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Master's Thesis:

TRADE UNIONS AND THE INFORMAL ECONOMY: A MEDIATION ANALYSIS

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Abstract:

The aim of the paper is to analyze whether the informal sector acts as a mediator between the labor unions, in particularly the bargaining system, and the formal economic activity. The motivation behind the research lies in the fact that the informal sector is estimated to employ around 2.5 billion people in the world, and trade unions are being encourage to capture these workers in order to help them achieve rights (International Labour Office, 2019). Moreover, there is a close link between the negative externalities arising from the trade unions activity and the determinants of the informal economy. The cross-country path analysis is carries out using Structural Equation Models. Two models are included, a static path analysis and a dynamic cross-lagged panel model. the sample includes 39 countries for the period 2001-2017. The main results are that the informal economy acts as a mediator for the formal one and the bargaining indicators have a stronger relationship with the informal sector than the formal one. The dynamic model is in line with the static one and the lagged effect of the variables of interest is small as the institutions are relatively stable over time.

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1. Introduction.

Trade unions have been studied for years given their close relationship with the macroeconomic outcome (Aidt & Tzannatos, 2002, 2008; Calmfors, 1993). They are also expected to have positive impacts in the economy if they are able to internalize the negative externalities they produce. Those externalities are a consumer price externality; unemployment; input price externality; and a fiscal externality, among others (Aidt & Tzannatos, 2002, 2008; Calmfors, 1993; Calmfors & Driffill, 1988; Driffill, 2006).

However, the empirical results from the relationship between the bargaining indicators and the macroeconomic performance are non-conclusive. The results are sometimes contradictory and mainly depend on the control variables and other modelling aspects such as the sample of countries or the type of dependent variable used (Aidt & Tzannatos, 2002, 2008; Calmfors, 1993).

Moreover, during the last decades, the unions movements have lost strength and members. This is possibly due to the fact that the informal sector has grown over the years and today employs around 2.5 billion people (International Labour Office, 2019). The recommendations of the International Labour Office are for trade unions to revitalize themselves by becoming the voices of the informal workers in order to help them secure their rights, nevertheless, this is not a simple and straightforward situation (International Labour Office, 2019).

Moreover, the informal sector determinants are closely related to the negative externalities of unions. For example, the tax burden and the unemployment are two important drivers of the informal sector (Medina & Schneider, 2018; 2019). This sector will foster those economic activities that aim to circumvent the government authorities and hence, its measurement comes with complications and limitations (Medina & Schneider, 2018; 2019). Furthermore, the informal sector is usually neglected when conducting research as the measures depend from others research and calculations. Hence, not having an

Given the close links between the trade unions activities (especially their externalities) and the informal sector, there could be an unexplored relationship between the informal economy and the trade unions. Moreover, the informal economy could be acting as a mediator to diffuse the

impact of the trade unions in the formal economic sector. Therefore, the research question of this paper is if the informal economy acts as a mediator for the labor unions, particularly the bargaining system, to the formal one.

To answer the research question, a mediation analysis is carried out with structural equations modelling, a common technique used in the social science, particularly in psychology and behavioral science. The mediation is modelled in two different ways, as a static model and also as a dynamic model.

The paper is structured as follows. chapter 2 provides the literature review divided between the labor unions and their impact in the macroeconomic performance of a country, and the informal sector. The chapter is concluded with the hypothesis derived from the review. Chapter 3 is dedicated to explain the methodology and the different models' as well as the data collection. It is followed by the empirical section which analyses the variables, explain some methodological concerns as well as the results for both, the static and the dynamic models. Finally, the paper will continue with a chapter dedicated to the conclusion and recommendations for further research.

2. Literature review

The following chapter consists in a review of the relevant literature for the aim of the thesis. Therefore, the sections are divided in labor unions and collective bargaining, starting with a theoretical review followed with an empirical one. Section 2.2 will consist in informal (or shadow) economy distributed in the same way. Both main sections are oriented and limited to the aim of the thesis. Finally, a summary and hypothesis of the research will close the chapter.

2.1 Labor unions and collective bargaining

The labor markets create frictions between the employers and employees (or demand and supply side) given the existing contracting asymmetries. These asymmetries are mainly in the bargaining power and information the parties have (Aidt & Tzannatos, 2002, 2008). Therefore, labor unions, acting as mediators, should reduce these asymmetries and help both parties find an equilibrium between their demands. Labor market institutions vary across time, countries and types of economies. Despite these differences, trade or labor unions are usually involved in collective bargaining to reduce the beforementioned asymmetries (Aidt & Tzannatos, 2002, 2008).

Their relation with the economic performance was of interest of many researchers throughout the years as the labor market affects different macroeconomic aspects. Therefore, the research in the area shows there will be positive outcomes produced by the labor institutions if the involved parties are able to internalized the produced externalities (Aidt & Tzannatos, 2002; Calmfors, 1993). There are different negative externalities that can arise from these agreements. For example, in the case where a collective agreement implies a higher wage for a given sector or industry, the wage increase has an impact in the general price level of a country which in turn affects the real wage of the workers that are not included in these agreements. Therefore, there is a **consumer price externality** (Aidt & Tzannatos, 2002, 2008; Calmfors, 1993; Calmfors & Driffill, 1988; Layard et al., 1991, 2005). In addition, an **unemployment externality** occurs due to the real wage rise in a given sector. In turn, with the real wage increase, the difficulties to get a new job also increase for those unemployed (Aidt & Tzannatos, 2002, 2008; Calmfors, 1993; Calmfors et al., 1988; Hoel, 1991; Jackman, 1990; Layard et al., 11991, 2005). Moreover, the wage increase in the sector could produce an **input price externality** when it increases the cost of material inputs for other firms. As a consequence, there will be lower output as well as lower employment for those cases that labor is complementary to the material inputs in terms of production (Aidt & Tzannatos, 2002,

2008; Calmfors, 1993; Soskice, 1990). Consequently, there is a **fiscal externality** that follows this situation: on the one hand, the lower output implies a lower tax base, and on the other hand, the rise in unemployment implies an increase in the unemployment's benefit costs for the government. The choices for the government in these situations are limited to an increase in taxes or a decrease in the government expenditures (Aidt & Tzannatos, 2002, 2008; Blanchard & Summers, 1986; Calmfors, 1993; Calmfors & Driffill, 1988). Other externalities arising from the centralized bargaining are related to the individual level: a worker can perceive someone else wage increase as a demotivator factor, decreasing their productivity. This is considered an **efficiency-wage externality** as the effort depends on the relative wage they perceive (Aidt & Tzannatos, 2002, 2008; Calmfors et al., 1988; Oswald, 1979) Moreover, there could also be an **envy externality** when the workers welfare depends negatively on other workers' wages (Aidt & Tzannatos, 2002, 2008; Calmfors, 1993; Calmfors et al., 1988; Layard et al., 1991, 2005).

According to the literature, if these externalities produced by the collective bargaining are internalized by the parties, the bargaining process is convenient for the economic outcomes: the externalities pressure the demand for a higher wage, and thus, produce higher employment. Hence, these reflects the negative monotonic relationship that arise between the aggregate wage of the economy and employment with the level of centralization (Calmfors, 1993) which is known as the corporativist theory (Aidt & Tzannatos, 2002, 2008). Therefore, the collective bargaining while facing the trade-offs mentioned above, synchronize the pay requirements with the macroeconomic ones (Traxler & Brandl, 2011).

However, the capacity the bargaining institutions have to internalize the externalities differs according to their level of centralization (Traxler & Brandl, 2011). The Calmfors-Driffil hypothesis (1988) suggest a hump-shaped relationship between the level of bargaining centralization and the aggregate real wage as at high and low levels of bargaining centralization are likely to produce high employment as they foster real wage moderation. The static model is based in game theory as the final economic outcome is modeled as a Nash equilibrium between the wage setters (Calmfors & Driffill, 1988; Driffill, 2006). They specified a simple static closed economy model where all the workers are unionized. The key assumptions behind the result has to do with the elasticity of the demands faced by industries: the higher the aggregation level, the less substitutes goods are between each other, the more inelastic the demand became for the

industry, and less elastic the good demand at the aggregate level of the economy. Also, the more centralized the union, the more power they have to demand wage raise, which in turn raises the prices of some goods of the economy. Therefore, the union faces the consumer price externality which acts as a constraint for demanding a raise in the wages. Consequently, the non-monotonic relationship between the level of bargaining centralization and real wages and employment, depends on the elasticity of demand, performing poorly in those countries where the centralization of bargaining occurs in the industry level. (Aidt & Tzannatos, 2002, 2008; Calmfors, 1993; Calmfors et al., 1988; Driffill, 2006; Hoel, 1989).

2.1.1 Empirical literature: macroeconomic performance and collective bargaining

When considering the bargaining system in regards of macroeconomic performance, the literature focuses on different indicators in an attempt to measure social welfare (Aidt & Tzannatos, 2008). Three different streams can be considered here: first, the macroeconomic indicators such as GDP, wage dispersion, employment, unemployment or inflation rate. Second, performance indexes such as the Okun index, which considers inflation as well as unemployment, or the open economy index which considers unemployment together with the current account deficit of GDP. Finally, others have focused in the labor market flexibility using the wage flexibility and search effectiveness for instance (Aidt & Tzannatos, 2008).

Collective bargaining is complex to measure, therefore the empirical research in the area has focused mainly in 3 different measures of the system: (i) **union density**, which express the percentage of unionized workers in terms of the total employment; (ii) **bargaining coverage**, which is the ratio between the amount of workers that, regardless of being unionized or not, their payment and employment conditions are determined by a collective agreement, with regards to the total employment. This means that the measure captures the relative importance of collective agreements against individual contracts, (Aidt & Tzannatos, 2002, 2008; Traxler & Brandl, 2011). Finally, the (iii) **bargaining coordination** has been measured using different indicators for the system which mainly focus in the union centralization and concentration, the employer centralization, level of bargaining, the informal coordination, corporativism as well as other aspects which can be seen in table 2.1.

Table 2.1 Bargaining coordination aspects

Aspect	Description
Union centralization	The capacity of the national union confederation to influence wage levels/patterns across the economy.
Union concentration	Union concentration is high if 'few' unions at the relevant level of bargaining are representing workers.
Employer centralization	The capacity of the national employers' confederation to influence wage levels/patterns across the economy.
Level of Bargaining	Collective bargaining takes place at different levels: the firm level, the industry level and the regional/national level.
Informal coordination	1. Informal consultations at the industry, regional or national level among unions and firms. 2. Pattern bargaining (an agreement in a dominant sector is mimicked by other sectors)
Corporativism	A combination of 1. High union density and bargaining coverage and a high degree of union and employer centralization/concentration and 2. Social partnership between national workers' and employers' organizations and the government.
Other aspects	This includes different types of dispute resolution procedures, the proportion of unionized workers employed in sectors that are subject to international competition, and union density.

Source: Aidt & Tzannatos (2002, 2008)

Theoretically, union density can be considered as a measure of power of the unions as it measures the power they have to go in strikes. Hence, the economic impact is expected to be negative. However, the negative effect is reduced when the unions take part significantly in productivity-enhancing activities (acting as mediators between the employers and employees)(Aidt & Tzannatos, 2002). Empirical research come across mixed results regarding the relationship between macroeconomic variables and the union density. For example, some found no effect between the union density and the unemployment rate (Freeman, 1988; OECD, 1997). On the contrary, others, found evidence that there is a direct effect, increasing the unemployment (Layard et al., 1991, 2005). Furthermore, union density seems to have no or little impact regarding the macroeconomic performance indicators when controlled for the bargaining coverage (Aidt & Tzannatos, 2002; Justino, 2006). However, this only holds for developed economies as, when considering developing countries, the association between union density and economic performance is negative (Aidt & Tzannatos, 2002; Justino, 2006) The reason behind the difference in the relationship according to the type of economy is not due to the union itself but the political and economic environment they are set in, for example, highly regulated markets (Rama, 1997).

When considering the impacts of the bargaining coverage, and once union density and bargaining coordination is controlled for, countries with higher coverage are found to have higher unemployment as well as inflation rates and lower employment that those countries with low bargaining coverage (Aidt & Tzannatos, 2002; Traxler, 2003; Traxler & Brandl, 2011; Traxler & Kittel, 2000) The implications behind the results of coverage having negative correlation with the economic performance is that the extension of the collective agreements to those workers that are not unionize does not generate the right environment for productivity-enhancing factors (Aidt & Tzannatos, 2008; Freeman & Medoff, 1984). However, the result should not be considered as a harmful activity for the economy as it could be signaling that unions can be consider productive when they are able to develop, and given that the union density and economic performance does not have a strong negative correlation (Aidt & Tzannatos, 2008). This means that, although there is a high level of bargaining coverage, if there is coordination in the different levels (ranging from firm to cross-industry), the negative effects can be offset (Aidt & Tzannatos, 2008).

As beforementioned, the bargaining coordination is difficult to measure and different studies focus on different parameters of it. According to Aidt & Tzannatos (2002, 2008), although bargaining coordination is associated with lower unemployment, there is little evidence that it is associated with higher levels of employment which questions the previous mentioned results. Also, the authors (2002, 2008) highlight that the more sophisticated the techniques used and better controls for country-specific effects are introduced, the relationship with the bargaining coordination and the economic performance becomes weaker.

In regards to the hump hypothesis, although the non-monotonic relationship is found in different empirical papers (as reported by Driffill, 2006: Bleaney, 1996; Elmeskov et al., 1998; Scarpetta, 1996; Zetterberg, 1995), when the assumptions of the original model are relaxed, the non-monotonic relationship tends to disappear. For example, there is evidence that shows that this happens when considering open economies with intense competitive levels of bargaining, diminishing the chances of forming a bargaining cartel, hence, power. (Aidt & Tzannatos, 2008; Danthine and Hunt, 1994; Rama, 1994). Moreover, the non-monotonic relationship disappears when considering the informal channels of coordination at the industry level such as in the case of Switzerland and Japan (Aidt & Tzannatos, 2002, 2008; Calmfors, 1993; Calmfors et al., 1988;

Hoel, 1989). The hump hypothesis is confirmed in those cases that the dependent variable is either unemployment or productivity (Aidt & Tzannatos, 2008).

Aidt & Tzannatos (2002, 2008) highlight the importance of analyzing the different indicators of the labor market institutions together as when doing so, the negative effect that inion density and bargaining coverage have for the unemployment rate is counteracted when there is bargaining coordination.

Therefore, the bargaining coordination relationship with the economic performance is subject to the model, the assumptions behind it (as if to consider informal coordination or not), and the control variables used in every case.

Some rigidities may arise from the labor market. The most common measures used as dependent variables are based in wages and unemployment. Such measures are (i) wage flexibility; (ii) adjustment speed to wage shocks; (iii) unemployment persistence (also known as hysteresis); and (iv) search effectiveness of unemployed workers (Aidt & Tzannatos, 2002, 2008). The evidence suggests that where there are high levels of bargaining coordination, the real wage adapts more quickly to shocks and employment conditions (Aidt & Tzannatos, 2002, 2008; Layard et al., 1991, 2005). Hence, the coordination eases the shocks adjustments at lower employment costs (Aidt & Tzannatos, 2002, 2008). Moreover, although the macroeconomic shocks are capable to explain the time-series unemployment patterns, they fail to explain the cross-country differences, which in turn, can be explained by the labor institutions (Blanchard & Wolfers, 2000). Blanchard & Wolfers (2000) also found evidence that although bargaining coordination reduce macroeconomic shocks, the unionization raises it.

Regarding hysteresis, the evidence suggests that the employee coordination has a negative association with it while the employer coordination would reduce it (Layard et al., 1991, 2005). Furthermore, there is evidence that the employee effect is bigger than the employer one, and that the hysteresis persist longer in those countries that have a semi-coordinated bargaining system (Scarpetta, 1996).

Finally, the levels of union membership and bargaining coverage have decrease in the last decades (Aidt & Tzannatos, 2002, 2008; Calmfors, 1993; Calmfors et al., 1988; Hoel, 1989). Part of these downturn is due to the fact that the workers are shifting to the informal sector, and a way to renew

the unions movement is to turn to the informal sector, capturing these informal workers (International Labour Office, 2019).

2.2 The informal sector

The informal sector estimated to employ 2.5 billion workers in the world, and the tendency is expected to grow in the developing countries (International Labour Office, 2019). These workers are usually the most vulnerable from the population and their rights are not being assured as they do not have the benefits of being represented by unions. (International Labour Office, 2019).

The informal, shadow, parallel or underground economy[1] is hard to define and therefore, to measure as it consists in activities that happens out of the government radar, including tax evasion and avoidance as well as illegal activities (Medina & Schneider, 2018, 2019; Schneider, 2008). The informal sector is therefore composed by legal and illegal activities. Both can be categorized as monetary and non-monetary transactions, and in the case of the legal activities there is a subdivision regarding the driver for taking the activity underground: either tax avoidance or tax evasion (Medina & Schneider, 2018; Schneider & Enste, 2000; Schneider & Williams, 2013). Table 2.2 describes the type of activities that could take place in every possible combination of categories. When considering the literature, the usual methodology is to consider both, monetary and non-monetary legal transactions avoiding those household economic activities (Medina & Schneider, 2018; Schneider & Enste, 2000; Schneider & Williams, 2013). Consequently, the size of the shadow economy is always affected by the definition that is used.

Table 2.2 Taxonomy of the types of informal activities

Type of activity	**Monetary transactions**		**Non-monetary transactions**	
Illegal activities	Trade in stolen goods; drug dealing and manufacturing; prostitution; gambling; smuggling; fraud; human trafficking, drug trafficking and weapon trafficking		Barter of drugs, stolen goods, smuggling, etc.; producing or growing drugs for own use; theft.	
Legal activities	Tax evasion	Tax avoidance	Tax evasion	Tax avoidance
	Unreported income from self-employment; wages, salaries and assets from unreported work related to legal services and goods	Employee discounts; fringe benefits	Barter of legal services and good	All do-it yourself work and neighbor help

Source: Schneider & Williams (2013)

[1] Note that these terms are use as synonyms throughout the paper.

The causes of the shadow economy are widely investigated in the literature. One of the most significant causes are the **tax and social security contribution burdens**. This is due to the fact that taxes create a labor–leisure trade off, stimulating the informal sector labor supply (Arsić et al., 2015; Medina & Schneider, 2018; Schneider, 2004). The bigger the gap between the income before and after taxes (mainly driven by the social security contributions), the greater the incentive to switch to the informal sector (Schneider, 2004). The relationship between the informal sector and the taxation burden is found statistically significant in several papers as reported by Medina & Schneider (2018, 2019).

