World Bank, World Economic Forum, European Central Bank, European Mortgage Federation and specialised agencies, including the Heritage Foundation and Transparency International. The cultural variable is taken from Hofstede, Hofstede and Minkov (2010). Our variables (indices) cover the period of 2010-2014 and are averaged across this period for each EU country, with the exception of culture, which is only available for 2010.<sup>8</sup> Averaging is theoretically valid as a difference over five years is unlikely to be significant enough to affect the results, since changes in institutional and cultural factors happen over a longer time-frame (Hofstede, Hofstede and Minkov, 2010; Minkov, 2011).

The institutional features considered define the multidimensional phenomenon, and in collecting data on them, the following factors need to be taken into account: (i) the variables are within the field of public authority; (ii) they are influenced by the market process; (iii) they are calculated by using a similar method; and (iv) they are available in all of the EU countries.

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<sup>7</sup> In fact, the cultural sub-index is produced by Hofstede, Hofstede and Minkov (2010). Since they have different score numbers, we only rescaled them to compare the indices constructed in this study.

<sup>8</sup> Cultural features do not change quickly. The process may take centuries. This case is proven by the scores of the cultural index included in our analysis, which is produced by Hofstede, Hofstede and Minkov (2010). Their indices are built on surveys. The first surveys are done between 1967-73 and replicated by other researchers many times. In 2010, they add a new cultural dimension, and produce new indices for other countries. All the country scores form one cohesive set. The fact that some scores are added later is because they are 'discovered' later, not because they have changed.



At the end of the data selection process, 30 institutional features are determined and categorised within four sub-groups: financial, legal, openness, and cultural drivers (see Appendix 1).

#### **4.1. Financial Drivers**

Financial drivers cover variables related to the financial features of the institutional environment, such as availability of financial services, credit information, affordability of financial services, etc. These variables are also recognised as the indicators for the development of the mortgage credit markets as well as their functioning. The general expectation is that developed markets are also efficient markets. The most efficient markets are those with the lowest risk, minimum transaction costs, normal profit opportunities, and access to full information for all parties in the credit markets— and thus essentially well-functioning. In such markets, no market participant has a privileged position in estimating market prices since there are no data that could provide any additional advantage (Fama, 1970; Tobin, 1984).

#### **4.2. Legal Drivers**

Like the financial drivers, a legal framework may lead to difference in development between mortgage markets. A high-quality legal structure can also support the development of these markets, for example by increasing transparency, enforcing contracts quickly and fairly, and protecting property rights. In the literature, the relationship between the legal system and financial development is explained with reference to the law and finance theory, which acknowledges the centrality of legal traditions in accounting for cross-country differences in financial development and pays attention particularly to the role and nature of law in the economy, its role in creating reasons for action, and its association with morals (Porta *et al.*, 1998; Schiehl and Martins, 2016).

A large number of empirical studies on the financial sector as well as mortgage markets show that the legal environment severely affects the development of the financial sector (the size of the capital markets, access to external resources). While Levine *et al.* (2000) find that cross-country differences in legal and accounting systems help to explain for cross-country differences in financial development, Djankov, McLiesh and Shleifer (2007) and Qian and Strahan (2007) point out the importance of creditor protection and creditor rights in the banking sector, and conclude that a high degree of creditor protection and credit rights increase the availability of financial products with lower interest rates as well as mortgage loans with longer maturity. Svensson (1998) and Bae and Goyal (2003) emphasise the importance of strong property rights for productive investment. They suggest that weak property rights may deter investment even when banks have available funds for lending. That is, countries with better property rights protection have larger loan sizes and lower interest rate spreads. Warnock and Warnock (2008) highlight the importance

of both lenders and borrowers in the mortgage markets with strong legal rights (bankruptcy law and collateral). Ashraf (2017) confirm the findings of previous studies and conclude that legal institutions influence the risk behaviour of financial intermediaries along with political institutions.

### 4.3. Openness

The openness driver shows the extent to which the economy is open; that is, the volume of non-domestic transactions in an economy (foreign capital inflows and outflows, imports, exports). The financial liberalisation theory suggests that with increasing degree of openness, borrowers will not need to only depend on domestic funds, and will be able to access external funds at a relatively low cost. In addition, openness enables participants in the financial sector to increase their cross-border activities, since a significant aspect of financial liberalisation is the reduction (or removal) of constraints, for both domestic and foreign financial intermediaries, against operating in other countries (McKinnon, 1973; Alzer and Dadasov, 2013). Thus, a more competitive and dynamic financial environment can be created for the players in the market by increasing the degree of openness.

Such an environment can also contribute to an increase in institutional quality by reducing perceived investment risks, since foreign investors enforce market discipline on private and public borrowers at the macro and micro levels (Auerbach and Siddiki, 2004; Schmukler, 2008). In addition, openness enables dissemination of good practices from one country to another and contributes to the improvement of financial infrastructures by reducing the problem of asymmetric information, such as adverse selection and moral hazard. Therefore, it is expected that openness of the financial sector will contribute to the development of the credit markets, for example, by creating a more competitive environment.

### 4.4. Culture

According to the new institutional economics theory, institutions include the cultural features of a country as informal institutions in addition to legal features (formal institutions) (North, 1990). The literature offers a vast number of definitions of culture. Their commonality is that culture covers a set of values or beliefs that affect preferences, behaviours, decisions and perceptions.<sup>9</sup> The existing literature shows that cultural factors have an impact on the

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<sup>9</sup>Hofstede (1983, p. 76) defines culture as ‘the collective programming of mind that leads to patterned ways of thinking, feeling, and acting that distinguish the members of one group or category of people from others’. North (1990, p.37) describes culture as providing a ‘framework for encoding and interpreting the information that the senses are presenting to the brain’. According to Rapoport, (2001), the components of culture cover world views (i.e., values, norms, meanings, standards, rules, and expectations), social networks, family structure, kinship and kinship relations.

configurations of the financial sector and the nature of financial activities as well as buying and saving decisions (Stulz and Williamson, 2003; Karolyi, 2016).

Porta *et al.* (1998) and Stulz and Williamson (2003) consider religion as a proxy for culture when examining the role of culture in financial development and indicate that differences in national cultures cause difference in legal systems (investor protection, especially creditor rights) across countries. Kwok and Tadesse (2006) and Aggarwal and Goodell (2010) explore the reasons for the different financial system configurations among countries (bank-based or market-based) and show the effect of the national culture on the financial sector. The findings of Gaganis, Hasan and Pasiouras (2020) which only focus on mortgage credit markets also indicate that deeply rooted differences in the cultural environment of different societies are related to the size of mortgage loans. In conclusion, the findings of previous studies are similar, which show that cultural characteristics influence the financial sector, even if they focus on different finance related factors (financial intermediation, risk-taking behaviour).