Another driver of the informal sector is the **intensity of the regulations** as the more the regulations and laws in an economy, the lower the freedom of choice an individual has in the formal economy, hence, the higher the incentives to go underground. For instance, labor market regulations increase the labor costs, which in turn, are shifted to employees. The higher the possibility to shift cost to employees in the form of lower wages, the higher the incentive to work in the informal sector in order to avoid these costs (Medina & Schneider, 2018, 2019; Schneider, 2004; Schneider & Williams, 2013)

The quality of institutions and or the corruption is another driver of the informal sector. While high corrupted government officials are associated with bigger informal sectors, a good rule of law that ensures property rights incentivizes the formal activity. (Medina & Schneider, 2018, 2019; Schneider, 2004; Schneider & Williams, 2013)

A fourth driver of the informal economy is the **public sector service provision.** They are closely related to the informal sector as the increase in the informal sectors' activity reduces the tax revenue perceived by the government which in turn is used to provide the services. Consequently, the government can opt to raise taxes in order to be able to provide the services which, in turn, incentivizes the population to shift their activity to the informal sector. The final outcome is a deterioration of the public goods quality which makes the incentives to shift even stronger. (Medina & Schneider, 2018, 2019; Schneider, 2004; Schneider & Enste, 2000).

When the government provision of public goods is considered inefficient by the tax payer, their **tax morale** is affected. This is a psychological driver, when the citizens feel that their taxes are not reflected in the public goods they receive in exchange, their tax compliance decreases. However, if the taxpayers perceive a fair treatment in behalf of the tax agencies, they would not

be incentivized to shift to the informal sector as the tax morale is increased (Medina & Schneider, 2018, 2019; Schneider, 2004).

The official economy development is a driver of the informal sector as people may be incentivized to shift to the informal sector by the unemployment rate. The higher the unemployment, the higher the incentives to be in the informal sector. (Medina & Schneider, 2018, 2019; Schneider, 2004)

Other drivers that affect the informal economy are: the **self-employment rate**, as the higher it is, the amount of activities that can be performed in the informal sector increases (Medina & Schneider, 2018, 2019; Schneider, 2004). The **unemployment rate**, as while it increases, also does the probability of working in the informal economy (Medina & Schneider, 2018, 2019; Schneider, 2004). Finally, the **size of the agricultural sector** is said to be another driver as the larger the sector, the more possibilities one has to work in the shadows (Medina & Schneider, 2019)

2.2.1 Empirics for the informal sector

The difficulties encounter when trying to measure the informal sector are several given the nature of the activities. And, although authors try to avoid measuring illegal transactions in their definition, the macroeconomic approaches consider part of these transactions in their estimations (2013). Currently, there are approaches to measure the informal sector. As specified by Medina and Schneider (2019) the approaches can be divided between direct and indirect, where the latter includes the model-based approach.

The direct approach consists in using surveys which can lead to underestimation of the shadow economy as they are self-reported by those who are choosing to perform the activity in the shadows (Schneider & Williams, 2013).

The indirect approach considers macroeconomic indicators. As explained by Schneider & Media (2019), the category can be divided in:

1. **National expenditure and income statistic discrepancies:** this methodology considers that those having an illegal activity are able to hide the source of income but not the expenditure paid by it. Therefore, this approach considers that (i) there is no error in the expenditure measurement (Medina & Schneider, 2019); (ii) that the informally obtained

income is going to be spent and in the country, hence there will be no outflows of money to fiscal paradise.

2. **Discrepancies between the actual and official labor force:** the assumptions behind this method is that the labor force participation is constant and consequently, a decline in the participation can be consider a shift from the formal to informal employment. This is considering a weak indicator as there are many other reasons that can explain the decrease in the labor force participation such as business cycles (Medina & Schneider, 2019).
3. **Electricity approach:** this methodology considers that the best indicator of all the economic activity is the use of electricity given that the electricity- overall GDP elasticity is close to 1. Therefore, the difference between the electricity consumption and the formal economic growth can be used to proxy the informal economy. Some weaknesses about the approach is that the electricity- overall GDP elasticity is not constant over time and regions, and hence there could be significant variations. Also, the method could be underestimating the informal economy as not all the activities are electricity intensive or they could also depend on other sources of energy (Medina & Schneider, 2019).
4. **Transaction approach:** the approach uses Fishers's quantity equation adapted to the informal sector under the assumption that the relationship between the transaction in the total value added and the money flows is constant. Therefore, the methodology derives Money*Velocity= k *(official GDP + informal economy). Being the only unknown variable in the beforementioned equation the informal economy, as the velocity can be estimated and the other two variables are known. However, the approach has some weaknesses as for example, the assumption that k is constant over the years; or that the velocity could be affected by the evolution of the transaction system as well as credit cards, hence, the use of a benchmark year could be problematic (Medina & Schneider, 2019) .
5. **The currency demand approach:** the assumption behind the approach is that transactions in the informal economy are made in cash in order to circumvent the government without leaving trace. Therefore, an increase in the currency demand can be interpreted as an increase in the shadow economy (Medina & Schneider, 2019). Tanzi (1980, 1983) estimates the shadow economy using cash to M2 monetary aggregate as dependent variable, using several control variables such as tax burden, interest rates and the income evolution. The differential between the cash demand and the model will be produced by the informal

economy (Medina & Schneider, 2019). The approach allows calculate the share of the informal sector in the total GNP by using the demand of the informal economy cash. However, the assumptions behind the model is that the velocity of money is equal for both sectors (Dybka et al., 2017; Medina & Schneider, 2019). Another questionable assumption of the model is that the base year has no informal sector activity (Medina & Schneider, 2019). Moreover, other weaknesses of the approach are that the model is not considering transaction that are not monetary in the informal sector, which leads in an underestimation of the sector (Medina & Schneider, 2018), and neither the electronic payment systems' development (Dybka et al., 2017) .

6. **Multiple indicators, multiple causes approach:** the method use several observed causes and observed indicators to estimate the unobserved variable (Acock, 2015; Buehn & Schneider, 2008; Dybka et al., 2017; Medina & Schneider, 2018, 2019; Schneider, 2004; Schneider & Williams, 2013), the informal economy. The method uses the structural equation modelling to calculate the value of the latent variable, mainly used in social science research. It is dependent on strong theory models to describe the paths the variables will take (Acock, 2015; Buehn & Schneider, 2008; Dybka et al., 2017; Medina & Schneider, 2019; Schneider, 2004; Schneider & Williams, 2013). This is basically an equations system where the latent variable will be determined according to the causes and the theoretically derived interaction of the unobserved variable with the variables it affects. The disadvantages of this model are that one can overestimate the size of the informal economy as the common factor used includes tax burden and unemployment which in turn rises the demand for household self-employment (Medina & Schneider, 2018); it is econometrically complex and depends on ad hoc restriction that are informally introduce in the model (Dybka et al., 2017)

The last two approaches are the most commonly used. Dybka and colleagues (2017) proposed a hybrid model between these two methods, addressing the different critiques the models have. The novel method incorporates neglected variables in the case of the currency demand approach. Later, the means and variables of the improved current demand approach are used as anchoring values for the multiple causes and indicators method (instead of using arbitrary measures), also they restrict the model to have negative variances in the structural errors. This novel approach gives a more accurate estimation of the informal sector.

To conclude, the informal sector, fulfilling its purpose, is hard to measure. Moreover, depends on many variables linked to government desertions, which will decide how many vulnerable people is employed in the sector. These people will lack their working rights and reasonable wages. The informal work force is estimated to be higher than half of the working age population in the coming years, specially driven by developing countries as they informal sectors grows over time (International Labour Office, 2019).

2.3 Summary and hypothesis.

From the previous sectors we learned that the unions need to internalize the externalities they produce in order to have a positive impact in the economic performance. These externalities are closely related to the determinants of the informal economy. Therefore, if the unions are not able to internalize those externalities, there should be an impact in the informal economy, which by definition is not measured officially, and hence, not considered in the previous analysis. Moreover, the union membership and coverage decreased over time while the informal sector workers grow every year. The research question therefore is if the informal economy acts as a mediator between the formal economy and the bargaining system.

From the previous section, we learned that empirically there are different approaches to measure both, the unions impact and the informal sector. More explicitly, when measuring the impact of the labor institutions, there are mixed results that depend mainly on how the model is design. Given the relationship between the labor market institutions and unemployment, and given that unemployment is a key determinant of the informal sector, the hypothesis are as follows:

1. The informal sector affects positively the formal one as part of the activity that happens underground goes back into the formal system. This allows the informal sector to act as a mediator for the formal one.

2. Union density, when controlled for bargaining coverage and centralization, has no relationship in the informal sector. This is due to the fact that there is no or little evidence of the variable impacting the unemployment rate[2].

[2] Union density has a positive impact in terms of income equality (for a discussion in the topic see (Aidt & Tzannatos, 2002, 2008)

3. The bargaining coverage will have a positive relationship with the informal economy as it is found to have a negative association with the unemployment rate.

4. There is a monotonic negative relationship between the bargaining centralization and the informal economy following the theory of the non-monotonic relationship between the bargaining centralization and unemployment.

3. Methodology and data

In this chapter, I discuss the data and research methods employed in this thesis. First of all, I discuss the methodological approach which mainly consist in the quantitative analysis using Structural Equation Models with panel data to study if the informal sector acts as a mediator between the labor market and the economic growth of a country. Two different types of models will be carried out to perform the mediation (or path) analysis. The first model is a contemporaneous or static one. The second one is a cross-lagged panel model which, in contrast to the previous one is a dynamic model. Variables will include lags of themselves to analyze the behavior of the labor market institutions across time. Later, I will delve into the data selection and determination of the units (countries) and time horizon. Finally, I will conclude with an exploration of the data and the empirical considerations to have with the sample.

3.1 Methodological approach: Structural Equation Modelling

To analyze if the informal sector acts as an intermediary or mediator between the labor market institutions and the economic growth a country experiences, path (or mediation) analysis using Structural Equations Modelling (SEM) is performed. The mediation analysis is a common technique used mainly in social sciences as it allows the study of unobserved mechanisms between the variables (Iacobucci, 2011; Preacher, 2015; Selig & Preacher, 2009).

SEM allows the researcher to estimate the paths or effects between different variables working with the covariance matrix (Tarka, 2018). The observed covariance matrix is used to estimate the coefficients by fitting the implied covariance structure modelled (Olsson et al., 2000). Hence, as described by Kaplan (2012), the function F $(S, \hat{\Sigma})$ where S denotes the data/observed covariance matrix; $\hat{\Sigma} = \Sigma\hat{\Omega}$; and $\hat{\Omega}$ denotes the fitted covariance matrix, is minimized, minimizing the discrepancy between the implied and observed (S) covariance matrix, testing the hypothesis that the implied covariance matrix by the model is equal to the observed covariance matrix from the measured variables (Flora & Curra, 2004, Kaplan, 2012). The proprieties behind the discrepancy function F $\left(S, \hat{\Sigma}\right)$ are: it is a positive real number; it is zero only in the case of perfect reproduction of the sample matrix; and is a continuous function (Kaplan, 2012).

The Structural Equations Model parameters can be estimated using different methods such as Maximum Likelihood (ML) and Generalized Least Squares or Weighted Least Squares, among other techniques (Iacobucci, 2011; Kaplan, 2012; Olsson et al., 2000; Tarka, 2018). The selection

of the technique will depend on the data characteristics and how well they meet the assumptions behind each technique. ML is the most common technique and one of the most important assumption behind it is that the data has a continuous normal distribution. (Deng et al., 2018; Hoyle, 2012; Tarka, 2018). This is the biggest criticism against the ML as it is hard to comply with. Moreover, when the data does not provide a normal distribution but a quasi-normal approximation can be achieved, then the use of ML is valid under robust estimations. (Deng et al., 2018; Hoyle, 2012; Tarka, 2018). Otherwise, the Weighted Least Squares is a good alternative for non-normally distributed data. In this case, the weighted matrix is the inverse of the population covariance matrix, addressing heteroskedasticity problems (as otherwise, the weighted matrix could be the identity matrix which assumes homoscedasticity) (Kaplan, 2012).

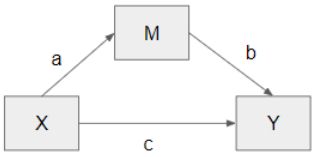
other important statistical assumptions behind the Structural Equations Modelling are: (i) the data is complete, which usually is not the case as there are missing values; (ii) that the model is well specified and therefore, there is no omitted variables; (iii) the exogenous variables can take any value (also called variation free), which lead to having weak exogenous variables in the model (Kaplan, 2012)

Another important assumption behind the Structural Equation Modelling is that there is no multicollinearity between the variables. If so, the estimations are not accurate, having large standard errors and possibly making the coefficients unstable under minimum changes in the model (Can et al., 2015; Grewal et al., 2004; Tarka, 2018).

3.1.1 Path Analysis: the contemporaneous model

Path analysis (also referred as mediation analysis) allows to study if an independent variable is affecting the dependent variable through a direct relationship (as OLS regressions do) and also, allows to examine whether there could be an indirect one between the dependent and independent variable that is made possible by the mediator variable (Iacobucci, 2011). The case where the independent variable affects the dependent variable directly and indirectly through the mediator is the simplest case as seen in figure 3.1, where path *c* represents the direct impact of the independent variable on the dependent one, path *b* is the impact from the mediator to the dependent variable and path a is the effect between the dependent variable and the mediator variable (Baron & Kenny, 1986).

Figure 3.1 Simple trivariate mediation system



Source: own elaboration using Baron & Kenny (1986)

The equations underlying the relationships shown in figure 3.1 are as follows (Iacobucci, 2011:

(3.1) $M = \beta_1 + aX + \mathcal{E}_1$

(3.2) $Y = \beta_2 + cX + \mathcal{E}_2$

(3.3) $Y = \beta_3 + c'X + bM + \mathcal{E}_3$

Where M is the mediator variable, Y the outcome variable, and X the independent variable. The β are the intercepts while the ε are the disturbance terms of the endogenous variables.

There is evidence for mediation if (i) there is significant evidence of a linear relationship between the mediator (M) and the independent variable (X), measured by *a* in equation (3.1); (ii) if there is a significant linear relationship between the independent variable and the dependent variable (Y), measure by *c* in equation (3.2); and (iii) if there is a significant relationship between the mediator and the dependent variable, measure by *b* in equation (3.3) and being *c'* significantly smaller than *c* from equation (3.2) Iacobucci, 2011.

The indirect path between X and Y mediated by M is the product of the direct path between X and M times the direct effect of M on Y (Acock, 2015).

When adapting the simple case to the thesis aim, the equations are as follows:

(3.4) $SE_{it} = \beta_1 + aLMI_{it} + eW_{it} + \mathcal{E}_1$

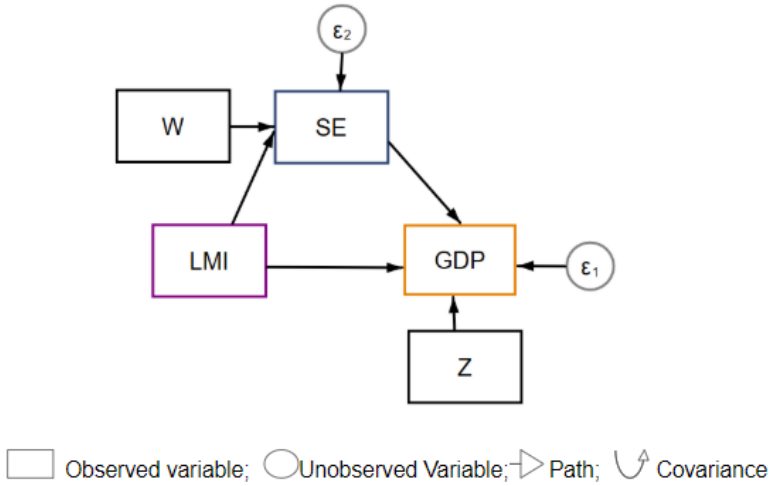
(3.5) $GDPG_{it} = \beta_2 + cLMI_{it} + dZ_{it} + \mathcal{E}_2$

(3.6) $GDPG_{it} = \beta_3 + c'LMI_{it} + bSE_{it} + dZ_{it} + \mathcal{E}_3$

Where SE is shadow or informal economy, LMI are the different labor market indicators taken into account and tested separately (the indicators will be further detailed in the variables section),

GDPG is the GDP annual growth rate, W and Z are the control variables. Control variables are included in order to avoid having a misspecification problem. As visible from the equations system, the control variables are considered as exogenous in the model as well as the labor market indicator. On the contrary, the GDP growth and the informal sector are modelled as endogenous variables, both have the disturbance term ε. The graphical representation can be seen in Figure 3.2

Figure 3.2 The contemporaneous model



Source: own elaboration.

3.1.2 Path Analysis: the lagged model

In order to allow the analysis to consider the labor market and employment time rigidities, another mediation analysis will be carried out using a cross-lagged panel model. This is a special case of the mediation analysis described above that acknowledges the time lag the variables experience when affecting one another. Hence, this is a dynamic approach intended to address those critiques about the labor market institutions being dynamic over time and the inability of the static models to capture this. The equations behind the model are as follows:

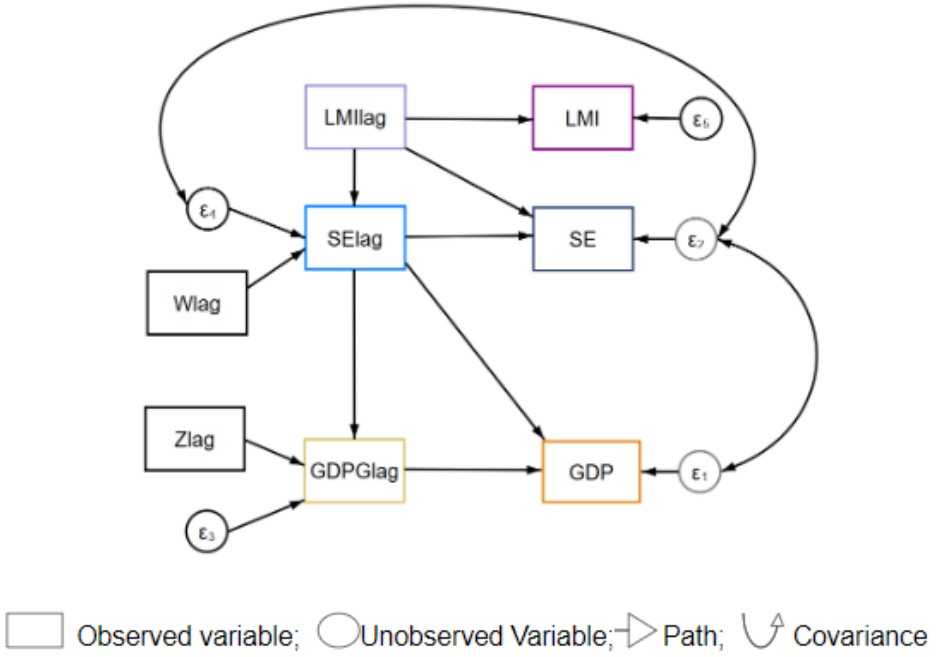
(3.7) $LMI_{it} = \beta_{LMI,t-1} * LMI_{i,t-1} + \mathcal{E}_{LMI,it}$

(3.8) $SE_{it} = \beta_{LMI,t-1} * LMI_{i,t-1} + \beta_{SE,t-1} * SE_{i,t-1} + \beta_{W,t}W + \mathcal{E}_{SE,it}$

(3.9) $GDPG_{it} = \beta_{GDPG,t-1} * GDPG_{it-1} + \beta_{LMI,t-2} * LMI_{i,t-2} + \beta_{SE,t-1} * SE_{i,t-1} + \beta_{SE,t} * SE_{i,t} + \beta_{Z,t}Z + \mathcal{E}_{GDPG,it} + cov(\mathcal{E}_{SE,it} * \mathcal{E}_{GDPG,it}) + cov(\mathcal{E}_{SE,it} * \mathcal{E}_{SE,it-1})$

The graphical description of the lagged model can be seen in Figure 3.3. The curved arrows between the error terms represent the correlation between the residuals of the variables, by this means, one acknowledges that the variance of the variables is not fully determined by the antecedent variable (Acock, 2015). Moreover, this is also a strategy to deal with collinearity (Kaplan, 2012).