We consider ‘indulgence’ as a cultural variable which is developed in Hofstede, Hofstede and Minkov, (2010), which is the most widely cited study in the literature.<sup>10</sup> They define indulgence as ‘...the extent to which people try to control their desires and impulses, based on the way they were raised’ (Hofstede, Hofstede and Minkov, 2010, p.191). That is, the cultural variable in this study includes habits and customs of a certain society.<sup>11</sup>

The descriptive statistics of our dataset are provided in Appendix 2.

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<sup>10</sup>The literature review reveals two studies that measure cultural factors: Schwartz (1994) and Hofstede, Hofstede and Minkov (2010), whose studies are used in the majority of the existing literature. In this study, the data set in Hofstede, Hofstede and Minkov, (2010) is used for two reasons. First, their data are more established, having been used by many studies; secondly, their data is publicly available, whereas the full data set of Schwarz (1994) is not. However, we choose only one of their cultural measurements – indulgence (i.e. customs and habits) – because of limitations in the other measurements across all of the EU countries.

<sup>11</sup>Their cultural index numbers are available for all EU members, except for Cyprus which consists of two nations; Greek and Turkish Cypriots. The former are a member of the EU, but not the latter. Here, the index number of Greece is considered for Cyprus because the Greek Cypriots are culturally Greek (Kyritsi & Christofis, 2018).

## 5. Empirical Analysis and Results

To test our hypothesis, we use a factor analysis. At the end of the analysis, five indices are produced: the overall index and four sub-indices. The overall index is labelled as the Institutional Index. Based on the classification of the institutional features of the credit markets described in the previous section, the sub-indices are labelled the financial, legal, openness and cultural sub-indices.

In our analysis, the first step is to select the variables and determine their suitability, after which it can be determined whether a factor analysis is feasible by using these variables. First, Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) test are carried out (see Appendix 3 and 4). Both allow us to assess the overall suitability of the variables. The Bartlett's test of sphericity tests whether the correlation matrix is different from the identity matrix: if so, the use of a factor model might be more appropriate. To determine whether a factor model is used, the p-value in the Bartlett's test should be small ( $<0.05$ ). The KMO test is used to assess the partial correlations between the variables. The KMO statistics reveal the proportion of variance among our variables that could be caused by other underlying factors. If the KMO value is greater than 0.60, the variables share common factors (OECD and JRC European Commission, 2008). If not, a factor analysis may not yield meaningful results. The KMO statistic (0.776) and Bartlett's test results (chi square = 1514.080, p-value $<0.00$ ) show that the data set is adequately sampled. Finally, it is necessary to consider whether the underlying data structure is appropriate for describing a uni-dimensional construct and whether the groups of indicators identified provide a good interpretation of the result. The Cronbach's alpha coefficient is used to assess whether the dataset measures uni-dimensionality. The coefficient is between zero and one, and the acceptable threshold for an appropriate data structure is 0.70 (Lieser and Groh, 2011; König and Ohr, 2013). The estimation gives a Cronbach's alpha coefficient of 0.9667.

The second stage of the analysis involves the selection of an aggregation and weighting procedure. To prevent subjective bias, the variables should be weighted according to statistical relevance; thus, the informative value of the index can be maximised (OECD and JRC European Commission, 2008).

A principal component analysis (PCA) is carried out to calculate the weights, in which the overall index is constructed by using 27 institutional variables. Finally, the number of factors is determined by considering three criteria. According to these criteria, the factors that should be retained: (i) individually contribute to the explanation of the total variance by more than 10%; (ii) have associated eigenvalues greater than one; and (iii) cumulatively contribute to the explanation of the overall variance by more than 60% (OECD and JRC European Commission, 2008). According to these criteria, four factors can be chosen, which are shown in Table 1. More than 10% of the total variance individually and 82.44% of the total variance cumulatively are explained by these four

factors. Each factor is described as a set of coefficients, which are referred to as factor loadings (or factor coefficients).

**Table 1 Eigenvalues and Variances of Principal Components**

<b>Factor</b>	<b>Eigenvalue</b>	<b>Explained Variance (%)</b>	<b>Cumulative Variance (%)</b>
Factor 1	15.65	61.22	61.22
Factor 2	10.76	10.76	71.98
Factor 3	1.41	5.53	77.51
Factor 4	1.26	4.93	82.44

**Source:** Authors' calculations. This table was prepared from Appendix 5 and 6.

The third step is the rotation of the factor loadings, which minimises the number of individual variables that have a high loading on the same factor. For this purpose, the varimax rotation method is used. After rotation of the factor loadings, again, 82.44% of the total variability of the original variables is explained by the four factors. Thus, it is observed that the number of factors does not change. In this case, the factor coefficients that are obtained before rotating are used to construct the composite indices (i.e., the Institutional Index and sub-indices).

The factor loadings ( $\alpha_1, \alpha_2, \alpha_3, \alpha_4$  and  $\alpha_5$ ) are listed in Table 2. The factors are listed in the order of variance explained. It can be observed that a large number of the institutional features are represented by the first factor (Factor I). Factor I captures most of the variance in all of the legal variables. The majority of the change in the variables included in the financial and openness drivers is also explained by Factor I.

**Table 2 Factor Loadings and Weighting**

<b>CODE</b>	<b>Factor 1</b>	<b>Factor 2</b>	<b>Factor 3</b>	<b>Factor 4</b>	<b>Uniqueness</b>
<b>Financial Driver</b>					
F_AVA	0.8853	0.3057	-0.0059	-0.0194	0.1224
F_AFF	0.8957	0.234	-0.0556	-0.0715	0.1348
F_LOC	0.8518	0.3357	0.0307	-0.0509	0.1583
F_ACC	0.6592	0.5901	0.1751	0.1729	0.1567
F_RIS	0.8494	0.3622	0.0827	0.1242	0.125
F_BAN	0.3755	0.8531	0.1408	0.0529	0.1086
F_SEC	0.8731	0.1698	0.1458	-0.0242	0.1871
F_CRE	-0.1745	-0.0481	-0.5794	0.4932	0.3882
F_MEV	0.3756	-0.1869	0.495	0.2191	0.531

(Continued...)

(Table 2 Continued)

<b>Legal Driver</b>					
L_PRO	0.9561	-0.0776	-0.0275	-0.1183	0.0651
L_INV	0.9265	-0.24	-0.0913	0.0635	0.0716
L_JUD	0.9379	-0.1885	-0.0388	-0.1076	0.0718
L_EFF	0.9666	-0.0264	0.0601	-0.0557	0.0582
L_EFR	0.96	-0.0612	0.0398	0.0003	0.073
L_ENF	-0.5544	-0.5266	0.2444	-0.2566	0.2897
L_RIG	0.9265	-0.24	-0.0913	0.0635	0.0716
<b>Openness Driver</b>					
O_INV	0.689	0.2151	-0.2272	-0.2986	0.3382
O_XT	0.8226	-0.1662	-0.0473	0.18	0.2611
O_XC	0.3328	-0.3498	0.1421	0.398	0.5883
O_MT	0.8393	-0.1831	0.0854	0.2125	0.2095
O_BUS	0.4377	0.0419	-0.6184	-0.2961	0.3367
O_REA	-0.5329	0.4222	0.1469	-0.3785	0.3729
O_REC	-0.6892	0.3055	0.2784	0.2472	0.293
O_BAR	0.6942	-0.3023	0.0898	0.039	0.417
O_BUR	0.8741	-0.1686	0.0511	-0.0087	0.2049
<b>Transparency</b>					
TRNS	0.952	-0.1325	-0.027	0.0066	0.0754
<b>Cultural Driver</b>					
C_IND	0.6023	-0.3692	0.304	-0.4363	0.2182
<b>Explained Variance (%)</b>	61.22	10.76	5.53	4.93	17.56

**Source:** Authors' calculations.

**Notes:** The bolded areas show the highest value of each variable across the four components. F\_AVA: Availability of financial services, F\_AFF: Affordability of financial services, F\_LOC: Financing through local equity, F\_ACC: Ease of access to loans, F\_RIS: Venture capital availability, F\_BAN: Bank soundness, F\_SEC: Regulation of securities exchanges, F\_CRE: Getting credit- depth of credit information, F\_MEV: Mortgage equity withdrawal, L\_PROP: Property rights, L\_JUD: Judicial independence, L\_EFF: Efficiency of legal framework in settling disputes, L\_EFR: Efficiency of legal framework in challenging regulations, L\_RIG: Getting Credit- Strength of legal rights, L\_ENF: Enforcing Contracts, O\_INV: Investment freedom, O\_XT: Trading cross borders – time to export, O\_XC: Trading cross borders – cost of export, O\_MT: Trading cross borders - time to import, O\_BUS: Starting a business – number of procedures, O\_REA: Cost of real estate, O\_REC: Recovery rate of insolvency, O\_BAR: Prevalence of trade barriers, O\_BUR: Burden of customs procedures, TRAN: Corruption perceptions index, and C\_IND: Habits and customs.

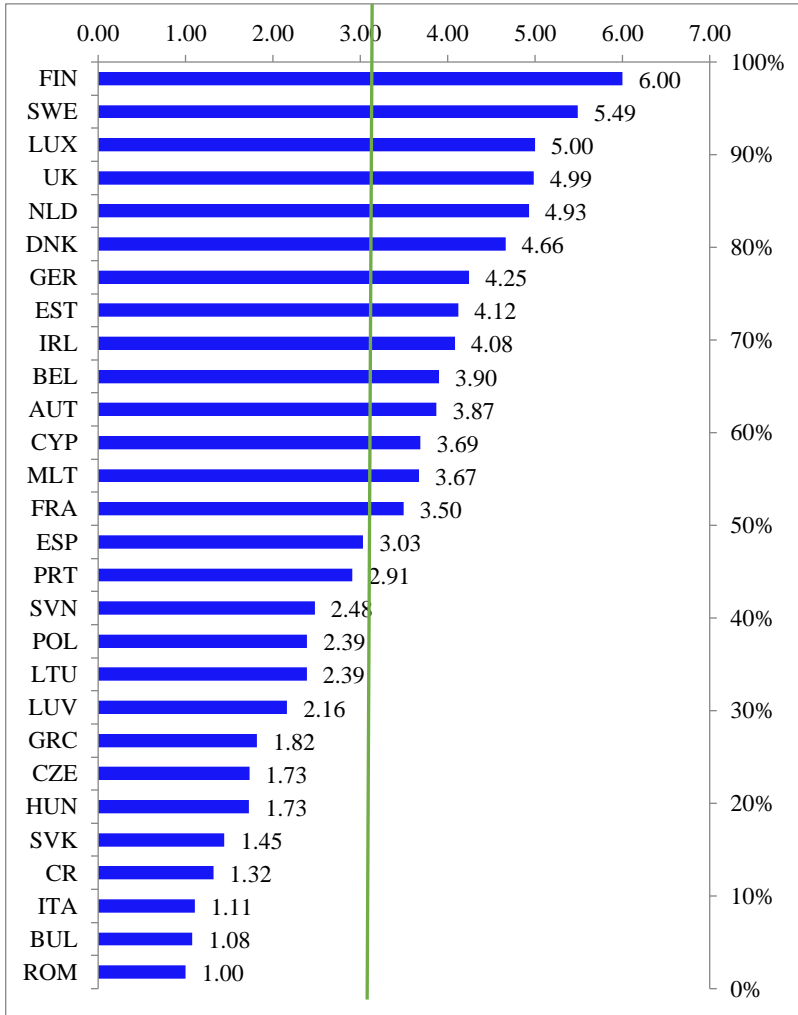
The variables retained after factor extraction are correlated with the four factors and these factors explain for 82.44% of the total variance in the 27 institutional variables. These results show that the legal drivers have the strongest association with Factor I among all of the variables in the analysis.

The final stage of the factor analysis is to construct a composite index and visualise the results. As aforementioned, this process is based on weighting according to the proportion of variance explained by the factor in each variable, and each factor is weighted by considering its contribution to the portion of the explained variance in the data set. Following this process, the overall index is produced and labelled the Institutional Index. This index shows the quality of the institutional environment of the mortgage credit markets of the EU member countries. The Institutional Index ranges from -1.333 to 1.204 and then is rescaled between *one* and *six*. This index, as shown in Figure 1, shows the country rankings and index points for all 28 EU member countries. The largest number indicates the mortgage credit markets with the highest institutional quality, and the smallest number the markets with the lowest institutional quality.

Then, by following the same stages, the sub-indices are produced according to the four dimensions of the institutional environment in the credit markets; i.e., the financial, legal, openness and cultural sub-indices. Like the Institutional Index, the sub-indices are rescaled between *one* and *six* for comparability. The country rankings of these sub-indices are listed in Figure 2. Again, the numbers reveal the differences between credit markets with the highest quality and those with the lowest.

Figure 1 shows that the EU mortgage markets have different outlooks in terms of institutional features. Northern European countries and the UK are at the top of the Institutional Index and take the lead with respect to the institutional environment of their credit markets. The index numbers show that all the central and eastern European countries are below the index average of the EU countries, with the exception of Estonia. This is also true for the southern European countries. Finland ranks the highest on the Institutional Index. That is, its mortgage credit markets have the highest institutional quality among all of the EU countries. Romania is at the bottom of the ranking with a credit market that has the lowest institutional quality. In other words, northern European countries and the UK have a better institutional environment than the southern, central and eastern European countries. For example, the northern European countries and the UK have an institutional environment with a more judicial independence, stronger protected property rights, more government transparency in policymaking and better market protection of the market participants than the others. So, their mortgage markets have higher institutional quality than the other EU members. In this case, it can be argued that the northern European countries and the UK have mortgage markets with