Figure 3.3 The lagged model



Source: own elaboration.

Where SE is the informal sector GDPG is the GDP growth, LMI are the labor market indicator and Z and W the control variables and epsilon the error terms.

3.2 Variables

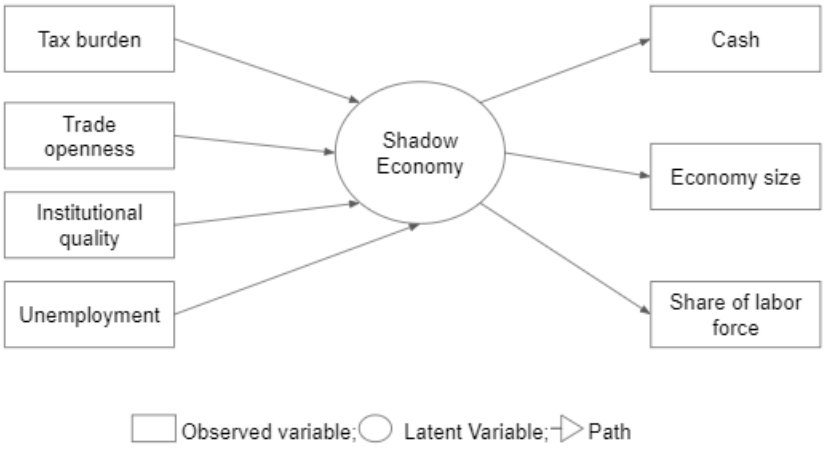
The **independent variables** are divided in three groups: (i) the labor market indicators; (ii) the informal economy; and (iii) the control variables.

The **labor market indicators** are (i) **the trade union density rate (UD),** calculated as the net union membership over employed wage and salary earners; (ii) **the adjusted bargaining coverage rate (BC),** measure as percentage of employees covered by valid collective bargaining agreements over all wage and salary earners with the right to bargaining, adjusted for the sectors

who are excluded from the right , expressed as percentage; (iii) the **bargaining centralization (Bargcent)** which is a constructed measure that ranks from 1 to 5 and it includes the level at which the bargaining process takes place (ranging from the firm level to cross-industry level), together with the incidence of an extra company bargaining considering whether or not it is under control, and also consider to which extent the agreements can be perforated using 'opening clauses'. Hence, the measure capture some of the aspects of the bargaining coordination mentioned in table 2.1. These three measures come from the ICTWSS database (Visser, 2019) and are based on the literature review in chapter 2.

The **Informal Economy (SE)** data comes from Medina & Schneider (2019) and the variable is the rate of informal or shadow economy over the real GDP growth of a country. Following the definition of the authors (2019), from now onwards, informal economy is defined as monetary and non-monetary legal activities that would otherwise be taxed if done in the formal economy (see table 2.2). Hence, informal do-it yourself activities are not considered in the analysis. Given the nature of the informal economy, it cannot be measured officially. In an attempt to measure the legal activities that go underground, that otherwise would be contributing to the GDP of a nation (Medina & Schneider, 2019), the authors obtain the value of the latent variable using the Multiple Causes Multiple Indicators approach with structural equations modelling. By this means, they use a set of economic variables as causes such as: (i) tax burden on the economy (including social contributions), (ii) the quality of institution (including political instability), (iii) trade openness, (iv) unemployment; and a set of indicators or effects as (i) use of cash, (ii) share of labor force and (iii) a measure of the size of economy (Medina & Schneider, 2019). The aim of the authors is to measure the legal activities that go underground, that otherwise would be contributing to the GDP of a nation (Medina & Schneider, 2019). The graph shown in Figure 3.4 summarize the construction of the variable and can be read as the previous figures: the variables inside a box are observe variable, in the left hand there are the causes, modelled as exogenous, and on the right hand, the indicators ae modelled as endogenous (with error terms). The shadow economy lies in a circle as it is the latent variable. The arrows symbolize the effect paths.

Figure 3.4 Variables for the estimation of the Shadow Economy



Source: own elaboration using Medina & Schneider (2019)

A second source of informal economy will be used to test whether the results are consistent when changing the methodology behind the informal economy calculations. To do so, the informal economy calculated using the currency-demand approach will be used from Tan et al. (2017)

The **dependent variable** is **GDP growth rate** (in percentage terms) **(GDPG)** as seen in equation (3.10). As economic growth can be modelled as dependent of different variables, the extent to which one set of variables determines the economic growth of a country is dependent on the countries state of development (Durlauf, 2001)

The **control variables for the informal economy[3] (W** in equation 3.4-3.10) includes (i) the government final expenditure as percentage of GDP as a proxy for the tax burden which is one of the decisive determinants of the informal sector as described in chapter 2. The higher the government consumption, the higher the tax revenue needed. If the tax system is not efficient enough, the tax burden will increase. Furthermore, an expenditure fiscal policy is expected to stimulate both the formal and informal sector (Medina & Schneider, 2019); (ii) The net trade balance, as the original measure considers the trade openness, the trade net balance will have a negative relationship with the informal sector as it implies less regulations in the sense of trade barriers, and more development in terms of general economic growth. Another variable is (iii) the

[3] The variables are based on the information provided by Medina & Schneider (2018, 2019) and discussed in the chapter2.

unemployment rate, the higher it is, the higher the incentives to work in the informal sector ; and (iv) human capital index, which will have a negative relationship with the informal sector as the higher the human capital is, more educated is the labor force, and therefore, less incentives to work in the informal sector.

The **control variables for GDP growth (Z** in equation 3.4-3.10) vector considers (i) the government final expenditure percentage of GDP, which is expected to have a positive impact for the economic activity; (ii) the net trade balance, as the more open the economy, the more growth it experiences; (iii) the unemployment rate, which is expected to have a negative impact in the formal economy; Following Mankiw et al. (1992), (iv) annual gross fixed capital formation increase (as percentage) and (v) human capital index. Both are expected to affect the formal sector in a positive way. Finally, a dummy variable for (vi) 2009 economic crisis.

Control variables regarding corruption and are not included as they are included in the shadow economy variable as indicators. If included, the informal economy variable will suffer of high values of multicollinearity and thus, the econometric analysis would not be accurate enough. Furthermore, the inflation rate is not included as it is used as one of the indicators of the informal economy, hence, if included it needs to be modelled as an endogenous variable given its relationship with the informal sector. As it is not the interest of this research to model the inflation rate, the variable is excluded from the analysis. If included only for GDP growth, there would be a misspecification problem in the model and consequently, the model would be unstable. There are different variables that affect the GDP growth and therefore is up to the researcher the selection of those (Durlauf, 2001; Sala-i-Martin, 1997). Therefore, the GDP growth can be modelled in different ways without decreasing the validity of the research nor contradicting other theories (Durlauf, 2001) Hence, the selection of the control variables is not exhaustive. The choice is based on theory of endogenous growth (Mankiw et al., 1992), including other determinants of growth that are related to the bargaining system externalities as well as the informal economy detailed in chapter 2.

All the macroeconomic indicators are from the World Development Indicators (World Bank, 2020) with exception of the human capital index which comes from Feenstra et al. database (2015). Table 3.1 summarizes the expected relationships between the control variables and the dependent variables.

Table 3.1 Expected relationship between dependent and independent variables

Variable		GDP growth	Informal Economy
Control variables	Informal Economy	+	
	Gross fixed capital formation	+	
	Dummy 2009	-	
	Government expenditure	+	+
	Trade balance	+	-
	Unemployment rate	-	+
	Human capital index	+	-
Labor market institution variables	Union Density	0/-	0/+
	Bargaining centralization	+	-
	Bargaining coverage rate	-	+

Source: own elaboration.

The countries involved in the analysis are 39: Australia, Austria, Belgium, Bulgaria Canada, Chile, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Netherlands, New Zealand, Norway, Philippines, Portugal, Romania, Singapore, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom[4]. The time frame is 2001-2017 as the selected variables have most of the observations for those years. Moreover, there is a change in the tendency of the informal sector since 2000 (Medina and Schneider 2018, 2019). Therefore, it makes sense to analyze the informal economy since that period.

3.3. Empirical considerations

As seen in table 3.1, the variables show a high degree of variability and heterogeneity between them. This is expected as the sample of countries is wide and includes different types of economies. As seen in table 3.2, the missing values of the variables of interest are less than 38% overall. For empirical purposes, the missing values are extrapolated to complete the sample, the comparison of the descriptive statistic from the extrapolated variables can be found in the appendix B. The only variable which is not extrapolated is the informal economy calculated with the currency demand approach as will be used to check the robustness of the models and the sample is not complete for all of the countries. From now onwards, the variables reported are the extrapolated variables with the complete sample size unless specified otherwise.

[4] A description of the variables for the different countries can be found in the appendix A, together with a plot of the main variables. In addition, the matrix of data availability for the informal economy calculated with the currency demand approach.

Table 3.2 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDP growth	663	2.57	3.40	-14.81	25.16
Informal Economy	663	17.85	7.89	5.10	43.70
Gross fixed capital formation	663	3.19	9.88	-38.90	55.68
Government expenditure	663	2.13	2.93	-12.39	15.70
Trade balance	663	108.71	74.61	19.80	437.33
Unemployment rate	663	7.59	3.98	1.81	27.47
Human capital index	663	3.15	0.37	2.02	3.97
Union Density	543	28.90	19.12	4.30	83.21
Bargaining centralization	663	1.81	0.92	0.80	4.70
Bargaining coverage rate	415	50.74	30.66	0.80	100.00
Informal Economy CDA	272	13.46	6.78	3.10	59.60

Source: own elaboration.

Table 3.3 Missing values description

Variable	Missing	Total	Percent Missing
GDP growth	0	663	0
Informal Economy	0	663	0
Gross fixed capital formation	0	663	0
Government expenditure	0	663	0
Trade balance	0	663	0
Unemployment rate	0	663	0
Human capital index	0	663	0
Union Density	120	663	18.1
Bargaining centralization	0	663	0
Bargaining coverage rate	248	663	37.41
Informal Economy CDA	391	663	58.97

Source: own elaboration.

The path analysis will be carried out using structural equation modelling. One important assumption behind such approach is that there is multivariate normality for the estimation when using maximum likelihood. As this assumption is violated[5], two possibilities arise for empirical testing: (i) transform the data to meet normality or (ii) use a form of Weighted Least Squares with asymptotic free distribution (Deng et al., 2018; Hoyle, 2012; Tarka, 2018). Given that the possible variables transformations do not provide a quasi-normal distribution of the exogenous variables[6], the models are run using the latter option. Using the asymptotic free distribution is a valid and better option given that the sample size is above 200 observations (Deng et al., 2018; Hoyle, 2012; Tarka, 2018).

[5] The Doornik-Hansen (2008) test for multivariate normality was conducted to address this issue and can be found in the appendix B. The conclusion is that the sample has variables with a non-normal distribution.
[6] The transformations can be seen in the appendix B together with the Doornik-Hansen (2008) test for multivariate normality for the transformed variables.

Multicollinearity is another issue that must be assessed before running the regressions as it could lead to biased results (Can et al., 2015; Grewal et al., 2004; Tarka, 2018). The Variance Inflation Factor test[7]was conducted to detect possible multicollinearity. The variable with the highest value is the adjusted bargaining coverage rate followed by bargaining centralization and the informal economy, nevertheless, they are lower than 5 (3.73, 2.74 and 2.11 respectively). Therefore, there is no severe multicollinearity within these variables[8].

[7] The variance inflation factor (VIF) is used as an index for multicollinearity as it measures increased variance due to multicollinearity and it is measure as: $VIF_i = (1/ (1-R_i^2))$(Hancock & Mueller, 2013; Powell & Schafer, 2001). Values above 2.5 indicates multicollinearity(Adeboye et al., 2014; Alin, 2010; Grewal et al., 2004). Values above 5 indicates severe multicollinearity.

[8] The results of the test can be found in appendix B section.

4. Empirical Analysis

In this chapter I will explain the empirical analysis and results from the mediation analysis the chapter is divided between the contemporaneous and the cross-lagged panel model. each section will include an analysis of the results where the goodness of fit of the models are explained and analyzed as well as the mediation between the variables. Both sections are concluded with a robustness checks of the models.

4.1 Contemporaneous Model

Different models are run in order to teste the individual relationships of the labor market indicators as well as the overall relationships. Results from the nine contemporaneous mediation models can be seen in table 4.1. Model 1 to 3 test the labor institution variables union density, bargaining coverage rate and bargaining centralization respectively, Model 4 includes the three labor institution variables together. Model 5 to 8 are variations of the model to improve the specification of the model. Firstly, from the models we can appreciate that the dummy variable is not statistically significant for the case of the informal sector, and neither the government expenditure (include as a proxy for the tax system). The possible explanation behind the lack of significance for the government expenditure is that it was intended as a proxy for the tax burden. However, in those countries that the government tax system is efficient, the tax burden will not be as high as for the inefficient countries. Hence, those with efficient tax system may have an equal level of expenditure financed by a lower tax burden. This argument is valid as the sample of countries includes different types of economies, ranging from developing to developed ones, but is mainly developed countries.

Therefore, Model 5 discards the variable of the 2009 dummy as control variable for the informal economy, and Model 6, the government expenditure control variable, as none is significant for the informal sector.

When analyzing the relationships from the equations, the control variables present the expected signs, except the human capital index which is also not significant. Although according to theory the human capital is an important determinant of the economic growth, the model is capturing this relationship through the mediator (the informal economy). This is evident as when the equations

are regressed in separate models, the human capital index is significant for the GDP growth[9]. Therefore, the variable is not taken out form the models. Moreover, the negative association is considered as a possible non-linear relationship, where, from certain point onwards, the human capital does not foster economic growth (Kalaitzidakis et al., 2001). This could be the reason behind the result as the sample contains mainly high income or upper middle-income countries and thus, the regression could be capturing that association. The inclusion of the quadratic term would raise the collinearity for other variables (including the main variable of interest, the informal sector), hence, as it is not the interest of this research to analyze the relationship of the human capital and the economic growth, the quadratic term is not included in the regressions.

When inspecting the variables of interest, the informal sector is significant for the GDP growth in every model and positive. This confirms hypothesis 1, the informal sector has a positive impact to the formal one as part of the activity that happens underground goes back to the formal sector. Also, this enables the mediation analysis as this is a necessary condition to run such analysis. When considering the labor institutions variables, while the union density behaves as expected, the bargaining coverage rate and the bargaining centralization variables seems to have a polynomic relationship with the economic activity as they have the same signs for both the formal and informal economy. Therefore, Model 7 includes square terms[10] of both variables in order to understand if such relationship exists. However, as seen in table 4.1, although there is evidence of a non-linear relationship, in the case of bargaining centralization, the relationship is only significant for the case of the informal economy. Nevertheless, there is a problem of structural multicollinearity arising from the incorporation of the square terms, especially for the case of bargaining centralization. This implies that the coefficients for those variables are not to trust and also explains the variability of the coefficients while making small variations in the model. As bargaining centralization is the variable with the highest collinearity issue[11], Model 8 includes only the square term for the adjusted bargaining coverage rate. Further research should model the bargaining centralization variable and its quadratic term in order to clarify the issue.

[9] The independent equations can be found in the appendix C.
[10] Both variables are centered before performing its square power to reduce the high collinearity between them.
[11] Test available in the appendix C.

Table 4.1 Results from the contemporaneous path analysis

	Model 1		Model 2		Model 3		Model 4		Model 5	
VARIABLES	GDP growth	Informal Economy	GDP growth	Informal Economy	GDP growth	Informal Economy	GDP growth	Informal Economy	GDP growth	Informal Economy
Informal Economy	0.0520***		0.0378**		0.0476***		0.0377**		0.0376**	
	(0.0125)		(0.0150)		(0.0139)		(0.0150)		(0.0150)	
Dummy 2009	-3.713***	0.0895	-3.770***	0.215	-3.747***	0.127	-3.769***	0.268	-3.757***	
	(0.408)	(0.887)	(0.402)	(0.805)	(0.403)	(0.857)	(0.398)	(0.781)	(0.396)	
Gross fixed capital formation	0.210***		0.206***		0.208***		0.206***		0.206***	
	(0.0181)		(0.0181)		(0.0181)		(0.0179)		(0.0179)	
Unemployment rate	-0.0713***	0.296***	-0.0618***	0.319***	-0.0702***	0.276***	-0.0606***	0.356***	-0.0608***	0.357***
	(0.0176)	(0.0582)	(0.0181)	(0.0516)	(0.0176)	(0.0529)	(0.0182)	(0.0495)	(0.0182)	(0.0495)
Human capital index	0.0336	-12.46***	-0.137	-12.20***	-0.0852	-12.72***	-0.112	-12.23***	-0.111	-12.23***
	(0.209)	(0.590)	(0.225)	(0.487)	(0.225)	(0.500)	(0.231)	(0.415)	(0.231)	(0.415)
Trade balance	0.00502***	-0.00887***	0.00436***	-0.0122***	0.00455***	-0.0118***	0.00444***	-0.0135***	0.00443***	-0.0135***
	(0.00130)	(0.00219)	(0.00128)	(0.00246)	(0.00129)	(0.00232)	(0.00127)	(0.00194)	(0.00126)	(0.00194)
Government expenditure	0.178***	0.235**	0.171***	0.0866	0.180***	0.189**	0.170***	0.0895	0.170***	0.0891
	(0.0314)	(0.0932)	(0.0310)	(0.0893)	(0.0314)	(0.0892)	(0.0307)	(0.0857)	(0.0307)	(0.0857)
Union Density	-0.00957***	-0.0395***					-0.00171	0.0446***	-0.00179	0.0446***
	(0.00339)	(0.00798)					(0.00400)	(0.00809)	(0.00399)	(0.00809)
Adj. Bargaining coverage rate			-0.00965***	-0.0737***			-0.0110***	-0.102***	-0.0111***	-0.102***
			(0.00250)	(0.00687)			(0.00396)	(0.00920)	(0.00396)	(0.00920)
square adj. bargaining cov. rate										
Bargaining centralization					-0.202**	-1.696***	0.0807	0.553**	0.0798	0.555**
					(0.0789)	(0.205)	(0.116)	(0.249)	(0.116)	(0.248)
Square bargaining centralization										
GDP growth										
Constant	0.971	56.34***	2.005**	58.61***	1.568*	59.70***	1.878*	57.71***	1.886*	57.73***
	(0.811)	(2.374)	(0.960)	(1.971)	(0.942)	(2.105)	(0.970)	(1.793)	(0.970)	(1.792)
Observations	663	663	663	663	663	663	663	663	663	663

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own estimations.