**Figure 1 Institutional Index**

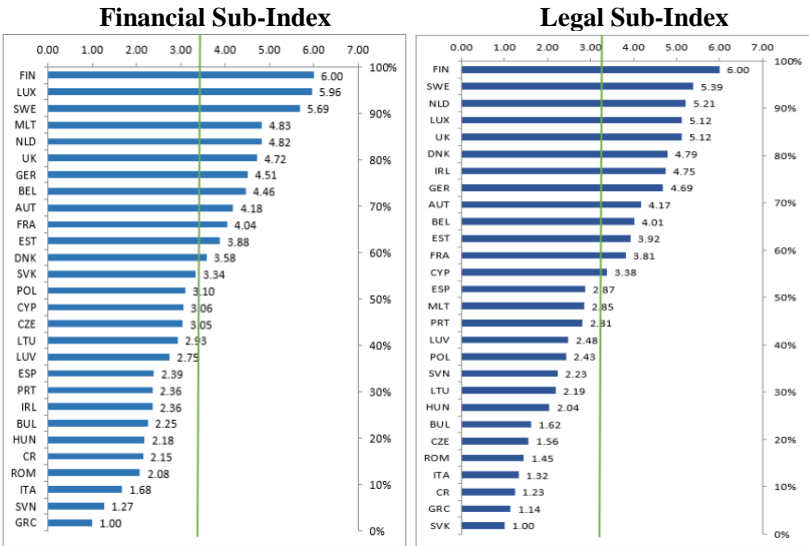


(\*). Green line shows average of the EU which is 3.16.

**Note:** AUT: Austria, BEL: Belgium, BUL: Bulgaria, CR: Croatia, CYP: Cyprus, CZE: Czech Republic, DNK: Denmark, ESP: Spain, EST: Estonia, FIN: Finland, FRA: France, GER: Germany, GRC: Greece, HUN: Hungary, IRL: Ireland, ITA: Italy, LTU: Lithuania, LUV: Latvia, LUX: Luxembourg, MLT: Malta, NLD: the Netherlands, POL: Poland, PRT: Portugal, ROM: Romania, SVK: Slovakia, SVN: Slovenia, SWE: Sweden, and UK: the United Kingdom.

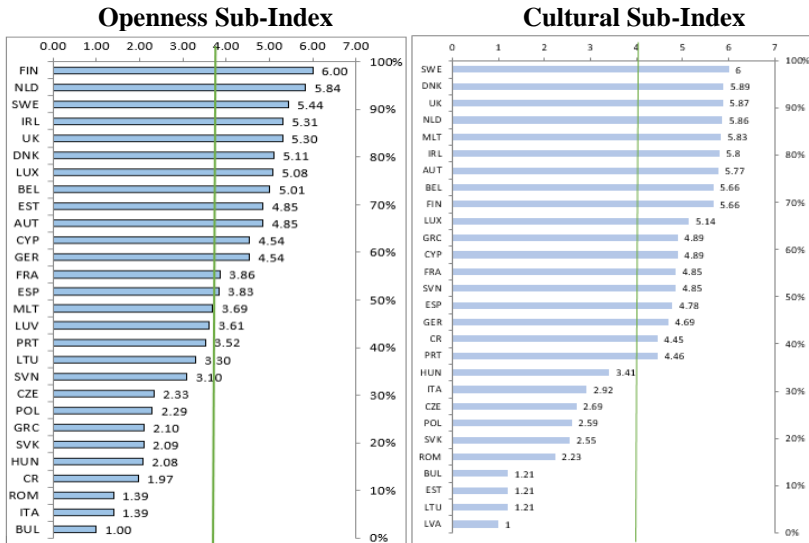


**Figure 2 Sub-Indices**



(\*) Average of the EU is 3.37.

(\*) Average of the EU is 3.19



(\*) Average of the EU is 3.69.

(\*) Average of the EU is 4.15

**Note:** Green line shows average of the EU. AUT: Austria, BEL: Belgium, BUL: Bulgaria, CR: Croatia, CYP: Cyprus, CZE: Czech Republic, DNK: Denmark, ESP: Spain, EST: Estonia, FIN: Finland, FRA: France, GER: Germany, GRC: Greece, HUN: Hungary, IRL: Ireland, ITA: Italy, LTU: Lithuania, LUV: Latvia, LUX: Luxembourg, MLT: Malta, NLD: the Netherlands, POL: Poland, PRT: Portugal, ROM: Romania, SVK: Slovakia, SVN: Slovenia, SWE: Sweden, and UK: the United Kingdom.

more depth, greater accessibility and higher efficiency. From these findings, one suggestion can be that the institutional environment, in addition to other factors, play a part in how these markets evolve and function in the different markets.

In the Institutional Index, all of the former members of the EU<sup>12</sup> are also above the EU-28 average with a few exceptions, such as countries on the peripheries (i.e. Greece, Italy, Portugal and Spain), which have lower positions in the ranking. The case of Italy, among the most advanced countries in the EU and the world, is interesting.<sup>13</sup> In the Institutional Index, Italy is ranked lowest among all of the former members of the EU. A similar case can be seen with France, albeit at a higher position than Italy. This might partly be explained by the origins of its law system, which is based on French civil law. In fact, Porta *et al.* (1998), who examine legal rules by classifying countries according to legal origins, find that French civil law countries (i.e., France, Greece, Italy, Portugal and Spain) are the weakest with respect to quality of law enforcement when compared to common law countries, or countries with Scandinavian or German civil law origins, and have less developed financial markets than former EU countries with the other law systems. Thus, the index scores of France, Greece, Italy, Portugal and Spain in the Institutional Index support to the findings of Porta *et al.* (1998).

The position of the EU countries on the Institutional Index is largely replicated across the sub-indices. The countries above the EU average in the financial sub-index largely remain in similar positions in the other sub-indices (Figures 2). Like in the Institutional Index, the sub-indices confirm that there is a large discrepancy between countries with the highest and lowest institutional quality with regard to their mortgage markets, except for the cultural sub-index. In contrast to the other sub-indices, the cultural sub-index indicates that the differences between the EU mortgage markets are smaller. This index is related to the ability to consider the future consequences of current actions. That is, a person can have either an indulgent or a restrained nature, according to his/her cultural background. Individuals with indulgent behaviour like to receive immediate gratification, whereas those with low indulgence will forego immediate gratification for the benefit of their future advancement (Hofstede, Hofstede and Minkov, 2010). The cultural index numbers show that a person from Latvia has less indulgent behaviour than their European peers. The cultural dimension of this sub-index differs from the other sub-indices. Most of the member countries are above the EU average. One explanation could be that the EU countries have more in common with each other culturally than they do

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<sup>12</sup> By former members, we are referring to the countries that joined the EU before 2004. They are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the UK.

<sup>13</sup> Moreover, France and Italy are members of the Group of Seven (G7), which consists of the most developed countries of the world.

with regard to other institutional characteristics although they do not have the same index scores.

In summary, the results of the Institutional Index and the sub-indices demonstrate that the EU mortgage markets remain diverse. In other words, these markets are heterogeneous in terms of their institutional environment and thereby support the hypothesis of this study. These findings are also in line with previous studies (Wyman, 2003; London Economics, 2005), although their indices only include a few institutional features of the EU mortgage markets.

## 6. Robustness Check

To check the robustness of the factor analysis results, two alternative methods are used: the scoring method and linear regression modelling. The former is used to check the robustness of the Institutional Index. Then, using the indices produced, the relationship between financial intermediation and institutional features is examined with the expectation that the institutional environment positively affects the development of the financial intermediaries in the mortgage markets. To do so, linear regression modelling is applied.

### 6.1. Scoring Method

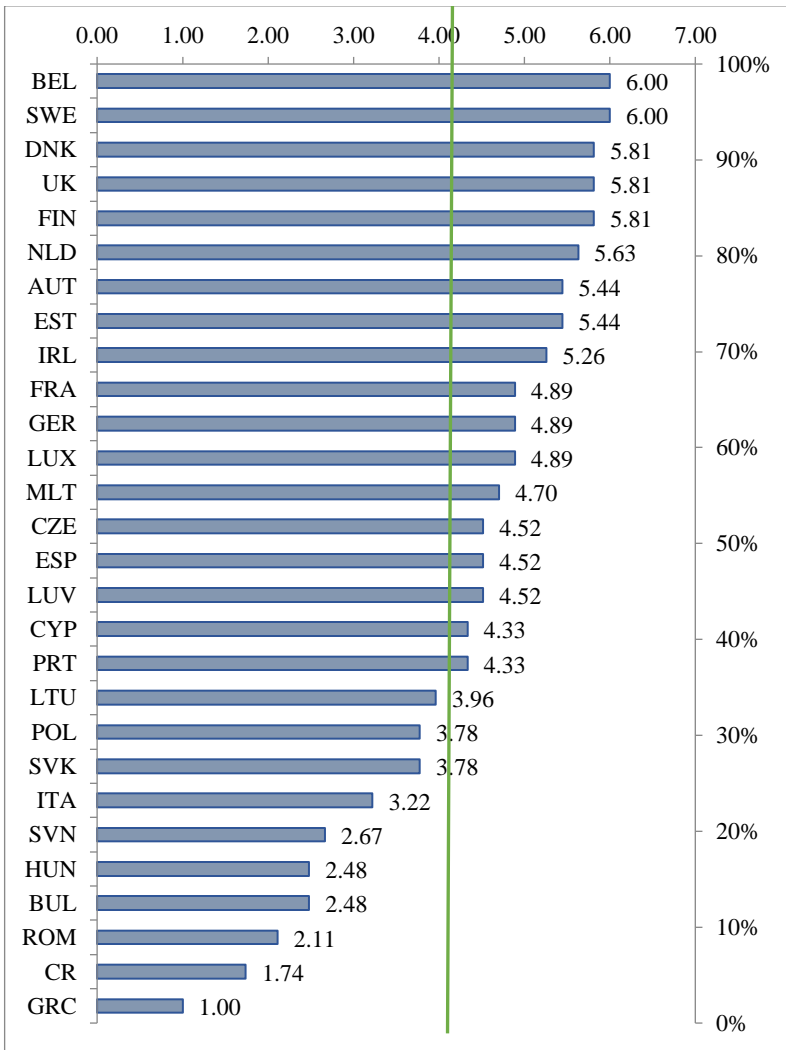
We use the scoring method by following the approach in Şeren-Güler (2016) to produce a new overall index. The scoring method result is technically acquired from the average of the variables. While a country is evaluated with respect to its institutional environment, the value of each variable is compared to a threshold value<sup>14</sup> of  $\pm 0.5$  standard deviation from the average which is set as the threshold of the institutional quality. Hence, the convergence between the countries is assumed to be equal to  $\pm 0.5$  for all institutional variables. If the value is above the threshold, the institutional quality of the mortgage markets is viewed as being relatively high and given a score of *one*; otherwise, they are seen as being low and given a score of *zero*. Then, an index is constructed with the total of the success scores of the related variables for each country.

After producing a new overall index, the scores obtained for all the countries are then rescaled from *one* to *six* like in the Institutional Index constructed by using a factor analysis. The new index is called the Score Index. Figure 3 shows the rankings in the Score Index. As with the Institutional Index, the largest number in the Score Index indicates the mortgage market with the highest institutional quality, while the smallest number indicates that with the lowest

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<sup>14</sup> The threshold value ( $T_1$ ) is calculated with the following equation;  $T_1 = \overline{X_{28}} - \alpha * \sigma(X_{28})$ , where  $\overline{X_{28}}$  and  $\sigma(X_{28})$  are the arithmetic average and the standard deviation, respectively, of each variable for all EU member countries; and  $\alpha$  is a convergence constant.

**Figure 3** Score Index



(\*) Green line shows average of EU-28.

**Note:** AUT: Austria, BEL: Belgium, BUL: Bulgaria, CR: Croatia, CYP: Cyprus, CZE: Czech Republic, DNK: Denmark, ESP: Spain, EST: Estonia, FIN: Finland, FRA: France, GER: Germany, GRC: Greece, HUN: Hungary, IRL: Ireland, ITA: Italy, LTU: Lithuania, LUV: Latvia, LUX: Luxembourg, MLT: Malta, NLD: the Netherlands, POL: Poland, PRT: Portugal, ROM: Romania, SVK: Slovakia, SVN: Slovenia, SWE: Sweden, and UK: the United Kingdom.

institutional quality. The results of the index scoring method confirm the robustness of the Institutional Index, although there are some minor differences in the rankings of the countries. Again, the northern European countries are above the EU-28 average in the Score Index, while the southern, central and eastern European countries are below average. This means that the northern countries with a higher score (i.e., higher institutional quality) have more developed mortgage markets, while the southern, central and eastern countries have less developed markets. Moreover, the findings clearly reveal the difference between the northern and southern European countries as well as between northern and eastern Europe. As a result, the Score Index confirms the reliability of the Institutional Index.

## 6.2. Linear Regression Modelling

The second robustness check is to ascertain whether the Institutional Index and the sub-indices produced represent reality and whether they can be a sound benchmark for the institutional quality of mortgage markets. To do so, the relationship between the development of mortgage markets and institutional quality are examined by using the indices produced with the expectation that the institutional environment positively affects the development of the mortgage markets. To test this relationship, linear regression modelling is carried out by applying the ordinary least squares (OLS) technique. For the development of the mortgage credit markets, the development of the financial intermediaries is examined with respect to their depth, accessibility and efficiency.

Thus, our linear regression model involves three equations: the depth, accessibility and efficiency equations with each index one at a time due to the multicollinearity problem. Each index individually demonstrates the association between the institutional quality of the mortgage credit markets and the development of those markets with the three dimensions of financial intermediation.