Table 4.1: Results from the contemporaneous path analysis (cont.)

	Model 6		Model 7		Model 8		Model 9		Model 10	
VARIABLES	GDP growth	Informal Economy	GDP growth	Informal Economy	GDP growth	Informal Economy	GDP growth	Informal Economy	GDP growth	Informal Economy
Informal Economy	0.0390***		0.0356**		0.0356**		0.0361**		0.0252	
	(0.0148)		(0.0145)		(0.0147)		(0.0146)		(0.0178)	
Dummy 2009	-3.750***		-3.773***		-3.781***		-3.776***		-3.783***	
	(0.396)		(0.393)		(0.394)		(0.398)		(0.390)	
Gross fixed capital formation	0.205***		0.204***		0.204***		0.204***		0.202***	
	(0.0179)		(0.0178)		(0.0179)		(0.0181)		(0.0179)	
Unemployment rate	-0.0609***	0.331***	-0.0522***	0.387***	-0.0512***	0.402***	-0.0531***	0.359***	-0.0471**	0.417***
	(0.0179)	(0.0428)	(0.0184)	(0.0393)	(0.0184)	(0.0403)	(0.0182)	(0.0435)	(0.0190)	(0.0427)
Human capital index	-0.0935	-12.38***	-0.0115	-11.26***	-0.00969	-11.24***	-0.0274	-11.29***	-0.108	-11.17***
	(0.232)	(0.389)	(0.234)	(0.322)	(0.234)	(0.348)	(0.233)	(0.492)	(0.253)	(0.352)
Trade balance	0.00449***	-0.0135***	0.00469***	-0.0114***	0.00472***	-0.0109***	0.00469***	-0.00957***	0.00460***	-0.0113***
	(0.00127)	(0.00194)	(0.00126)	(0.00162)	(0.00126)	(0.00170)	(0.00127)	(0.00225)	(0.00126)	(0.00176)
Government expenditure	0.174***		0.175***		0.175***		0.174***		0.176***	
	(0.0305)		(0.0301)		(0.0305)		(0.0307)		(0.0303)	
Union Density	-0.00177	0.0439***	-0.000651	0.0513***	-0.000642	0.0547***			-0.000719	0.0541***
	(0.00399)	(0.00807)	(0.00382)	(0.00641)	(0.00384)	(0.00717)			(0.00383)	(0.00719)
Adj. Bargaining coverage rate	-0.0111***	-0.104***	-0.0113**	-0.0980***	-0.0112***	-0.102***	-0.0106***	-0.0812***	-0.0121***	-0.0998***
	(0.00398)	(0.00906)	(0.00497)	(0.00793)	(0.00390)	(0.00795)	(0.00246)	(0.00601)	(0.00398)	(0.00816)
square adj. bargaining cov. rate			0.000157	0.00131***	0.000161*	0.00142***	0.000159*	0.00128***	0.000175*	0.00139***
			(9.63e-05)	(0.000173)	(8.89e-05)	(0.000205)	(9.45e-05)	(0.000282)	(8.98e-05)	(0.000206)
Bargaining centralization	0.0845	0.576**	0.0273	-0.186	0.0629	0.361*			0.0618	0.359*
	(0.116)	(0.248)	(0.190)	(0.331)	(0.114)	(0.214)			(0.114)	(0.214)
Square bargaining centralization			0.0180	0.315**						
			(0.0745)	(0.126)						
GDP growth										0.0782
										(0.0755)
Constant	1.792*	58.65***	1.431	53.87***	1.351	52.87***	1.490	54.52***	1.863*	52.37***
	(0.980)	(1.558)	(1.030)	(1.365)	(1.004)	(1.436)	(1.001)	(1.924)	(1.116)	(1.507)
Observations	663	663	663	663	663	663	663	663	663	663

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: own estimations.

Model 9 replicates model 2 with the square term of the bargaining coverage rate. Finally, as structural equations modelling allows for non-recursive models, Model 10 becomes one while including GDP growth as independent variable for the informal sector. This is a poor case to see if there is any significant impact from the formal to the informal sector. According to theory, for a path to become significant one needs instrumental variables. In the case of the informal economy, we can use the gross fixed capital formation as according to theory affects the formal economic activity but not the informal one. However, there is no appropriate instrumental variable for the formal sector. As describe, and due to the definition given to it, it is the consequence of citizens trying circumvent the government. Therefore, there is no appropriate instrumental variable that affects the informal economy but not the formal one. Hence, the non-recursive model is not the best specified one. According to theory, the lack of a proper instrumental variable will affect the significance of the path, signaling a non-significant relationship (Wong & Law, 1999). As seen from table 4.1, the variables are not statistically significant however the problem is the lack of an appropriate instrumental variable. Further research is needed for this issue. The lack of an appropriate instrumental variable and the possibility of having reverse causality issues is one of the critiques the measures for the informal economy has (Medina & Schneider, 2018; 2019).

To continue the analysis of the results, Model 8 is defined as the baseline model. The reasons behind this election is related to the overall goodness of fit of the model. In contrast to other regression approaches for economic analysis, there is no specific test to determine if the model is good enough or not, however, there are different tests to assess different parts of the models[12]. As seen in table 4.2, the Comparative Fit Index, which compares the models with a baseline where the variables are not related, is high and yields a good fitness as all the models range between 0.99 and 1, over the threshold 0.95 (Acock, 2015) Therefore, the relationships modelled are validated, as the model fit is almost 100% better than the baseline. This also validates the decision of excluding the insignificant terms form Model 1.

Another important index is the Root Mean Square Error of Approximation (RMSEA), which punishes the overspecification of a model (Chen et al., 2008; Hoyle, 2012), and therefore, is similar to the adjusted R-square from an OLS regression. values above 0.05 implies that the model is over

[12] The chi square test above 200 observations, usually yields a significant result (Hancock & Mueller, 2013; Powell & Schafer, 2001), therefore, it would be misleading to include it in this case.

specified (Hoyle, 2012). In this case, the models yield a RMSEA between 0.08 and 0.01. This index needs to be considered together with the p close value. In each case, there is no rejection of the null hypothesis of close fit (Acock, 2015), the only case where the RMSEA is bigger than the threshold is for Model 1. This is another sign that the models are well specified, and the increase in the p close values signals that the decisions made in the model specification where accurate.

Finally, the Standardized Root Mean Square Residuals (SRMR) are all below 0.05, which means that the model is good in terms of reproducing the covariance, and there is low risk of this goodness of fit being due to low correlations between the variables[13] (Acock, 2015) Finally, the Coefficient of Determination are above 0.83 which means that the model has a good explanatory power[14].

Table 4.2 Goodness of fit indexes

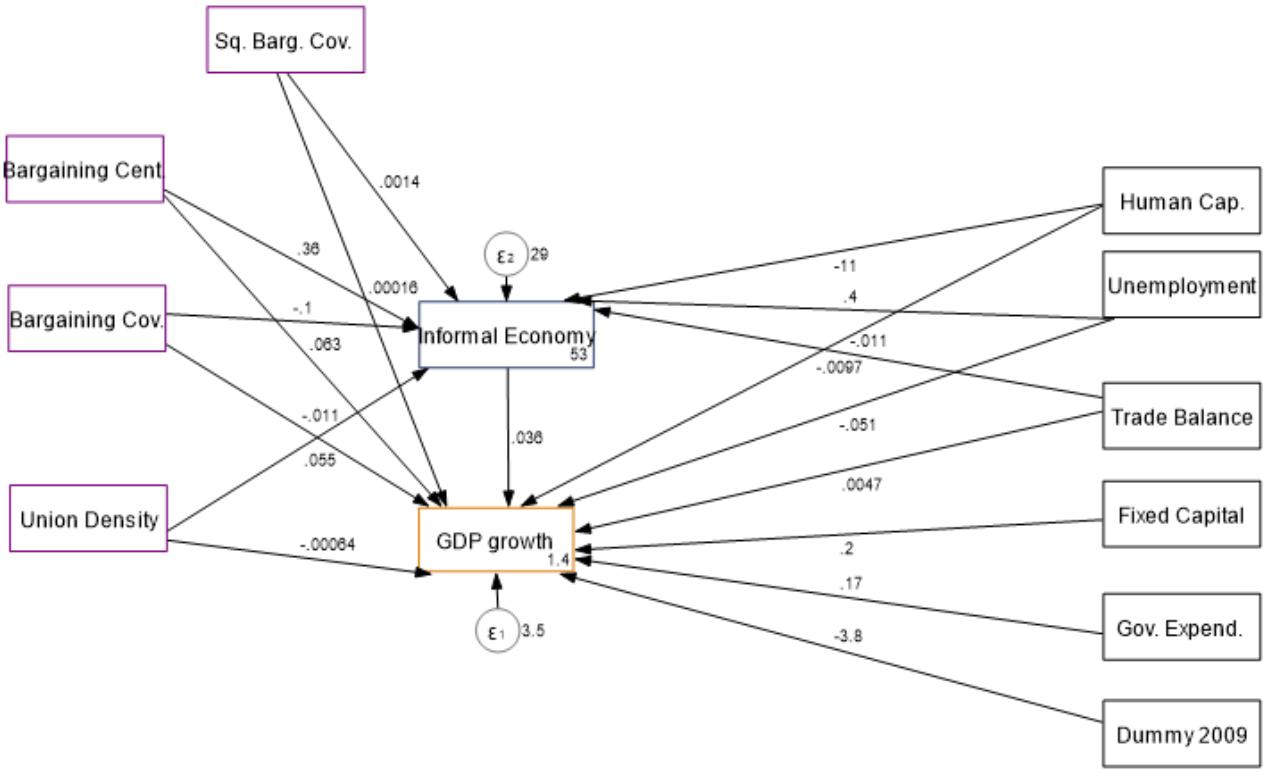
Fit statistic	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Baseline comparison										
Comparative fit index	0.993	0.997	0.995	0.997	0.999	0.999	0.999	1.000	1.000	1.000
Population error										
Root mean square error of aproximation	0.076	0.048	0.060	0.047	0.021	0.018	0.014	0.012	0.002	0.012
pclose	0.184	0.380	0.293	0.389	0.699	0.793	0.817	0.827	0.848	0.749
Size of residuals										
Standardized root mean error	0.010	0.008	0.009	0.006	0.006	0.007	0.005	0.006	0.007	0.004
Coeficient of determination	0.832	0.854	0.841	0.856	0.856	0.856	0.860	0.860	0.857	0.861

Source: own estimations.

From table 4.3, Model 10 seems to have the best fit statistics in terms of size of residuals. This, although true, is misleading for choosing the baseline model as it is a non-recursive model, and includes a path between the endogenous variables, which makes the model more stable in terms of reproducing the covariance matrix. Model 8 is selected as the baseline as it includes the bargaining centralization variable which is of interest for the analysis and has better statistics in terms of the size of the residuals than model 9[15]. The mediation relationships will be analyzed for the baseline model exclusively in the subsequent section. Figure 4.1 presents the path diagram for the baseline model, where every arrow has the path coefficient (or direct association) with the

[13] See appendix C for correlation matrix.
[14] See appendix C for the coefficient of determination split between the equations of GDP growth and Informal economy for baseline model.
[15] The residuals matrix is available in appendix C. The values of the matrix need to be as close as cero as possible to assure that the model is estable.

Figure 4.1 Baseline model path diagram



Source: own estimation.

As before mentioned, the informal economy is statistically significant in all cases. This means that the informal economy acts as a mediator between the different economic variables and the formal activity, confirming hypothesis 1. This is aligned with the theory as the informal sector allows those who cannot enter the formal economy to perform an economic activity, fostering market development and increasing financial resources, among other externalities, and that a high proportion of that activity enters the formal sector (estimated in 70 %) (Medina & Schneider, 2019). For every point the informal sector increase, the there is a positive spillover in the formal economy accounting for 0.036 percentage point increase.

When considering the determinants of the informal economy, the unemployment rate increases the informal sector in 0.4 percentage points. This is alleged with theory as those who are unemployed in the formal sector and facing barriers to enter it, turn into the informal sector (Medina & Schneider, 2018; 2019). Therefore, when considering the relationship between the formal activity

and the unemployment rate, given the positive indirect association through the informal economy, the total relationship is smaller than the direct one.

The trade openness of a country also determines the informal sector, however, the coefficient for this variable is small relatively to the other variables. For every point increase in the trade balance, the informal sector is reduced by 0.01 percentage points. The explanation behind the small and almost neglectable relationship is that the model is not accounting for the type of exportations behind the trade balance. This variable could be capturing part of the relationship of countries that are agrarian intensive which is said to enlarge the informal sector (Medina & Schneider, 2018; 2019). As expected, the trade balance has a positive association with the formal activity which is slightly decreased when combined with the relationship with the informal sector. Therefore, an increase in the trade balance of one percentage point would increase the formal economic activity in 0.0043 percentage points.

The human capital index is an important determinant of the informal sector. For each point increase in the index, the informal sector is reduced in 11.24 percentage points. This is a logical result as the measure of the human capital index involves the years of schooling the population has. If the population is well educated, the informal sector will be reduced as the barriers to enter the formal one is reduced. As before mentioned, the human capital index has a negative association with the formal economy. Although there is evidence for a non-linear relationship which is not contemplated in the analysis given the beforementioned reasons. Therefore, the final impact of the human capital index, for the specific sample of mainly high income and upper middle-income countries is a negative one. Acting the informal sector as a mediator, the indirect relationship of the variable is -0.4 percentage points that when combined with the direct relationship, the total relationship is a diminution of the economic sector in 0.41 percentage points. Therefore, the informal sector increases the negative association with the human capital index. The analysis of the human capital index is incomplete given the impossibility of including a quadratic term in the equations and deserves further research.

Table 4.3 Mediation relationships for GDP growth

	Model 8		
	Direct	Indirect	Total
Unemployment rate	-0.0512***	0.0143*	-0.0369*
	(0.0184)	(0.00603)	(0.01701)
Human capital index	-0.00969	-0.400*	-0.410*
	(0.234)	(0.1657)	(0.15933)
Trade balance	0.00472***	-0.000387*	0.00434***
	(0.00126)	(0.00017)	(0.00131)
Union Density	-0.000642	0.00195*	0.00130
	(0.00384)	(0.00084)	(0.00372)
Adj. Bargaining coverage rate	-0.0112***	-0.00362*	-0.0148***
	(0.00390)	(0.0015)	(0.00347)
Square adj. bargaining cov. rate	0.000161*	0.0000505*	0.000211*
	(8.89e-05)	(0.00002)	(0.00009)
Bargaining centralization	0.0629	0.0128	0.0757
	(0.114)	(0.00906)	(0.11398)
Observations	663		

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: own estimations.

When considering the results for the variables of interest for the informal economy, union density has a slightly positive and significant impact. Every percentage point increase in the rate would have a positive impact in the informal sector of 0.05 percentage point. This is consistent with the literature that finds positive associations with the unemployment rate and negative associations with the economic performance (such as Layard et al., 2005). Hence, this could be signaling that the frictions created in the formal sector between the unions and the employers, can generate certain shift towards informality. However, the impact is low and therefore, there is a neglectable association with the formal sector. Aligned with the theory, when comparing the results between model 2 and the baseline, once the bargaining centralization and coverage are controlled for, the size of the union density relationship is decreased for both, formal (Aidt & Tzannatos, 2002, 2008) and informal sector. Moreover, Model 2 shows a negative association with the informal sector that becomes positive once the other indicators of the labor institutions are controlled for. Hence, the variable, when set alone, captures other aspects of the bargaining institution. This is also aligned with theory and the criticism that the indicators should not be considered separately but together (Aidt & Tzannatos, 2002, 2008). Hypothesis 2, the union density having a small association with

the informal economy is rejected, the relationship is not neglectable, however, the indirect relationship to the GDP growth is small.

The adjusted bargaining coverage also has a negative association with the informal sector and the formal one, therefore, the total association to the formal sector is increased. However, as beforementioned, the variable exhibits a quadratic u-shaped relationship which minimum point is when the bargaining coverage is around 35%[16]. This means that for values above 35% of coverage, the unions have a positive relationship with the economic outcome. This is in line with theory as the higher the coverage, the more power the unions have for negotiation and internalize the negative externalities explained in chapter 2. The interesting result is that it also has a negative association with the informal sector. One possible explanation is that when the unions are not internalizing the externalities, the cool down of the economy happens in both sectors and not only in the formal one. Hence, the hypothesis 3 which stated that the relationship between the bargaining coverage and the informal sector was positive, can only be confirmed for levels above 35% of coverage.

When considering the bargaining centralization, there is a non-monotonic relationship which seems to be present only in the case of the informal sector. This is consistent with the Calmors-Driffill hypothesis (1988) which finds the same association with the unemployment rate, one of the most important drivers of the informal sector. Moreover, this could be the reason why empirically there is evidence of a negative relationship with the unemployment rate but no relationship with the employment one. Therefore, hypothesis 4 is rejected, though further research is needed to explore this relationship, it is not a monotonic one.

Finally, when considering the three indicators of the bargaining system together, the total final relationship is small, again, this is consistent with the literature that claims that the indicators must be consider together as they are part of an institution.

The robustness of the results is checked by three different models based on the baseline model: Model 11 includes a bootstrapping of 1000 repetitions to have a more accurate sense of the statistics behind the model. this is a suggested robustness check for path models in order to obtain

[16] This includes the total relationship in the GDP growth. The turning point for the GDP growth alone is in 34.78 and for the informal economy in 35.88.

more accurate standard errors (Tarka, 2018). Model 12 is the same model than before but with another measure of the informal sector. This measure is calculated using the Currency-Demand approach from Tan et al. (2017). However, the sample is not complete for this measure[17], reason why the observations are lower, nevertheless, this does not compromise the validity of the structural equation modelling as the sample is still big enough. Model 13 is the baseline for the same sample of country-years than the previous model. The models are presented in table 4.4 together with the goodness of fit statistics.

Table 4.4 Robustness checks

	Model 11		Model 12		Model 13	
VARIABLES	GDP growth	Informal Economy	GDP growth	Informal Economy CDA	GDP growth	Informal Economy
Informal Economy	0.0356*				0.0689***	
	(0.0184)				(0.0211)	
Dummy 2009	-3.781***		-3.766***		-3.894***	
	(0.499)		(0.371)		(0.376)	
Gross fixed capital formation	0.204***		0.236***		0.220***	
	(0.0234)		(0.0167)		(0.0167)	
Unemployment rate	-0.0512**	0.402***	-0.0294	0.350***	-0.0584**	0.394***
	(0.0224)	(0.0526)	(0.0262)	(0.0533)	(0.0269)	(0.0360)
Human capital index	-0.00969	-11.24***	-0.315	-0.200	0.306	-9.416***
	(0.284)	(0.609)	(0.244)	(0.854)	(0.311)	(0.418)
Trade balance	0.00472***	-0.0109***	0.00401**	-0.00546***	0.00577***	-0.0309***
	(0.00146)	(0.00317)	(0.00201)	(0.00170)	(0.00207)	(0.00153)
Government expenditure	0.175***		0.149***		0.146***	
	(0.0368)		(0.0409)		(0.0412)	
Union Density	-0.000642	0.0547***	-0.00338	-2.77e-05	-0.0115**	0.106***
	(0.00434)	(0.0128)	(0.00521)	(0.0103)	(0.00583)	(0.00695)
Adj. Bargaining coverage rate	-0.0112**	-0.102***	-0.0132***	-0.0578***	-0.00921	-0.118***
	(0.00448)	(0.0128)	(0.00496)	(0.0114)	(0.00616)	(0.00544)
square adj. bargaining cov. rate	0.000161	0.00142***	0.000119	0.00369***	-1.22e-05	0.00507***
	(0.000101)	(0.000335)	(0.000148)	(0.000355)	(0.000161)	(0.000151)
Bargaining centralization	0.0629	0.361	0.0342	1.447***	0.121	0.584***
	(0.133)	(0.430)	(0.159)	(0.557)	(0.155)	(0.192)
Informal Economy CDA			0.0555***			
			(0.0153)			
Constant	1.351	52.87***	2.407**	8.812**	-0.00425	45.32***
	(1.215)	(2.336)	(1.022)	(3.522)	(1.399)	(1.725)
Observations	663	663	272	272	272	272
Comparative fit index	0.9995		1.0000		0.9436	
Root mean square error of aproxi	0.0116		-		0.1330	
pclose	0.8272		0.8046		0.0094	
Standardized root mean error	0.0058		0.0091		0.0117	
Coeficient of determination	0.8598		0.8095		0.9181	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

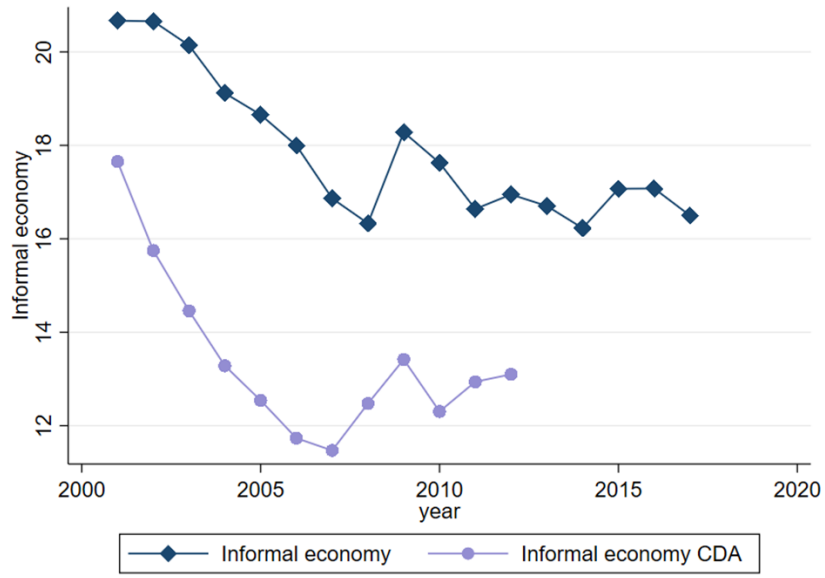
Source: own estimations.

[17] The data is available until 2012. A matrix of the available data for the variable is provided in the appendix A.

Both models yield consistent results. For the bootstrapping model, the bargaining centralization is not significant. This is due to the fact that the methodology itself as the resampling may find the variable not significant enough.

Regarding Model 12, the results are consistent with the original informal economy measure. The interesting differences with Model 13 are that (i) unemployment is fully affecting the formal sector through the mediator; (ii) the relationship between the human capital index and the informal sector is significantly smaller. The latter is probably due to the fact that the currency demand approach has a lower value of the informal economy than the multiple causes multiple indicators one, nevertheless, both have the same tendency. Figure 4.1 offers a graphical understanding of this difference. Moreover, the human capital index also reflects the quadratic relationship. This issue needs further investigation which is not possible with the sample nor the objective of the paper.

Figure 4.2 Different measures of the informal economy



Source: own elaboration.

4.2. Cross-lagged panel model:

This section is dedicated to address the use of static models for labor institutions critiques. As mentioned in Chapter 2, these critiques state that the dynamic models should be used as the labor institutions change over time (Aidt & Tzannatos, 2002, 2008).

Besides from the empirical considerations stated before, the cross-lagged panel model has some extra requirements and complications one must be aware of as a dynamic model. In the first place, given that the model requires lagged values, the time frame of the sample is reduced by a year. Secondly, as the model includes the lagged variables, the multicollinearity becomes a serious problem[18]. For that purpose, the model allows for covariance between the variable and its lagged value (Kaplan, 2012). Therefore, each model will report these values.

As the model includes the lagged value and the current value to assess time influence, the root mean square error of approximation will tend to be higher than the threshold explained in section 4.1. Therefore, it is acceptable to have a higher root mean square error of approximation as certain paths are only to verify how the variables work through time, thus, the model will suffer some acceptable overspecification. According to the literature, the thresholds use for the fit indexes are set arbitrarily by the authors (Chen et al., 2008; Hoyle, 2012). In the contemporaneous model, the lower threshold is used in order to give the model, the best validity. In this case, given that the overspecification is part of the construction of the model, the limit is set lower than 0.1. Values between 0.06 and 0.08 are consider a mediocre fit while above 0.1 is poor fit and should not be considered (MacCallum & Browne, 1993; Rigdon, 2009; Song et al., 2012). The minimum standard for the comparative fit index is 0.9 (Rigdon, 2009). The coefficient of determination in this case is also misleading as the model is allow to covariate between the different error terms. Thus, what is not explained by the variables falls in that category.

Finally, given the construction of the model and high collinearity, it is not possible to include the quadratic term for the bargaining centralization nor bargaining coverage variables. The reason behind this is that the model does not allow the covariances between endogenous and exogenous variables. In this case, the lagged values of the labor indicators are exogenous.

The models are presented as follows: Model 1 to 3 are simple model with no control variables (but with the covariances between the variables error terms) for each of the labor institution indicators. Model 4 presents the model with the three variables together. Model 5 adds the control variables (homologous for the baseline model in the previous analysis but without the quadratic variable), Finally, Model 6 is the non-recursive model to see if there are lagged interactions between the

[18] Multicollinearity tests are available in appendix D.

formal and the informal sector. The considerations for this type of model are the same that for the contemporaneous models. There is a lack of good instrumental variables for the informal and formal economy. Again, the informal economy has the gross fixed capital formation as a weak instrumental variable for the reasons mentioned in the previous section. The output can be seen in table 4.5, followed by the goodness of fit statistics in table 4.6. As seen from the output, the formal economy has a non-significant relationship with the informal sector. This issue needs further research, especially in those developing economies as the informal sector tends to be bigger than in the developed ones.

As seen from table 4.6, the baseline model is Model 5 as it has the best fit statistics from the group of models. As said before, the threshold for the root mean square error of approximation is acceptable for values lower than 0.1 and the comparative fit index for values above 0.9. in this case, the model is just in that limit.

The standardized root mean error is bigger than expected, this is due to the fact that the union indicators are set endogenous for the current values and exogenous for the lagged values. Moreover, in order to understand how the variables impact over time, the model allows control variables only to determine the lagged endogenous variables. Hence, the parameter will be accepted with the higher value as manipulating the model for improving it goodness of fit would require to make several paths that have no sense theoretically. The residual matrix can be seen in the appendix D.

Table 4.7 highlights that from the variables of interest, the time span does not create a big difference. Only in the case of the formal economy does the variable change significantly from one period to the other. Moreover, the size of the coefficients and their significance signal that the variables have a stronger relationship with the contemporaneous value of the formal and informal economy. Hence, the significant relationship between time spans are probably due to the lack of variation of the variable in the selected time span. Therefore, the variables have a stronger relationship in the present time than across periods. In this case, the informal economy also acts as a mediator to the formal one. Hence, the mediation analysis is presented for the baseline model in table 4.8.

Table 4.5 Cross-lagged panel model regressions

	Model 1					Model 2					Model 3				
VARIABLES	Lagged GDP growth	GDP growth	Lagged Informal Economy	Informal Economy	Union Density	Lagged GDP growth	GDP growth	Lagged Informal Economy	Informal Economy	Adj. Barg. coverage rate	Lagged GDP growth	GDP growth	Informal Economy	Lagged Informal Economy	Bargaining centra.
Lagged Informal Economy	0.314***	0.0870***		0.987***		0.236***	-0.178**		1.081***		0.314***	0.104***	0.982***		
	(0.0834)	(0.0174)		(0.0118)		(0.0368)	(0.0769)		(0.0336)		(0.0944)	(0.0169)	(0.0104)		
Dummy 2009															
Lagged Gross fixed capital formation															
Lagged Unemployment rate															
Lagged Human capital index															
Lagged Trade balance															
Lagged Government expenditure															
Lagged GDP growth		0.402***					2.243***					0.374***			
		(0.0841)					(0.477)					(0.0838)			
Lagged Union Density			-0.0871***	-0.00189	0.992***										
			(0.0145)	(0.00196)	(0.00277)										
Lagged Adj. Bargaining coverage								-0.0926***	0.00849**	1.001***					
								(0.0100)	(0.00341)	(0.00289)					
Lagged Bargaining centralization													-0.0975***	-1.848***	0.944***
													(0.0361)	(0.298)	(0.0200)
Constant	-2.952**	0.328	20.00***	-0.0938	-0.243***	-1.552**	-0.0757	22.45***	-2.140***	-0.400***	-2.980*	0.102	0.107	21.25***	0.101***
	(1.433)	(0.281)	(0.560)	(0.235)	(0.0697)	(0.631)	(0.590)	(0.609)	(0.737)	(0.120)	(1.640)	(0.268)	(0.219)	(0.680)	(0.0296)
Error Covariances															
Lagged Informal Economy	-14.18***			-1.043**		-6.647***			-6.004***		-15.13***		-1.1026**		
	(4.661)			(0.6187)		(2.321)			(1.803)		(5.821)		(0.5726)		
Observations	624	624	624	624	624	624	624	624	624	624	624	624	624	624	624

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own estimations

Table 4.5: Cross-lagged panel model regressions (cont.).

	Model 4							Model 5						
VARIABLES	Lagged GDP growth	GDP growth	Lagged Informal Economy	Informal Economy	Bargaining centra.	Adj. Barg. coverage rate	Union Density	Lagged GDP growth	Lagged Informal Economy	GDP growth	Informal Economy	Bargaining centra.	Adj. Barg. coverage rate	Union Density
Lagged Informal Economy	0.464***	0.0477		0.992***				0.156***		0.0950***	0.975***			
	(0.0557)	(0.0302)		(0.00905)				(0.0274)		(0.0109)	(0.00563)			
Dummy 2009								-3.813***						
								(0.337)						
Lagged Gross fixed capital formation								0.169***						
								(0.0142)						
Lagged Unemployment rate								-0.0964***	0.224***					
								(0.0165)	(0.0351)					
Lagged Human capital index								1.281***	-12.68***					
								(0.362)	(0.373)					
Lagged Trade balance								0.00670***	-0.0113***					
								(0.00116)	(0.00185)					
Lagged Government expenditure								0.237***						
								(0.0275)						
Lagged GDP growth		0.693***	-0.582							0.277***				
		(0.176)	(35.50)							(0.0308)				
Lagged Union Density			0.00840	0.00154			0.994***		0.0527***		0.00164			0.987***
			(0.110)	(0.00196)			(0.00247)		(0.00687)		(0.00165)			(0.00220)
Lagged Adj. Bargaining coverage			-0.140	-0.00108		1.003***			-0.0876***		-0.00698***		0.998***	
			(1.815)	(0.00223)		(0.00180)			(0.00627)		(0.00134)		(0.00150)	
Lagged Bargaining centralization			1.347	-0.0469	0.998***				0.189		0.0307	0.955***		
			(17.48)	(0.0411)	(0.0144)				(0.189)		(0.0339)	(0.0102)		
Constant	-5.326***	0.107	23.80	-0.128	0.0153	-0.390***	-0.286***	-4.830***	59.60***	0.623***	0.230*	0.0661***	-0.197**	-0.138***
	(0.972)	(0.272)	(160.0)	(0.199)	(0.0184)	(0.0983)	(0.0624)	(1.578)	(1.489)	(0.197)	(0.124)	(0.0134)	(0.0809)	(0.0521)
Error Covariances														
Lagged Informal Economy	-20.27			-1.7293				-4.0697***			-0.5102*			
	(118.85)			(22.44)				(0.9764)			(0.2053)			
Observations	624	624	624	624	624	624	624	624	624	624	624	624	624	624

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own estimations

Table 4.5: Cross-lagged panel model regressions (cont.).

	Model 6						
VARIABLES	Lagged GDP growth	Lagged Informal Economy	GDP growth	Informal Economy	Bargaining centra.	Adj. Barg. coverage rate	Union Density
Lagged Informal Economy	0.156***		0.0946***	0.975***			
	(0.0276)		(0.0111)	(0.00563)			
Dummy 2009	-3.803***						
	(0.355)						
Lagged Gross fixed capital formation	0.169***						
	(0.0145)						
Lagged Unemployment rate	-0.0968***	0.223***					
	(0.0165)	(0.0372)					
Lagged Human capital index	1.285***	-12.69***					
	(0.363)	(0.384)					
Lagged Trade balance	0.00676***	-0.0112***					
	(0.00119)	(0.00194)					
Lagged Government expenditure	0.237***						
	(0.0278)						
Lagged GDP growth		-0.00748	0.283***	-0.00199			
		(0.0710)	(0.0378)	(0.00801)			
Lagged Union Density		0.0528***		0.00165			0.987***
		(0.00705)		(0.00165)			(0.00221)
Lagged Adj. Bargaining coverage		-0.0878***		-0.00701***		0.998***	
		(0.00655)		(0.00135)		(0.00151)	
Lagged Bargaining centralization		0.191		0.0304	0.955***		
		(0.189)		(0.0340)	(0.0102)		
Constant	-4.856***	59.67***	0.617***	0.237*	0.0664***	-0.196**	-0.137***
	(1.586)	(1.587)	(0.198)	(0.126)	(0.0134)	(0.0812)	(0.0522)
Error Covariances							
Lagged Informal Economy	-4.0724***			-0.5056*			
	(1.0205)			(0.2067)			
Observations	624	624	624	624	624	624	624

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own estimations

Table 4.6 Cross-lagged panel model comparative fit statistics

Fit statistic	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Baseline comparison						
Comparative fit index	0.915	0.951	0.932	0.934	0.897	0.896
Population error						
Root mean square error of aproximation	0.145	0.135	0.130	0.091	0.092	0.094
pclose	0.000	0.000	0.000	0.000	0.000	0.000
Size of residuals						
Standardized root mean error	0.138	0.173	0.148	0.103	0.076	0.075
Coeficient of determination	0.998	0.997	0.865	1.000	1.000	1.000

Source: own estimations

When analyzing the indirect associations, one must have in mind that analyzing how the lagged values affect the current value of the formal economy is possible due to the model construction. This means that if the model did allow control variables and the labor indicators to affect the current GDP growth, given the variability already explained in time, the variation would be captured by the current values. Therefore, the analysis will focus on the informal economy and lagged GDP growth. Respect the lagged GDP growth, the indirect and total associations are similar to the case of the contemporaneous model. therefore, the results are consistent as they are contemporaneous (all lagged values). The small variations in the coefficients are due to the different sample size and the different type of modelling techniques. Here, the relationship with the current GDP growth are only significant for the case of the control variables with the exception of the unemployment rate and the trade balance. Regarding the labor institutions indicators, the union density and the bargaining coverage rate are the ones to have a significant relationship with the next period GDP growth.