Equation (1) represents the association between the depth of the financial intermediation and the quality of the institutional environment, and Equations (2) and (3) show the relationship between the development of the financial intermediation and institutional quality with regard to the accessibility of financial intermediation and its efficiency respectively. Each equation consists of one dependent variable (the development of financial intermediation), one explanatory variable (the quality of the institutional environment) and a control variable (size of the economic activity (i.e., the GDP).

$$Depth_t = \alpha_0 + \alpha_1 Institution_{t-1} + \alpha_2 GDP_{t-1} + \varepsilon_{1t} \quad (1)$$

$$Accessibility_t = \delta_0 + \delta_1 Institution_{t-1} + \delta_2 GDP_{t-1} + \varepsilon_{2t} \quad (2)$$

$$Efficiency_t = \beta_0 + \beta_1 Institution_{t-1} + \beta_2 GDP_{t-1} + \varepsilon_{3t} \quad (3)$$

where  $Depth_t$  is the ratio of the mortgage credit to the GDP at time  $t$  as an indicator of the depth of the financial intermediation in the mortgage credit markets;  $Accessibility_t$  is the percentage of owner-occupied housing in a population bought with credit as an indicator of the accessibility of financial services for home buyers provided by financial intermediaries at time  $t$ ;  $Efficiency_t$  is the net interest margin at time  $t$  as an indicator of the efficiency of financial intermediation;  $Institution$  are the indices produced as an indicator of the institutional quality at time  $t-1$  and  $\varepsilon_1, \varepsilon_2$ , and  $\varepsilon_3$  are the error terms. The dependent and control variables are included in the model as real terms. All variables are inputted in the model in their logarithmic form except for the net interest margin. The dependent variables are based on the year 2015, while the institutional variables and control variable are averaged over the years 2010- 2014 to avoid a two-way causality.

The estimation comprises two stages. In the first stage, the three indicators of the development of financial intermediation are regressed against the Institutional Index. In the second stage, we extend our analysis by taking into consideration the four sub-indices. The estimation process for each of the three equations is repeated by adding each of the sub-indices to the equations. This enables us to properly elucidate the magnitude of the effect of each institutional index in their relationship to the mortgage market efficiency, accessibility and depth.

### 6.3. Empirical Results

The estimation results presented in Tables 3 to 5 are as expected. There is a positive relationship of both the depth and accessibility of mortgage markets with all indices produced but a negative relationship between the efficiency of these markets and the Institutional Index as well as the sub-indices. In other words, each additional improvement in the quality of the institutional environment contributes to deepening of financial intermediation and increasing its accessibility, and thus, an increase in the institutional quality of the markets makes it easier for households to obtain mortgage credit. The same is found for the efficiency of financial intermediation. Higher institutional quality prevents financial intermediaries from reaping excessive profit margins in the mortgage markets. It can be argued that an improvement in the institutional environment creates a more competitive environment for the mortgage markets and reduces the profit margins of financial intermediaries as well as increases the affordability of credit for home buyers. The test results

show that the institutional environment positively contributes to the development of mortgage markets. They also indicate that an improvement in institutional quality has a larger contribution to the accessibility of financial intermediation as opposed to their depth and efficiency in the mortgage markets.

**Table 3 Institutional Quality and Depth of the Mortgage Credit Markets**

	<b>Dependent variable: Mortgage Debt/GDP (%)</b>		
	<u>Coefficients</u>	<u>P value</u>	<u>R-squared</u>
<b>Institutional index (Overall index)</b>	.3513134 (***)	0.000	0.6449
<b>Financial sub-index</b>	.2426786 (***)	0.002	0.3494
<b>Legal sub- index</b>	.3456147 (***)	0.000	0.6582
<b>Openness sub-index</b>	.3071804 (***)	0.000	0.5322
<b>Cultural sub-index</b>	.924328 (***)	0.000	0.5442

**Notes:** (\*\*\*) indicates statistical significance at 1% level. Control variable included for every model is economic activity (GDP-volume). Dependent and control variables are in logarithmic form in real terms.

**Table 4 Institutional Quality V.S. Accessibility of Financial Intermediation**

	<b>Dependent variable: % of owner occupied with loan in population</b>		
	<u>Coefficients</u>	<u>P value</u>	<u>R-squared</u>
<b>Institutional index (Overall index)</b>	7.965422 (***)	0.000	0.7061
<b>Financial sub-index</b>	3.347911 (***)	0.000	0.4584
<b>Legal sub- index</b>	7.369179 (***)	0.001	0.6940
<b>Openness sub-index</b>	7.18195 (***)	0.000	0.6796
<b>Cultural sub- Index</b>	16.60179 (**)	0.013	0.6479

**Note:** (\*\*\*) and (\*\*) indicate statistical significance at 1% and 5% levels, respectively. Control variable included for every model is economic activity (GDP-volume). Dependent and control variables are in logarithmic form in real terms.

As expected, the estimation results show that the institutional environment affects the development of financial intermediation in a positive way. They also indicate that cultural characteristics (e.g. customs and habits) are more

important than any other institutional characteristic for decision-making in EU households with regard to owning a home and borrowing in order to buy the home. This result confirms the findings of Musso, Neri and Stracca (2011). Although the average income per capita is higher in the US than the eurozone, Musso, Neri and Stracca (2011) find that European households tend to hold more property (in particular, a primary residence) than US households and hence housing wealth (as a share of the GDP) is higher in the eurozone than in the US. In addition, our findings are consistent with those of previous studies that emphasise the role of the nation culture on the development of the financial sector and its sub-markets (Aggarwal and Goodell, 2010; Gaganis, Hasan and Pasiouras, 2020).

**Table 5 Institutional Quality V.S. Efficiency of Financial Intermediation**

	<b>Dependent variable: Net Interest Margin (%)</b>		
	<u>Coefficients</u>	<u>P value</u>	<u>R-squared</u>
<b>Institutional index (Overall index)</b>	-.3423321 (***)	0.001	0.5191
<b>Financial sub-index</b>	-.2566364 (**)	0.014	0.3836
<b>Legal sub- index</b>	-.3352324 (***)	0.006	0.5139
<b>Openness sub-index</b>	-.3267481 (***)	0.002	0.4006
<b>Cultural sub-index</b>	-.5106032 (*)	0.173	0.3165

**Notes:** (\*\*\*), (\*\*) and (\*) indicate statistical significance at 1%, 5% and 10% levels, respectively. Control variable included for every model is economic activity (GDP-volume). Dependent and control variables are in logarithmic form in real terms.

Among the institutional characteristics, the legal dimension follows the cultural dimension. This also confirms previous studies that have indicated the importance of legal traditions for financial development (Porta *et al.*, 1998; Schiehl and Martins, 2016). The openness dimension has the third highest effect on the development of mortgage markets. The test results show that increasing the degree of openness has an impact on the development of the mortgage markets by contributing to the increased availability of funds for the domestic markets; enabling cross-border activities; and creating a more competitive and dynamic financial environment. These findings also confirm those in the existing literature which have focused on the effect of financial liberalisation on the financial sector (Baltagi, Demetriades and Law, 2009; Auerbach and Siddiki, 2004). Based on the findings, one suggestion could be that policy makers, in pursuit of more developed mortgage markets, should consider prioritising the cultural, legal and openness characteristics of the institutional environment.