Table 4.7 Mediation analysis for the cross-lagged panel model

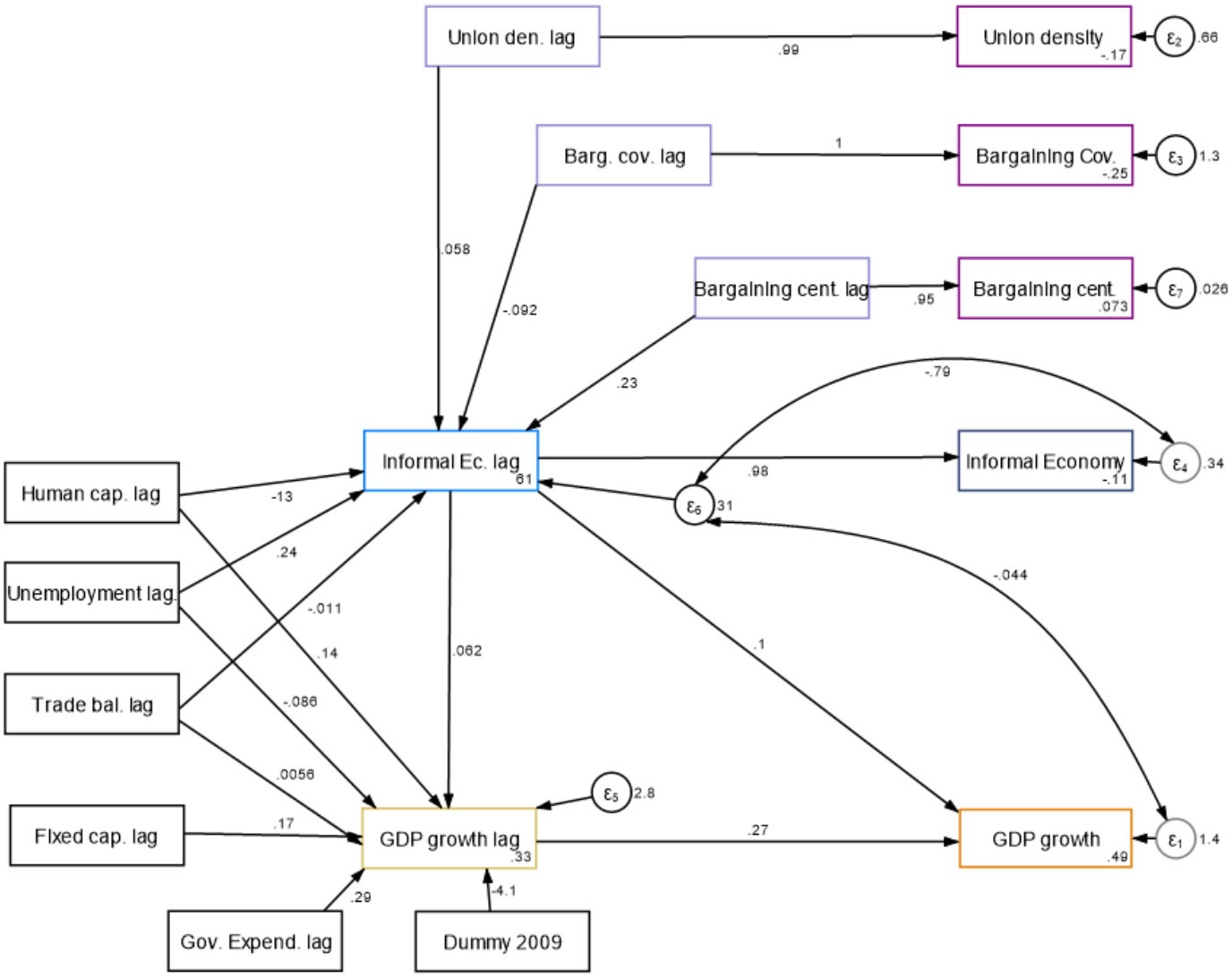
	GDP growth			Lagged GDP growth			Informal Economy		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Lagged Informal Economy	0.0950***	0.0433***	0.138***						
	(0.0109)	(0.0099)	(0.0137)						
Dummy 2009	0	-1.057***	-1.057***						
	(.)	(0.1305)	(0.1305)						
Lagged Gross fixed capital formation	0	0.0468***	0.0468***						
	(.)	(0.0054)	(0.0054)						
Lagged Unemployment rate	0	0.00428	0.00428	-0.0964***	0.0350***	-0.0615***	0	0.219***	0.219***
	(.)	(0.0071)	(0.0071)	(0.0165)	(0.0079)	(0.0154)	(.)	(0.0343)	(0.0343)
Lagged Human capital index	0	-1.399***	-1.399***	1.281***	-1.979***	-0.698***	0	-12.37***	-12.37***
	(.)	(0.1452)	(0.1452)	(0.373)	(0.3403)	(0.1382)	(.)	(0.3614)	(0.3614)
Lagged Trade balance	0	0.000297	0.000297	0.00670***	-0.00176***	0.00494***	0	-0.0110***	-0.0110***
	(.)	(0.0005)	(0.0005)	(0.00116)	(0.0004)	(0.0012)	(.)	(0.0019)	(0.0019)
Lagged Government expenditure	0	0.0657***	0.0657***						
	(.)	(0.0114)	(0.0114)						
Lagged Bargaining centralization	0	0.0262	0.0262	0	0.0295	0.0295	0.0307	0.215	0.215
	(.)	(0.0264)	(0.0264)	(.)	(0.0304)	(0.0305)	(0.0339)	(0.1811)	(0.1811)
Lagged Adj. Bargaining coverage	0	-0.0121***	-0.0121***	0	-0.0137***	-0.0137***	-0.00698***	-0.0924***	-0.0924***
	(.)	(0.0015)	(0.0015)	(.)	(0.0024)	(0.0025)	(0.00134)	(0.0061)	(0.0061)
Lagged Union Density	0	0.00729***	0.00729***	0	0.00823***	0.00823***	0.00164	0.0531***	0.0531***
	(.)	(0.0011)	(0.0011)	(.)	(0.0016)	(0.0016)	(0.00165)	(0.0066)	(0.0066)
Observations	624								

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own estimations.

The results are consistent with the static model. As already mentioned, the quadratic variables are not including due to multicollinearity issues, nevertheless, bargaining centralization and the adjusted bargaining coverage exhibit a non-linear relationship that requires further research. Figure 4.3 represents the cross lagged panel model diagram, where each path has the coefficients between those variables. The curved arrows are the covariance between disturbance terms.

Figure 4.3 Cross-lagged panel model path diagram



Source: own estimation.

To assess the robustness of the cross-lagged panel model, two different models are presented based in the baseline model. The first one is a bootstrapping which consists in 1000 repetitions in order

to get more accurate statistics. As the goodness of fit of the model is not perfect, and being the ability of replicating the covariance matrix low, the model was only able to replicate the results for 832 times. The second model is a replication of the baseline model with a 3-year spam for the lags. Results are presented in table 4.8 together with the goodness of fit. As seen from the models, the adjusted statistics are in line with the model, the informal sector still acts as a mediator for the formal one. In regards to Model 8, the variables still show little variance in the time span and the results are in line with the baseline model. Further research should include a bigger sample size to clarify issues regarding time varying institutions and how they affect the informal and formal sector.

Table 4.8 Robustness checks for the cross lagged panel model

	Model 7							Model 8						
VARIABLES	Lagged GDP growth	Lagged Informal Economy	GDP growth	Informal Economy	Bargaining centra.	Adj. Barg. coverage rate	Union Density	Lagged GDP growth	Lagged Informal Economy	GDP growth	Informal Economy	Bargaining centra.	Adj. Barg. coverage rate	Union Density
Lagged Informal Economy	0.156**		0.0950***	0.975***				0.144***			0.0818***	0.956***		
	(0.0621)		(0.0214)	(0.0104)				(0.0227)			(0.0142)	(0.00916)		
Dummy 2009	-3.813***							-4.160***						
	(0.808)							(0.290)						
Lagged Gross fixed capital	0.169***							0.174***						
	(0.0293)							(0.00977)						
Lagged Unemployment	-0.0964***	0.224***						-0.0796***	0.173***					
	(0.0326)	(0.0711)						(0.0145)	(0.0334)					
Lagged Human capital index	1.281	-12.68***						1.136***	-13.24***					
	(0.812)	(0.842)						(0.317)	(0.376)					
Lagged Trade balance	0.00670***	-0.0113**						0.00753***	-0.0139***					
	(0.00245)	(0.00463)						(0.00121)	(0.00191)					
Lagged Government	0.237***							0.198***						
	(0.0519)							(0.0246)						
Lagged GDP growth			0.277***								0.335***			
			(0.0841)								(0.0288)			
Lagged Union Density		0.0527***		0.00164			0.987***		0.0617***			-0.00156		0.970***
		(0.0171)		(0.00280)			(0.00412)		(0.00585)			(0.00288)		(0.00457)
Lagged Adj. Bargaining		-0.0876***		-0.00698***		0.998***			-0.0873***			-0.00696***	1.004***	
		(0.0173)		(0.00244)		(0.00273)			(0.00558)			(0.00207)	(0.00289)	
Lagged Bargaining centralization		0.189		0.0307	0.955***				-0.257	0.912***		-0.0390		
		(0.581)		(0.0581)	(0.0219)				(0.158)	(0.0114)		(0.0555)		
Constant	-4.830	59.60***	0.623*	0.230	0.0661**	-0.197	-0.138	-4.348***	62.15***	0.119***	0.413*	0.306	-1.138***	-0.630***
	(3.595)	(3.337)	(0.361)	(0.219)	(0.0291)	(0.144)	(0.0957)	(1.358)	(1.485)	(0.0153)	(0.247)	(0.206)	(0.163)	(0.110)
Error														
Lagged Informal Economy	-4.0697*			-0.5102				-3.7452***			-1.7705***			
	(2.2032)			(0.3965)				(0.7439)			(0.3109)			
Observations	624	624	624	624	624	624	624	546	546	546	546	546	546	546
index	0.8967							0.8559						
Root mean square error of pclose	0.0921							0.1141						
	0.0000							-						
Standardized root mean error	0.0760							0.0706						
Coeficient of determination	1.0000							1.0000						

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own estimatio

5. Conclusion and discussion.

This chapter aims clarify the answer of the research question: does the informal sector acts as a mediator between the bargaining system and the formal economy? The results will be discussing as well as the limitations of the research. Additionally, some recommendations for future research are made.

Approximately, 2.5 billion workers are employed in the informal sector, almost half of the world workforce, lacking working rights (International Labour Office, 2019). Moreover, the trade unions have been losing size in the past decades (Aidt & Tzannatos, 2002, 2008), which is explained mainly by the growth of the informal sector (International Labour Office, 2019). Therefore, the International Labour Office is advising the unions to organize the informal workers, which are by definition vulnerable, in order to give them a voice and rights (2019). Hence, it is relevant for the future trends to analyze if the trade unions are affecting the informal sector in order to provide the best policy recommendations and guidelines.

The purpose of the paper is to analyze whether the informal sector acts as a mediator for the labor unions to the formal economy. The research was motivated, besides from the above-mentioned reasons, from the close relationship between the determinants of the informal sector and the externalities that arise from the labor unions. Moreover, the impact of the unions is usually studied regarding macroeconomic performance variables such as GDP, inflation and unemployment among others. However, the empirical literature provides contradictory findings (Aidt & Tzannatos, 2002, 2008; Traxler & Brandl, 2011). Hence, the aim of the paper is to study these relationships considering the informal sector, which has been neglected for decades in the economic research. To do so, a path analysis was carried out using structural equations modelling. Two models were presented, a static and a dynamic one.

As seen from this research, the informal economy acts as a mediator between the bargaining system variables and the formal economy. This is found in both models, the dynamic and static one. This is logical given the close relationship of both, the informal economy and the bargaining system indicators, with some macroeconomic variables such as unemployment and the fiscal burden.

Moreover, hypothesis 1 is confirmed as the relationship between the formal and informal economy is positive. As estimated by Medina and Schneider (2019), approximately 70% of the income generated in the informal sector goes back to the formal one by different channels. Regarding hypothesis 2, the union density relationship with the informal sector, though positive, is not neglectable. This is a slightly surprising result as the usual relationship with the formal sector is almost neglectable. However, is in line with those authors that highlight the relationship of the variable and the unemployment rate.

Hypothesis 3 is only true for the cases where the bargaining coverage is bigger than 35% as a u-shaped relationship is found for the informal economy. Hypothesis 4 is rejected as the relationship between the bargaining coverage is non-monotonic. However, further research is needed as the analysis faced some statistical limitations. Moreover, when considering the variables in the dynamic model the results are similar and there is evidence that the variables have a small lagged relationship across time.

Therefore, the informal economy acts as a mediator for the formal one. More importantly, the research shows the intersection between the two economic activities (formal and informal) which is usually neglected given the lack of official estimates. This is still a limitation, nevertheless, one can use different approaches and compare the results as done in this research.

Furthermore, the impacts of the variables are higher for the informal sector than for the formal one. This could be the explanation behind the contradictory results the empirical literature presents regarding this issue when considering macroeconomic performance indicators. As reported in chapter 2, the use of different control variables yields different results. More explicitly, the better the controls for macroeconomic performance, the smaller the relationship with the variables of interest. This could be signaling that when adding control variables that are determinants of the informal sector, the strength of the relationship with the bargaining system indicators vanishes. Hence, such control variables may be capturing the effects from the bargaining system indicators towards the informal economy. This is an important consideration to have when drafting policies regarding the labor market as it is highly linked with the informal sector.

The research has some limitations regarding the data and methodology. Firstly, the data availability for the bargaining institution indicators is not complete for the different countries from the world. The data is mainly complete for developed countries and OECD members. Secondly, the

methodological approach suffers from limitations regarding for example multicollinearity and sample size. In turn, this limited the analysis as potential quadratic relationships between the bargaining centralization level and the economic activities could not be studied. Finally, modelling informal and formal economy in the same system of equations is complex in terms of using instrumental variables to see if there is an endogeneity problem.

Further research should explore the possible non-linear relationships between the informal sector and the bargaining centralization level which was limited by the methodological approach in this case. Moreover, as data becomes available, a similar research should be conducted for developing countries as they have higher levels of informality and a higher percentage of the population is employed in the sector (International Labour Office, 2019), and as beforementioned, different authors suggest that the bargaining institutions have negative impacts in the formal economic activity in developing countries (for example: Aidt & Tzannatos, 2002; Justino, 2006). Other lines of research could also include the modelling of the relationship as a moderator instead of a mediator. This would give more clarity on how the levels of informality affect the relationships. Finally, in light of the relationships found in this paper, further research should include the earnings inequality as unions are said to decrease this inequality19 to understand how the relationship is affected by the informality.

To conclude, the research contributes to the literature of trade unions and collective bargaining by exploring the informal economy as a mediator to the formal one. The results found in the research aims to clarify why there are contradictory results in the empirical literature. Furthermore, understanding the links between the informal economy and the trade unions is necessary for fostering the right environment for the unions to penetrate the informal sector and capture the informal workers under their wing as recommended (Recommendation 204) by the International Labor Organization (International Labour Conference (2015). The understanding of how the informal sector and trade unions complement each other and the possible trade off that may arise from this relation is a key aspect for the recommendation to be successful and improve the lives of those vulnerable workers in the informal sector.

[19] For a discussion on the topic see Aidt & Tzannatos (2002, 2008).

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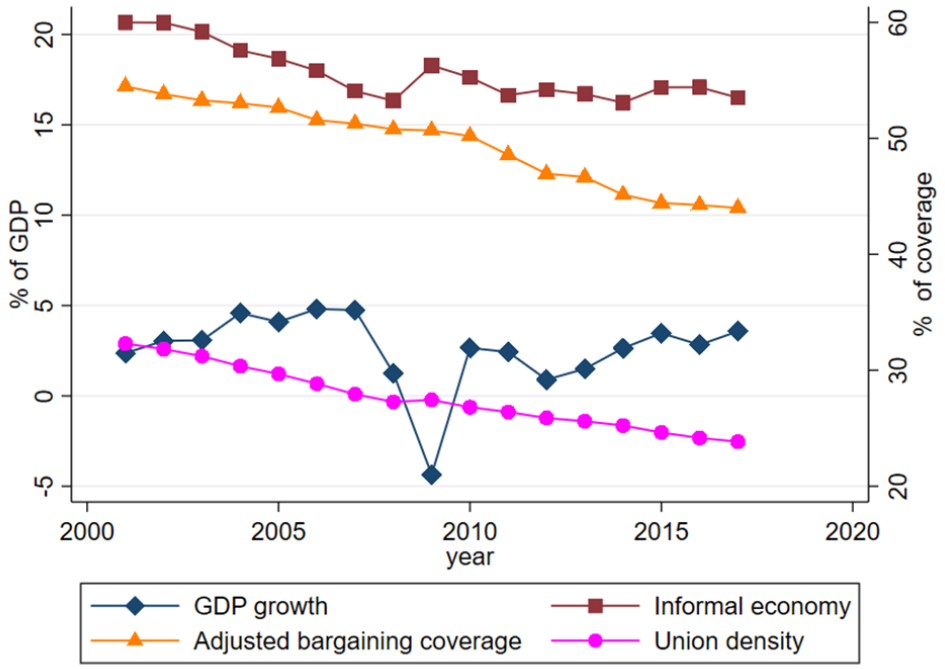
Appendix A: data description

A.1: Variables means by country

Country	GDP growth	Informal economy	Union density	Bargaining coverage	Bargaining centralization	Trade balance	Government expenditure	Unemployment rate	capital formation	Human capital index
Australia	2.9	11.2	18.4	58.9	1.6	41.7	3	5.5	3.7	3.5
Austria	1.5	7.4	30.5	98	2.3	97.6	1.3	5.1	1	3.3
Belgium	1.6	17.4	54.4	93.2	4.1	150.1	1.3	7.7	2	3.1
Bulgaria	3.6	27.6	15.4	36.8	2	109.7	1.6	10.8	5.6	3.1
Canada	2.6	12.3	30	29.2	1	66.7	1.9	7.1	2.8	3.6
Chile	3.8	16.1	13.7	14.7	1	67.1	4.3	8.4	6.3	3
Croatia	1.9	25.1	27	54	1.2	83.6	1.6	13.3	3.4	3.2
Cyprus	2.2	26.8	54.5	54.5	1.7	120.1	2	8	3.7	2.7
Czech Republic	2.8	13.8	16.8	29.7	1.8	129.3	1.5	6.4	2.5	3.6
Denmark	1.2	12.5	69.1	78	2.3	95.6	1.4	5.7	1.6	3.4
Estonia	3.7	22.4	7.9	24.3	1	141.9	2.5	9.2	6.6	3.5
Finland	1.4	11.2	69.7	88.5	3.1	75.2	1.1	8.6	1.3	3.3
France	1.2	12.1	9	95.3	2.4	56.7	1.5	8.9	1.3	3
Germany	1.3	10.5	19.7	61.4	2.2	77.2	1.7	7.2	0.9	3.6
Greece	0	23.7	22.9	81.2	2.6	56.9	0.4	15.5	-2.1	2.9
Hungary	2.2	21.3	13	26.6	1	149.9	1.8	7.6	2.5	3.2
Ireland	4.5	11.7	31.5	38.7	2.6	178.7	2.3	8.6	8.1	3
Israel	3.2	19.8	26.5	33	1.5	69.4	2.6	8.7	3.4	3.5
Italy	0.2	20.6	34.5	80	2.5	52.5	0.3	9.3	-0.6	3
Japan	0.8	11.1	18.4	17.5	1	29.3	1.4	4.3	-0.2	3.5
Latvia	3.8	21	14.6	28.3	1	105.6	1.6	11.9	4.9	3
Lithuania	4.2	24.1	9.8	9.6	1	125.2	1	10.9	6.7	3.1
Luxembourg	2.8	9	36.6	57.5	1.8	328.1	3.1	4.8	3.9	3.2
Malaysia	4.9	29.7	9.8	1.4	1	169.3	7	3.3	5.2	2.8
Malta	3.6	23.9	53.9	53	1	271.4	2.3	6.3	4.7	3
Mexico	2	28.8	14.3	13.7	1	60.9	1.5	4.1	1.9	2.6
Netherlands	1.3	9.4	19.5	82.9	2.4	134	2	4.9	1.3	3.3
New Zealand	2.8	10.6	20.4	18.5	1	58.1	3	5.2	4.6	3.3
Norway	1.6	11.9	50.1	72	2.4	69.7	2.2	3.7	3.2	3.5
Philippines	5.4	38.5	9.6	1.7	1	70.4	5.2	4	7.8	2.6
Portugal	0.5	18.6	19.4	78.4	2.7	71	0.5	9.6	-1.6	2.3
Romania	4.1	27.2	31.1	76.4	2.4	69.2	0.1	6.8	7.4	3.1
Singapore	5.2	11.1	19.1	18	1	371.1	4.4	4.5	4.4	3.1
Slovenia	2.2	21.5	32.2	85.7	3.1	129.8	1.6	7	0.3	3.4
Spain	1.6	20.9	16.7	70.5	2.4	58	2.6	16.1	0.5	2.8
Sweden	2.2	10.9	73.2	90.4	2.4	83.3	1.2	7	3.1	3.3
Switzerland	1.8	5.9	17.8	46.2	2.3	110.2	1.4	4.2	1.9	3.6
Turkey	5.2	28.8	11.3	8.4	1	48.8	5	9.9	8.7	2.2
United Kingdom	1.8	9.9	26.5	31.7	1	56.1	2.1	5.8	1.6	3.7

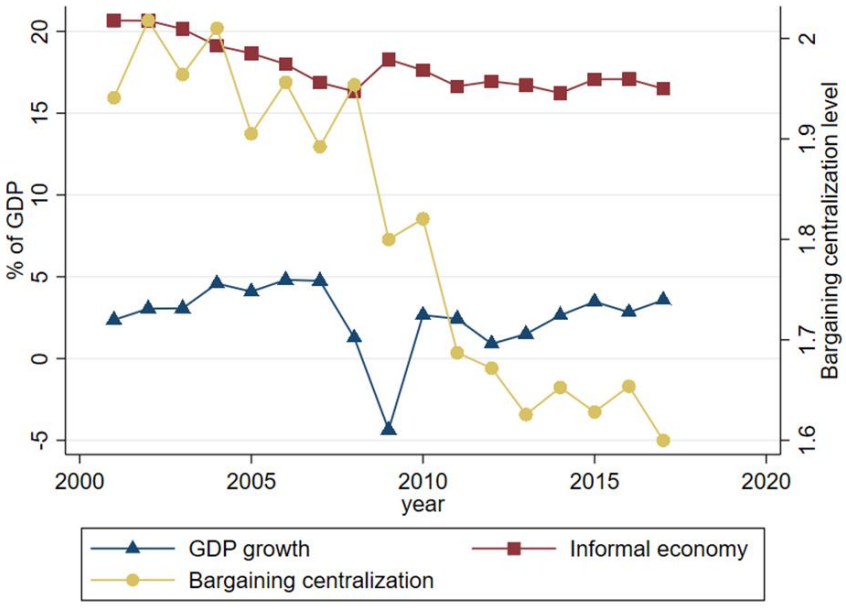
Source: own estimations.