As a result, the results of the two different methods confirm the robustness of our results. In this case, we can argue that the indices produced may be used a benchmark for the quality of the institutional environment in the mortgage credit markets.

## 7. Discussion and Conclusion

The aim of this study is to measure the institutional characteristics of the mortgage credit markets across the EU-28 and create a benchmark for these markets. To achieve this goal, a factor analysis is carried out and an overall index, namely the Institutional Index, has been developed along with sub-indices. These indices address the quality of the institutional environment of the mortgage markets with regard to four different institutional dimensions (i.e. legal, openness, financial and cultural). A high index number indicates that the country has a mortgage credit market with high institutional quality as well as a more developed mortgage market.

The findings of the study show the difference between the northern and southern European countries as well as the central and eastern European countries. The northern European countries (e.g. Finland and Sweden) are at the top of the ranking in all of the indices while the southern European countries (e.g. Greece and Italy) and central and eastern European countries (e.g. Bulgaria and Slovakia) are below the EU average. In other words, the northern European countries have mortgage credit markets with a more efficient legal framework, easier access to financial services and credit information, are more liberalised, are less inhibited by customs, etc.

The findings prove our hypothesis and provide empirical evidence that the institutional environment in the EU mortgage markets is heterogeneous. They also show a further and expected result that financial intermediation in those countries with a high-quality institutional environment is more developed with respect to depth, accessibility and efficiency. As such, one suggestion is that the institutional environment, in addition to other factors, play a part in how these markets evolve and function in the economies.

In addition, we find that our results are consistent with those in previous studies that have constructed indices for mortgage markets (Wyman, 2003; London Economics, 2005) as well as highlight the effect that the institutional environment has on the financial sector (Porta *et al.*, 1998; Gaganis, Hasan and Pasiouras, 2020). Thus, our findings confirm the institutional theory, which suggests that institutions influence many dimensions of the economy by determining the rules of the game in an economy and thus affecting the allocation of resources.

Furthermore, it can be argued that the Institutional Index scores can be taken as an indicator of the extent that the EU mortgage markets are integrated. It appears that the EU mortgage markets have not fully integrated yet despite the attempts of the EC to harmonise them since the late 1980s. As such, these results also concur with those of previous studies on the integration of the EU mortgage markets (European Commission, 2007; Andi n, Maside Sanfiz and Penabad, 2010; Martins et al., 2015). In this case, another suggestion can be that increased convergence of institutional environments in addition to addressing other issues (e.g. language barriers, market entry costs) may contribute to greater harmonisation of the mortgage markets. If so, the convergence of mortgage markets can contribute to increasing the convergence of the EU housing markets by shaping the preferences of the economic agents.

There is implication for policies based on the study findings in that policy makers at both the country and EU levels are advised to pay much more attention to the institutional environment if they are to succeed in achieving more developed and better-functioning mortgage credit markets, as well as greater integration of these markets among the EU members.

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## Appendices

### Appendix 1 Data Description and Source

Index	Variable	Data Source
F_AVA	Availability of financial services	The Global Competitiveness Report (World Economic Forum)
F_AFF	Affordability of financial services	The Global Competitiveness Report (World Economic Forum)
F_LOC	Financing through local equity	The Global Competitiveness Report (World Economic Forum)
F_ACC	Ease of access to loans	The Global Competitiveness Report (World Economic Forum)
F_RIS	Venture capital availability	The Global Competitiveness Report (World Economic Forum)
F_BAN	Bank soundness	The Global Competitiveness Report (World Economic Forum)
F_SEC	Regulation of securities exchanges	The Global Competitiveness Report (World Economic Forum)
F_CRE	Getting credit-depth of credit information	Doing Business (World Bank)
F_MEV	Mortgage equity withdrawal	European Mortgage Federation (2016), European Central Bank (2009)
F_PRO	Availability of mortgage products	European Mortgage Federation (2016), European Central Bank (2009)
<b>Legal Drivers</b>		
L_PROP	Legal protection of financial stability	The Global Competitiveness Report (World Economic Forum)
L_IRR	Irregular payments and bribes	The Global Competitiveness Report (World Economic Forum)
L_JUD	Judicial impendence	The Global Competitiveness Report (World Economic Forum)
L_EFF	Efficiency of legal framework in settling disputes	The Global Competitiveness Report (World Economic Forum)
L_EFR	Efficiency of legal framework in challenging regulations	The Global Competitiveness Report (World Economic Forum)
L_INV	Protecting Investors	Doing Business (World Bank)
L_RIG	Getting Credit-Strength of legal rights	Doing Business (World Bank)
L_ENF	Enforcing Contracts	Doing Business (World Bank)
L_AUD	Strength of auditing and reporting standards	Doing Business (World Bank)
TRNS	Corruption perceptions index	Transparency International

(Continued...)



**(Appendix 1 Continued)**

<b>Openness Driver</b>		
O_INV	Investment freedom	Heritage Foundation
O_XT	Trading cross borders – time to export	Based on question “What makes up the time and cost to export to a trade partner?” (Domestic transport +border, compliance documentary compliance). Source: Doing Business (World Bank)
O_XC	Trading cross borders – cost of export	Based on question “What makes up the time and cost to export to a trade partner? (Domestic transport +border compliance + documentary compliance)” Source: Doing Business (World Bank)
O_MT	Trading cross borders - time to import	Based on question “What makes up the time and cost to import from a trade partner?” (Time of documentary compliance + border compliance (hours). Source: Doing Business (World Bank)
O_BUS	Starting a business – number of procedures	Based on question “What is the number of procedures to get a local limited liability company up and running?” Source: Doing Business (World Bank)
O_REA	Cost of real estate (%)	Based on question “What are the time, cost and number of procedures to comply with formalities to build a real estate?” Source: Doing Business (World Bank)
O_REC	Recovery rate of insolvency	The recovery rate is recorded as cents on the dollar recovered by secured creditors through judicial reorganization, liquidation or debt enforcement (foreclosure or receivership) proceedings. Source: Doing Business (World Bank)
O_BAR	Prevalence of trade barriers	The Global Competitiveness Report (World Economic Forum)
O_BUR	Burden of customs procedures	The Global Competitiveness Report (World Economic Forum)
TRNS	Corruption perceptions index	Transparency International
<b>Cultural Driver</b>		
C_IND	Indulgence (habits and customs)	Defined as <i>the extent to which people try to control their desires and impulses</i> , based on Hofstede, Hofstede and Minkov, (2010), <i>Cultures and Organizations: Software of the Mind</i> . Revised and Expanded 3rd Edition. McGraw-Hill ( <a href="https://geert-hofstede.com">https://geert-hofstede.com</a> )