A..2: Union density, adjusted bargaining coverage and the formal and informal sectors over time



Source: own elaboration

A.3: Level of bargaining centralization vs. the formal and informal economic activity



Source: own elaboration

A.4: Informal economy from currency demand approach:

Country	year 2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Australia	21.4	14.9	15.4	16.2	16.0	16.1	14.4	14.7	14.9	10.6	12.4	13.4					
Austria																	
Belgium	19.3	15.7	15.1	12.8	15.6	13.3	12.7	14.2	12.6	5.6							
Bulgaria																	
Canada	17.8	19.1	17.1	17.7	18.1	15.4	12.1	11.2									
Chile																	
Croatia																	
Cyprus																	
Czech Republic	35.4	19.8	19.8	19.5	17.2	15.7	15.6	14.3	13.6	12.3	12.5	12.8					
Denmark	8.2	9.4	10.7	10.0	8.5	7.5	8.0	9.3	13.0	13.5	12.4	13.5					
Estonia																	
Finland																	
France	11.7	16.2	14.6	15.1	13.1	11.2	10.1	13.3	17.5	17.9	16.4	18.4					
Germany	8.1	8.5	9.0	8.5	7.8	6.9	7.0	8.7	8.6	7.9	7.9	7.3					
Greece																	
Hungary	13.5	12.9	11.9	12.1	10.9	10.0	10.6	12.4	14.4	12.8	11.8	12.2					
Ireland	22.8	25.6	10.6	10.6	9.9	8.9	8.6	10.7	8.7	7.9	9.0	9.9					
Israel																	
Italy	5.6	5.8	5.9	5.8	5.5	5.2	6.0	6.9	8.2	10.0	9.7	11.5					
Japan	12.1	9.1	7.4	7.3	7.0	6.5	6.0	5.8	5.9	5.7	6.0	6.0					
Latvia	27.2	27.4	18.5	16.2	15.4	13.0	12.8	14.5	16.7	18.2	17.3	15.6					
Lithuania	23.1	28.0	23.4	17.7	14.0	13.3	11.4	12.4	15.7	15.2							
Luxembourg	6.0	5.9	6.3	6.6	6.6	7.2	6.3	6.0	6.8	5.4	5.8	5.5					
Malaysia	19.3	15.4	15.0	16.8	18.1	17.9	15.3	16.4	17.4	12.4	15.4	14.9					
Malta																	
Mexico																	
Netherlands	12.6	11.9	11.1	11.0	13.0	13.1	15.4	16.8	15.0	9.4	11.5	11.0					
New Zealand																	
Norway	3.1	3.7	4.4	5.7	5.0	4.7											
Philippines	33.1	31.3	27.0	24.7	24.2	26.1	24.9	20.9	21.0	21.9	17.6	19.5					
Portugal	10.6	11.4	12.0	12.0	11.5	11.0	12.1	16.3	19.6	21.8	25.7	25.1					
Romania	19.5	21.3	22.1	20.8	19.2	14.8	10.7	12.5	15.7	17.4	18.3						
Singapore	17.0	15.8	15.8	13.2	12.6	12.4	11.8	12.2	11.3	8.4	8.2	8.5					
Slovenia	59.6	32.0	36.8	21.5	18.7	18.9	18.7	22.0	24.9	21.7	27.4	24.7					
Spain	10.3	9.5	10.0	10.2	6.3	6.5	7.6	8.2	7.6	8.7	7.6	6.0					
Sweden																	
Switzerland	6.4	7.4	7.1	6.8	6.8	6.0	5.7	7.2	6.1	6.0	5.9						
Turkey																	
United Kingdom																	

Source: own elaboration.

Appendix B: Empirical considerations and extras

B.1: Summary statistics for extrapolated variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Union density	543	28.90	19.12	4.30	83.21
Union density extrpolated	663	27.61	17.88	4.30	83.21
Bargaining coverage	415	50.74	30.66	0.80	100.00
Bargcainin coverage extrapolated	663	49.51	30.64	0.80	100.00

Source: own estimation.

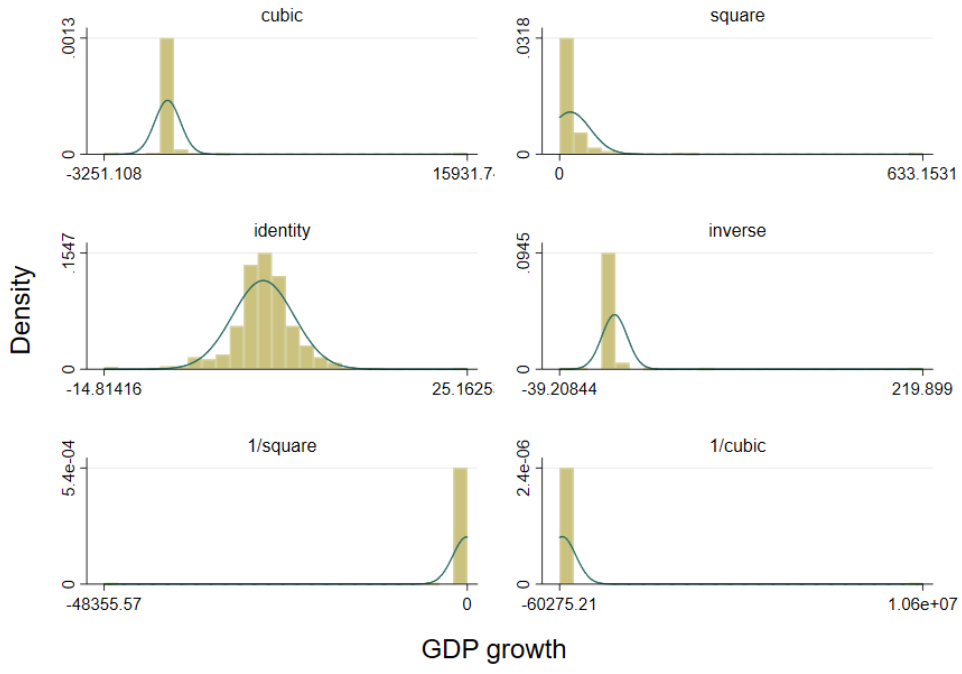
B..2: Test Doornik-Hansen for multivariate normality results:

chi2(22) =11159.736 Prob>chi2 =0.00 for original variables

chi2(18) = 8749.993 Prob>chi2 =0.00 for transformed variables (logarithms of trade balance, unemployment and union density)

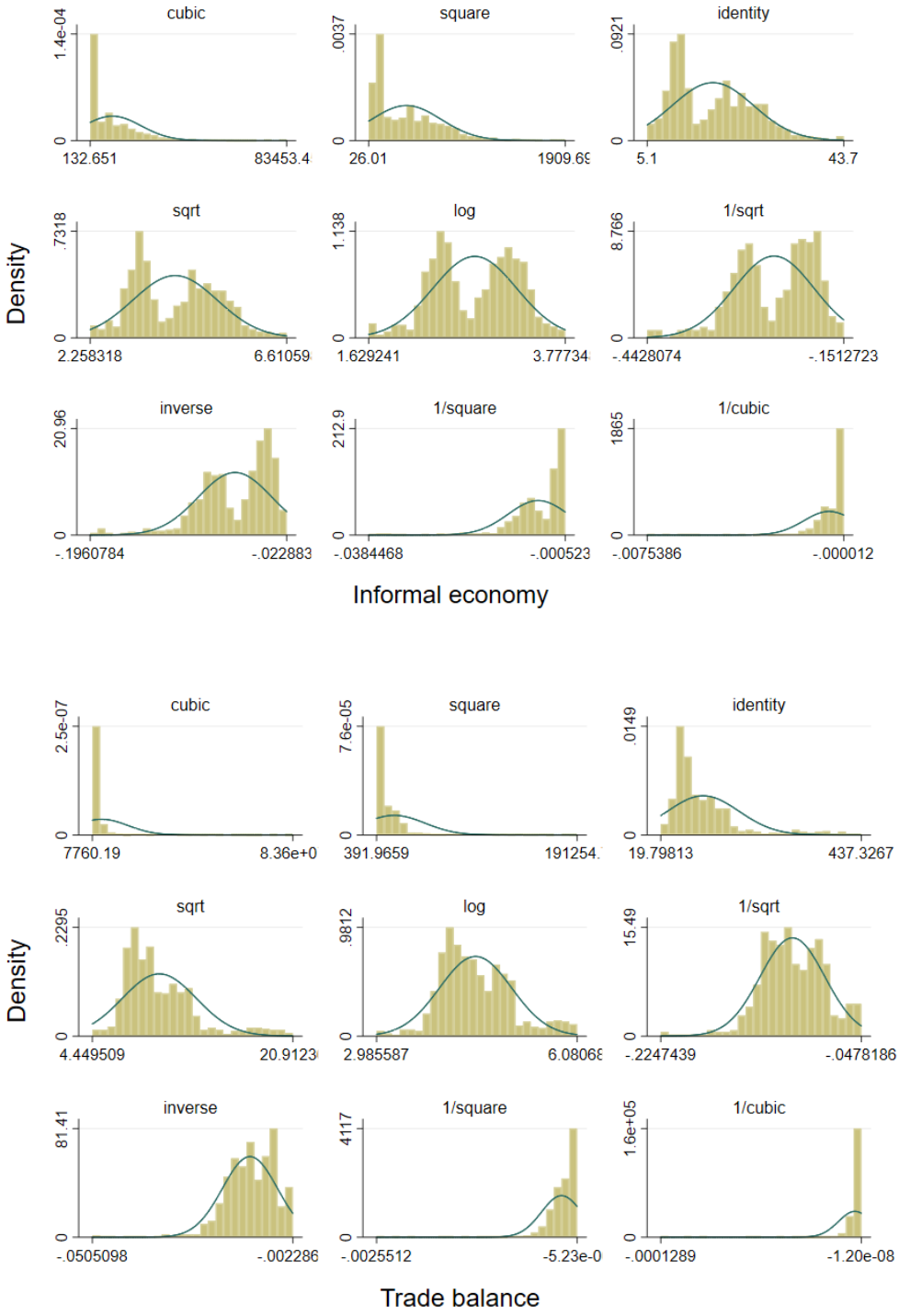
Source: own estimation.

B..3: Exploration of possible variables transformations



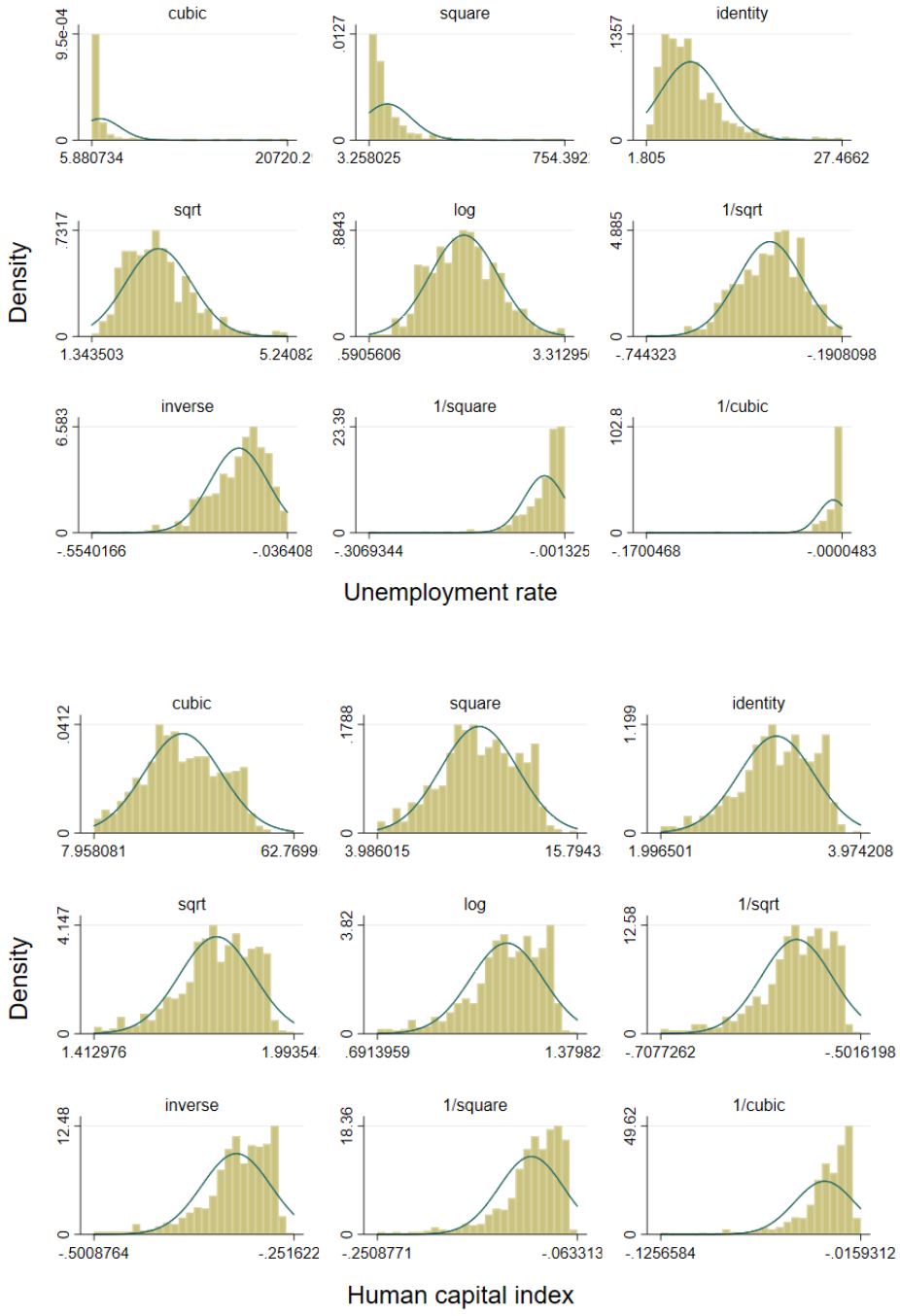
Source: own elaboration.

B..3: Exploration of possible variables transformations (cont.)



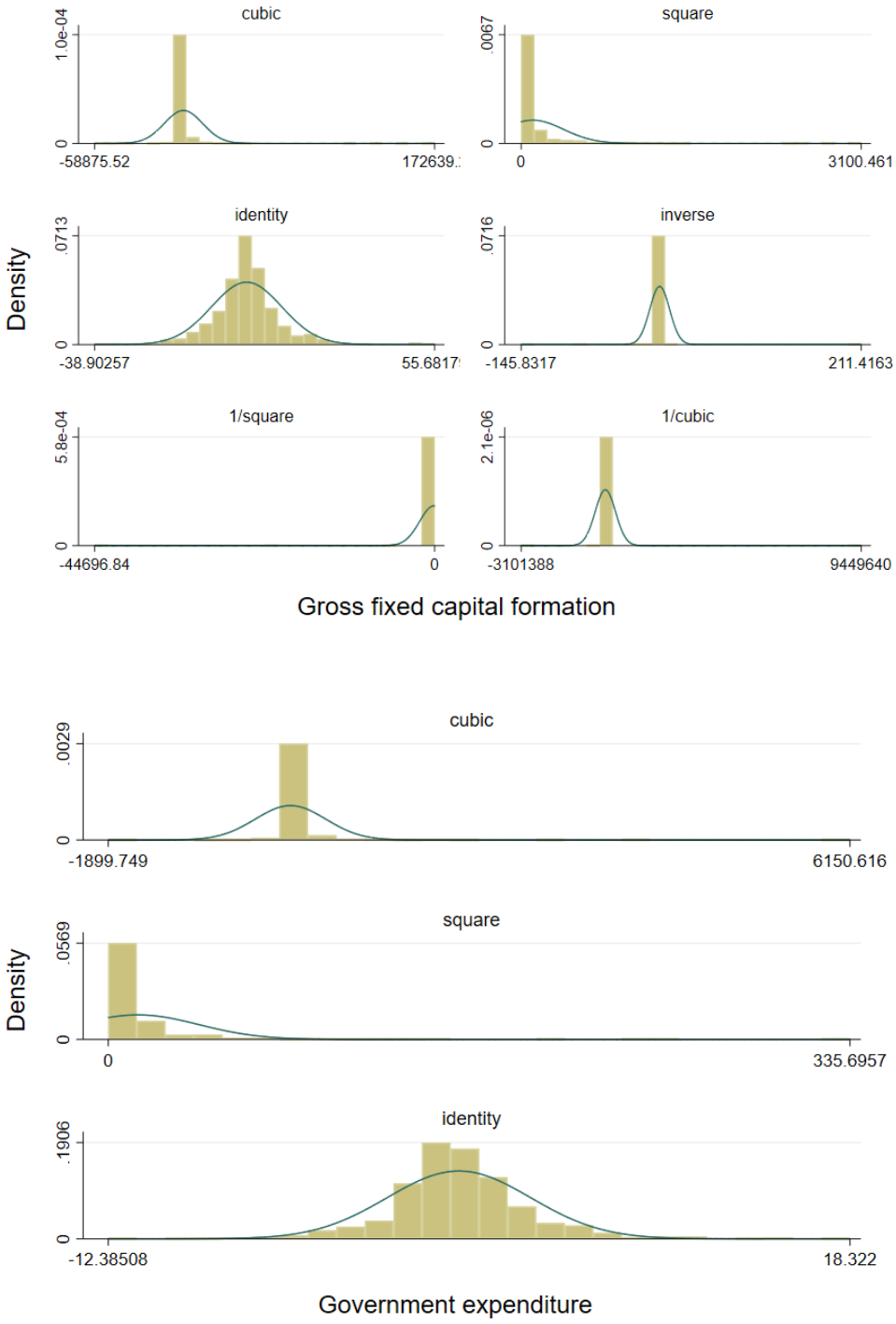
Source: own elaboration.

B..3: Exploration of possible variables transformations (cont.)



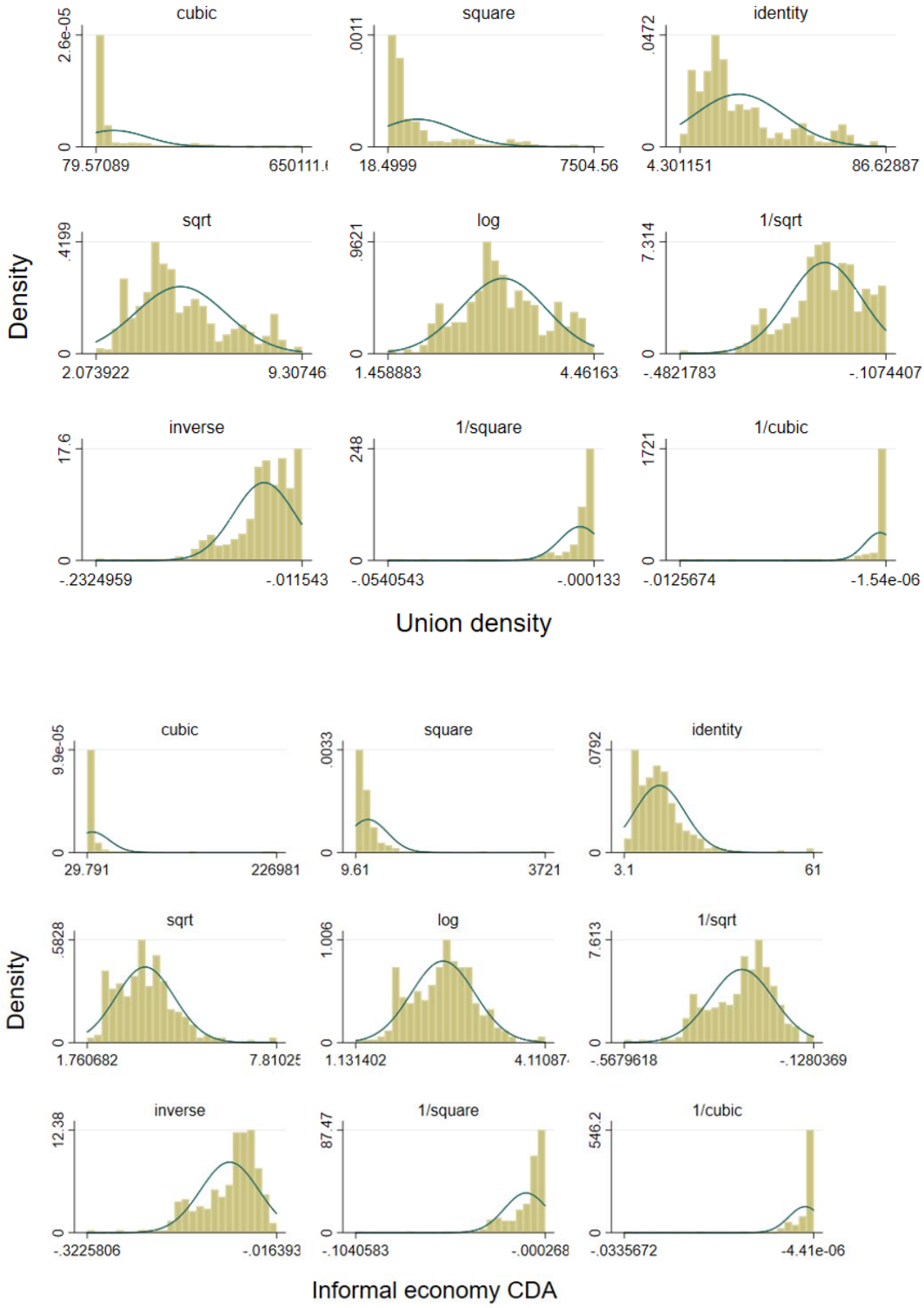
Source: own elaboration.

B..3: Exploration of possible variables transformations (cont.)



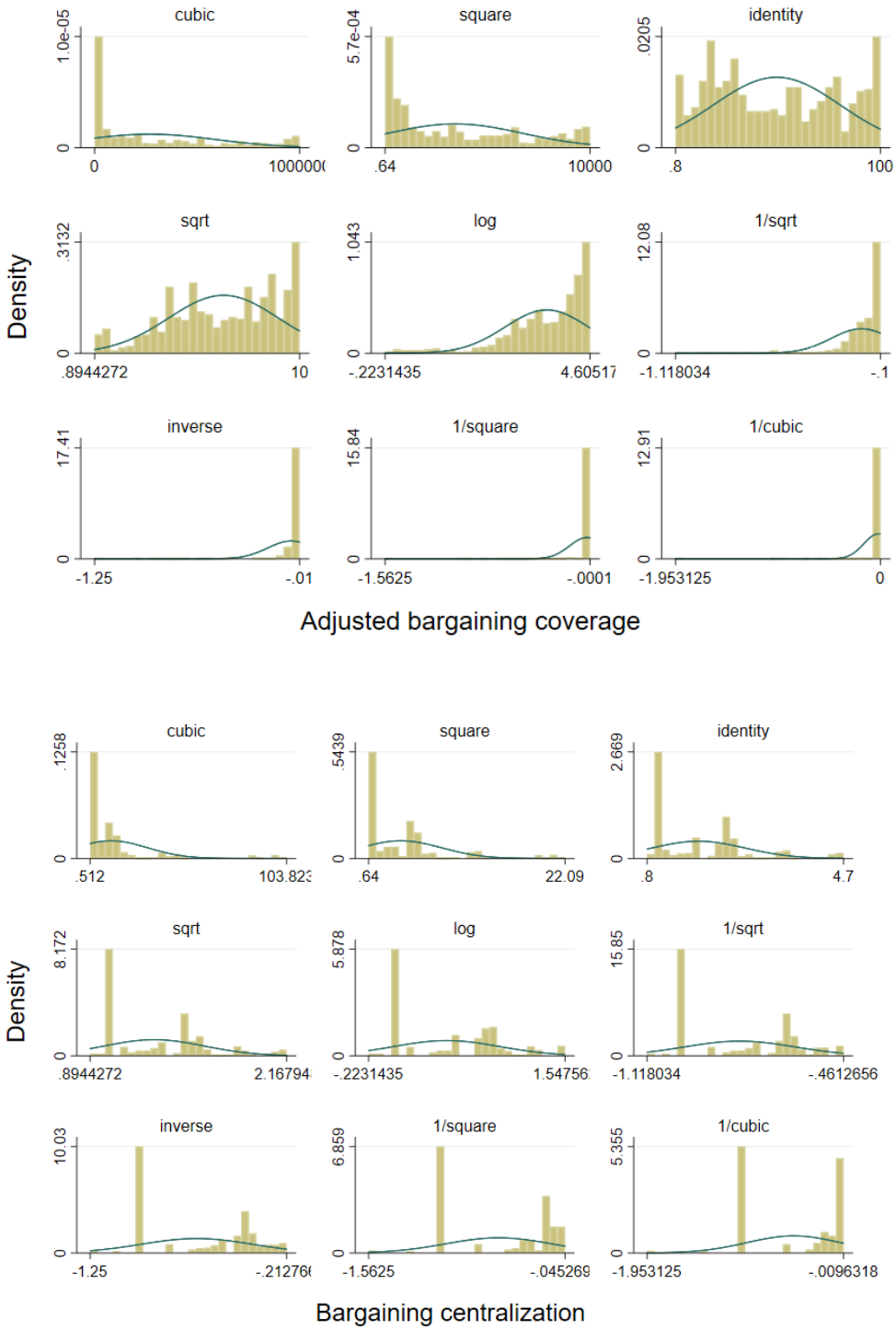
Source: own elaboration.

B..3: Exploration of possible variables transformations (cont.)



Source: own elaboration.

B..3: Exploration of possible variables transformations (cont.)



Source: own elaboration.

B..4: Multicollinearity tests

Variable	VIF
Informal economy	2.11
Gross fixed capital forr	1.32
Human capital index	1.83
Government expenditur	1.37
Trade balance	1.11
Unemployment rate	1.37
Union density	1.58
Bargaining coverage	3.74
Bargaining centralizatic	2.74
Dummy 2009	1.21
Mean VIF	1.84

Source: own elaboration.

Appendix C: Contemporaneous results

C.1: Independent equations of GDP growth and informal economy with their goodness of fit measures

	Model 14	Model 15
VARIABLES	GDP growth	Informal Economy
Informal Economy	0.0341**	
	(0.0150)	
Dummy 2009	-3.879***	
	(0.394)	
Gross fixed capital formation	0.199***	
	(0.0180)	
Unemployment rate	-0.0501***	0.411***
	(0.0186)	(0.0428)
Human capital index	0.00710	-11.26***
	(0.234)	(0.372)
Trade balance	0.00467***	-0.0108***
	(0.00125)	(0.00181)
Bargaining centralization	0.0604	0.371
	(0.113)	(0.230)
Government expenditure	0.178***	
	(0.0301)	
Adjusted Bargaining coverage rate	-0.0111***	-0.102***
	(0.00383)	(0.00861)
square adj. bargaining cov. rate	0.000169*	0.00142***
	(8.78e-05)	(0.000215)
Union Density	-0.00145	0.0540***
	(0.00380)	(0.00741)
Constant	1.340	52.95***
	(0.994)	(1.497)
Observations	663	663
Comparative fit index	1.00	1.00
Root mean square error of aproximation	-	-
pclose	1.00	1.00
Standardized root mean error	0.00	0.00
Coeficient of determination	0.71	0.54

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own elaboration.

C.2: Multicollinearity test for square terms

Variable	VIF	VIF
Informal Economy	2.18	2.18
Unemployment rate	1.5	1.55
Trade balance	1.14	1.17
Gross fixed capital formation	1.32	1.32
Dummy 2009	1.21	1.22
Government expenditure	1.37	1.37
Human capital index	1.92	1.92
Union Density	1.63	1.68
Adjusted Bargaining coverage rate	3.75	**5.19**
square adj. bargaining cov. rate	1.38	1.48
Bargaining centralization	2.77	**37.86**
Square bargaining centralization		**27.27**
Mean VIF	1.83	7.02

Source: own elaboration.

C.3: Correlation matrix

	GDP growth	Informal Economy	Gross fixed capital formation	Union Density	Unemployment rate	Trade balance	Government expenditure	Bargaining centralization	Bargaining coverage rate	Human capital index	Sq. bargaining centralization	Sq bargaining cov. rate	Informal economy CDA
GDP growth	1												
Informal Economy	0.165	1											
Gross fixed capital formation	0.7641	0.0935	1										
Union Density	-0.1125	-0.2132	-0.0441	1									
Unemployment rate	-0.1932	0.2521	-0.1043	-0.085	1								
Trade balance	0.1789	-0.1086	0.0809	0.0799	-0.1659	1							
Government expenditure	0.3829	0.1266	0.2636	-0.1346	-0.356	0.1154	1						
Bargaining centralization	-0.1594	-0.2073	-0.0879	0.4373	-0.0282	-0.1043	-0.141	1					
Bargaining coverage rate	-0.2567	-0.3252	-0.1332	0.5642	0.0882	-0.1143	-0.2704	0.7841	1				
Human capital	-0.1249	-0.6382	-0.065	0.152	-0.1825	0.0013	-0.1593	0.0147	0.1019	1			
Sq. bargaining centralization	-0.1166	-0.1351	-0.0667	0.394	-0.0257	-0.0736	-0.1042	0.9693	0.676	-0.0293	1		
Sq bargaining cov. rate	0.1296	0.3131	0.0747	-0.1747	-0.16	-0.156	0.1518	0.0746	-0.0516	-0.3576	0.1395	1	
Informal economy CDA	0.1466	0.5495	0.0335	-0.1215	0.0987	-0.0727	0.0636	0.0383	-0.0874	-0.2142	0.1192	0.45	1

Source: own elaboration.

C.4: Baseline model coefficient of determination split between the dependent variables.

Dependan variables	Variance fitted	predicted	residual	R-squared	mc
observed					
GDP growth	11.8	8.3029	3.4942	0.7038	0.8389
Informal Econom	61.8	33.1453	28.6245	0.5366	0.7325
overall				**0.8598**	

Where mc is the correlation between the dependent variable and its pedictors.

Source: own elaboration.

C.5: Residual matrix of observed variables from baseline model

Mean residuals

	GDP growth	Informal Economy	Dummy 2009	Gross fixed capital formation	Unemployment rate	Human capital index	Trade balance	Bargaining centralization	Government expenditure	Adjusted Bargaining coverage rate	square adj. bargaining cov. rate	Union Density
raw	-0.01	0.04	0	0	0	0	0	0	0	0	0	0

Covariance residuals

	GDP growth	Informal Economy	Dummy 2009	Gross fixed capital formation	Unemployment rate	Human capital index	Trade balance	Bargaining centralization	Government expenditure	Adjusted Bargaining coverage rate	square adj. bargaining cov. rate	Union Density
GDP growth	-0.241											
Informal Economy	0.489	0.372										
Dummy 2009	-0.001	0.014	0									
Gross fixed capital formation	-0.26	2.712	0	0								
Unemployment rate	0.016	0.143	0	0	0							
Human capital index	0.004	-0.008	0	0	0	0						
Trade balance	-0.601	-0.408	0	0	0	0	0					
Bargaining centralization	0	-0.006	0	0	0	0	0	0				
Government expenditure	0.002	0.49	0	0	0	0	0	0	0			
Adjusted Bargaining coverage rate	0.043	-0.322	0	0	0	0	0	0	0	0		
square adj. bargaining cov. rate	0.258	3.601	0	0	0	0	0	0	0	0	0	
Union Density	-0.212	-0.359	0	0	0	0	0	0	0	0	0	0

Source: own elaboration.

Appendix D: Cross-lagged panel model

D.1: Variance inflation factor test for cross-lagged panel model

Variable	VIF	VIF	VIF	VIF
Lagged Informal Economy	**116.49**	**115.35**	1.13	2.14
Lagged GDP growth	4.03	4.03		3.42
Informal Economy	**115.32**	**113.75**		
GDP growth	2.28	2.22		
Lagged Gross fixed capital formation	2.58	2.58		2.47
Lagged Union Density	1.7	1.59	1.47	1.58
Lagged Unemployment rate	1.56	1.41		1.39
Lagged Trade balance	1.24	1.16		1.14
Lagged Government expenditure	1.48	1.47		1.45
Lagged Dummy 2009	1.62	1.62		1.46
Lagged Human capital index	1.93	1.85		1.83
Lagged Bargaining centralization	**7.23**	**6.61**	2.61	2.74
Lagged Adj. Bargaining coverage rate	**95.35**	**92.85**	3.26	3.77
Adj. Bargaining coverage rate	**102.48**	**95.71**		
Bargaining centralization	**52.53**	**6.78**		
Sq. Bargaining cent.	**29.44**			
Sq. Adj. Barg. coverage rate	1.55			
Mean VIF	**31.7**	**29.93**	2.12	2.13

Source: own estimations.

D.2: Residual matrix of observed variables from the baseline model

Mean residuals

	Lagged GDP growth	Lagged Informal Economy	GDP growth	Informal Economy	Bargaining centralization	Adj. Bargaining coverage rate	Union Density	Dummy 2009	Lagged Gross fixed capital formation	Lagged Unemployment rate	Lagged Human capital index	Lagged Trade balance	Lagged Government expenditure	Lagged Bargaining centralization	Lagged Adj. Bargaining coverage rate	Lagged Union Density
raw	-0.227	0.218	-0.486	0.412	-0.005	-0.375	-0.034	0	0	0	0	0	0	0	0	0

Covariance residuals

	Lagged GDP growth	Lagged Informal Economy	GDP growth	Informal Economy	Bargaining centralization	Adj. Bargaining coverage rate	Union Density	Dummy 2009	Lagged Gross fixed capital formation	Lagged Unemployment rate	Lagged Human capital index	Lagged Trade balance	Lagged Government expenditure	Lagged Bargaining centralization	Lagged Adj. Bargaining coverage rate	Lagged Union Density
Lagged GDP growth	1.542															
Lagged Informal Economy	0.904	2.475														
GDP growth	2.344	-0.237	8.669													
Informal Economy	0.425	2.411	-1.98	2.801												
Bargaining centralization	0.092	-0.149	-0.297	-0.071	0.018											
Adj. Bargaining coverage rate	-0.324	-9.252	-15.015	-5.013	0.741	-3.303										
Union Density	-3.19	-7.292	-3.736	-6.222	0.308	3.296	2.324									
Dummy 2009	-0.03	0.021	0.115	-0.003	0.003	0.012	-0.006	0								
Lagged Gross fixed capital formation	3.01	2.565	5.69	1.334	0.229	1.75	-0.784	0	0							
Lagged Unemployment rate	0.473	1.902	0.253	1.765	-0.045	-2.915	-0.551	0	0	0						
Lagged Human capital index	0.009	-0.033	0.037	-0.037	0.001	0.02	0.027	0	0	0	0					
Lagged Trade balance	-8.073	-21.162	31.114	-24.565	-0.206	12.594	3.203	0	0	0	0	0				
Lagged Government expenditure	-0.324	0.185	1.111	0.047	0.074	1.735	0.196	0	0	0	0	0	0			
Lagged Bargaining centralization	-0.012	-0.067	-0.414	0.035	-0.051	0.087	0.039	0	0	0	0	0	0	0		
Lagged Adj. Bargaining coverage rate	-1.37	-5.576	-15.138	-1.436	0.466	-6.359	1.128	0	0	0	0	0	0	0	0	
Lagged Union Density	-2.755	-5.439	-2.887	-4.552	0.263	1.701	0.814	0	0	0	0	0	0	0	0	0

Source: own elaboration.