*(Continued...)*

**(Appendix 1 Continued)**

<b>Variables for the development of mortgage markets</b>		
Depth	Outstanding Mortgage Loan/ GDP (%)	European Mortgage Federation (European Mortgage Federation)
Efficiency	Net Interest Margin (%)	The World Bank
Accessibility	Owner occupied with mortgage or home loan (% of population)	Eurostat

**Appendix 2 Descriptive Statistics**

<b>Code</b>	<b>Sample</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
F_AVA	28	4.576615	0.709302	3.465613	5.991829
F_AFF	28	5.025243	0.726435	3.7712	6.147955
F_LOC	28	3.476908	0.77571	2.1595	4.829143
F_ACC	28	2.810484	0.765401	1.56991	4.228075
F_RIS	28	2.796596	0.671729	1.704493	4.303874
F_BAN	28	4.711251	1.106071	2.29418	6.494812
F_SEC	28	4.562418	0.741453	3.374724	6.236159
F_CRE	28	18.28571	30.98159	0	100
F_MEV	28	0.5714286	0.5039526	0	1
F_PRO	28	1.50	16.75325	0	1
F_LTV	28	25.15714	5.1101	50	100
L_PROP	28	4.907486	0.895186	3.537991	6.378975
L_IRR	28	4.966587	0.965765	3.391719	6.646954
L_JUD	28	4.584506	1.278847	2.336054	6.593963
L_EFF	28	3.889834	1.174511	2.330196	6.072338
L_EFR	28	3.725773	1.087749	2.244997	5.861499
L_INV	28	6.785714	1.474654	3	9
L_RIG	28	5.75	2.397916	2	10
L_ENF	28	576.0357	297.3449	300	1580
L_AUD	28	69.82143	19.36406	30	90
L_TRAN	28	63.28571	15.41249	40	91
O_INV	28	80.53571	10.30456	55	95
O_XT	28	11.57143	4.003966	6	19
O_MT	28	10.64286	4.347961	5	19
O_BUS	28	32.35714	5.306979	21	43
O_REA	28	10.25	4.667659	3.5	22
O_REC	28	62.1	21.08023	30.5	90.2
O_BAR	28	4.695188	0.399077	3.751671	5.434608
O_BUR	28	4.770806	0.595002	3.345826	6.148005
O_XC	28	1042.143	273.883	600	1525
C_IND	28	44.39286	19.9617	13	78

*(Continued...)*

**(Appendix 2 Continued)**

**Notes:** F\_AVA: Availability of financial services, F\_AFF: Affordability of financial services, F\_LOC: Financing through local equity, F\_ACC: Ease of access to loans, F\_RIS: Venture capital availability, F\_BAN: Bank soundness, F\_SEC: Regulation of securities exchanges, F\_CRE: Getting credit- depth of credit information, F\_MEV: Mortgage equity withdrawal, F\_PRO: Availability of mortgage products, F\_LTV: loan to value, L\_PROP: Property rights, L\_BRI: Irregular payments and bribes, L\_JUD: Judicial independence, L\_EFF: Efficiency of legal framework in settling disputes, L\_EFR: Efficiency of legal framework in challenging regulations, L\_INV: Protecting Investors, L\_RIG: Getting Credit- Strength of legal rights, L\_ENF: Enforcing Contracts, L\_AUD: Strength of Auditing and reporting standards, L\_TRAN: Corruption perceptions index, O\_INV: Investment freedom, O\_XT: Trading cross borders – time to export, O\_XC: Trading cross borders – cost of export, O\_MT: Trading cross borders - time to import, O\_BUS: Starting a business – number of procedures, O\_REA: Cost of real estate, O\_REC: Recovery rate of insolvency, O\_BAR: Prevalence of trade barriers, O\_BUR: Burden of customs procedures, and C\_IND: Habits and customs.

**Appendix 3 Kaiser-Meyer-Olkin Test and Bartlett's Test of Sphericity**

<i>Bartlett's Test of Sphericity</i>	
Chi-square	= 1514.080
Degrees of freedom	= 351
p-value	= 0.000
H0	= 0.000
<i>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</i>	= 0.776

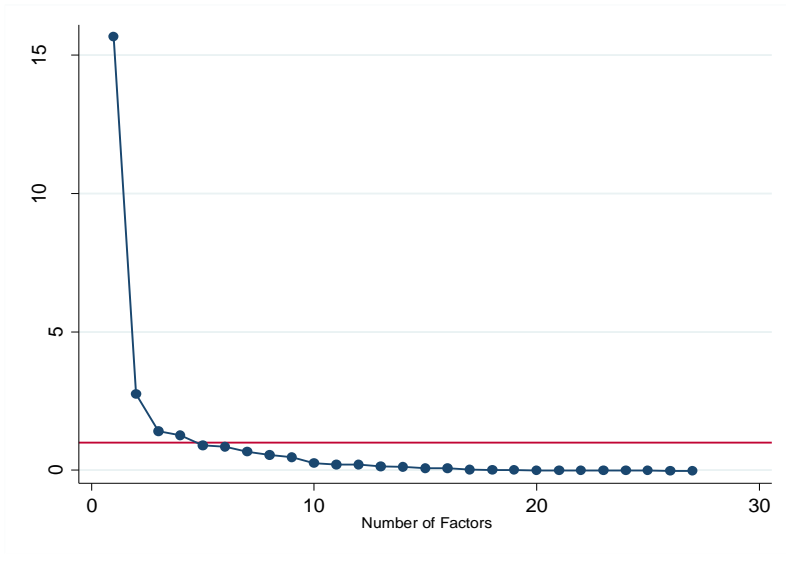
**Source:** Author's calculations.

**Appendix 4 Cronbach's Alpha Reliability Test**

Average interitem covariance:	.4900849
Number of items in the scale:	27
Scale reliability coefficient:	0.9667

**Source:** Author's calculations.

**Appendix 5 Scree Plot of Eigenvalues**



Source: Author’s calculations.

**Appendix 6 Eigenvalues and Variances of Principal Components**

Factor	Eigenvalue	Difference	Explained Variance (%)	Cumulative Variance (%)
Factor1	15.6487	12.89912	0.6122	0.6122
Factor2	27.4958	1.3358	0.1076	0.7198
Factor3	14.1377	0.15405	0.0553	0.7751
Factor4	12.5972	0.35847	0.0493	0.8244
Factor5	0.90125	0.04373	0.0353	0.8596
Factor6	0.85753	0.19322	0.0335	0.8932
Factor7	0.66431	0.10578	0.026	0.9192
Factor8	0.55853	0.08617	0.0219	0.941
Factor9	0.47237	0.22158	0.0185	0.9595
Factor10	0.25078	0.0372	0.0098	0.9693
:	:	:	:	:
:	:	:	:	:
Factor27	-0.02941	.	-0.0012	1

Notes: LR test: independent vs. saturated:  $\chi^2(351) = 1514.080$ ;  $\text{Prob} > \chi^2 = 0.0000$