

2.3 Applied Economics (regional and labour)

Chair: Vassilis Monastiriotis (LSE)

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The impact of integration on regional growth and cohesion in Greece

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This research paper was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the “2nd Call for H.F.R.I. Research Projects to support Faculty Members & Researchers” (Project Number: 3861 Acronym: DISINREG).

Objective

Examination of the adjustment of the Greek economy in the process of EU integration at the regional level during the recent recession period.

Investigation of the growth effects of various types of trade integration.

Contribution to the deeper understanding of the geographically uneven effects of increased integration in a peripheral economy.

Research question

Are the processes of development and integration on regional growth dependent on each other?



Do more advanced regions have better chances to benefit from the integration process?
If true, what is the critical development threshold after which integration has a positive impact?



Are higher levels of integration associated with divergence, while lower levels of integration with convergence?
If true, what is the critical threshold level of integration after which inequalities increase alongside the level of development?

Brief overview of empirical literature

Regional inequality in the EU has increased and divergence patterns tend to prevail in the new millennium (Iammarino et al. 2018; Petrakos and Artelaris 2009).

Most drivers of regional growth tend to favor more advanced, metropolitan, and regions with more competitive production structure (Ciccone 2002; Petrakos et al. 2012) → formation of regional income clubs (Iammarino 2018).

EU integration is accompanied by losses in the less competitive production systems of the South due to pressure of imports from the more advanced production systems of the North (Petrakos et al. 2005b)

Competition among unequal partners may create uneven growth returns across regions → winners and losers (Ezcurra and Rodríguez-Pose 2013; Iammarino et al. 2018; Petrakos et al. 2011)

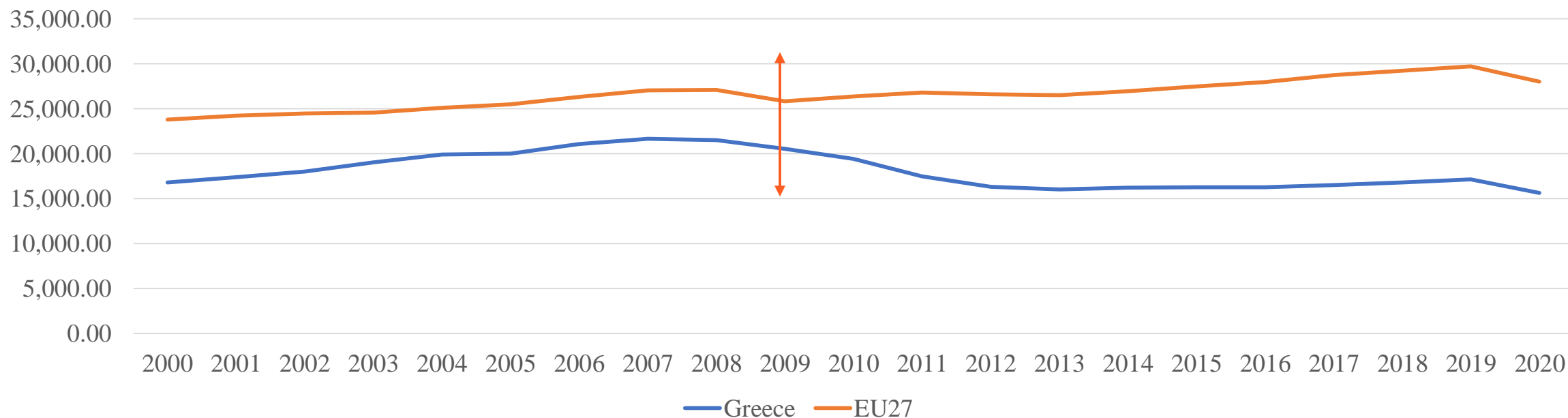
The footprint of EU integration on less developed regions may be responsible for increasing regional disparities, both at the national and international levels (Bradley et al. 2004; Ezcurra and Rodríguez-Pose 2013; Fotopoulos et al. 2010; Iammarino et al. 2018; Autor et al. 2013; Petrakos et al. 2005a; Rodríguez Pose 2012; Ezcurra and Rodríguez-Pose 2014).

The performance of the Greek economy: taking crisis into consideration

2000-2009: a trend of slow convergence with the EU average

2010-2020: a process of divergence that may still be active

Figure 1. GDP per capita of Greece and EU (constant prices 2015), 2000-2020

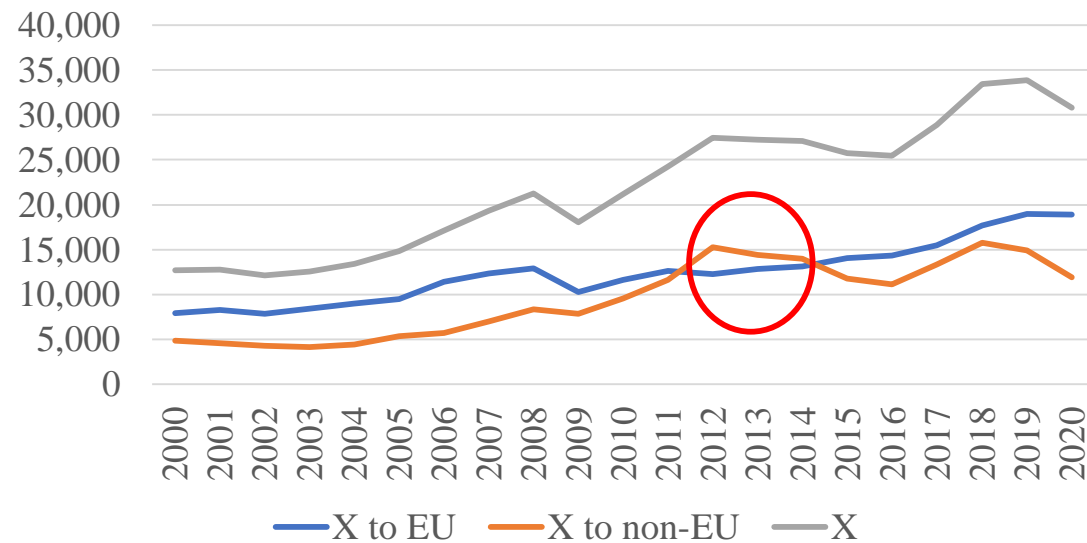


Source: own elaboration using data from the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy

Examination of trade relations: exports

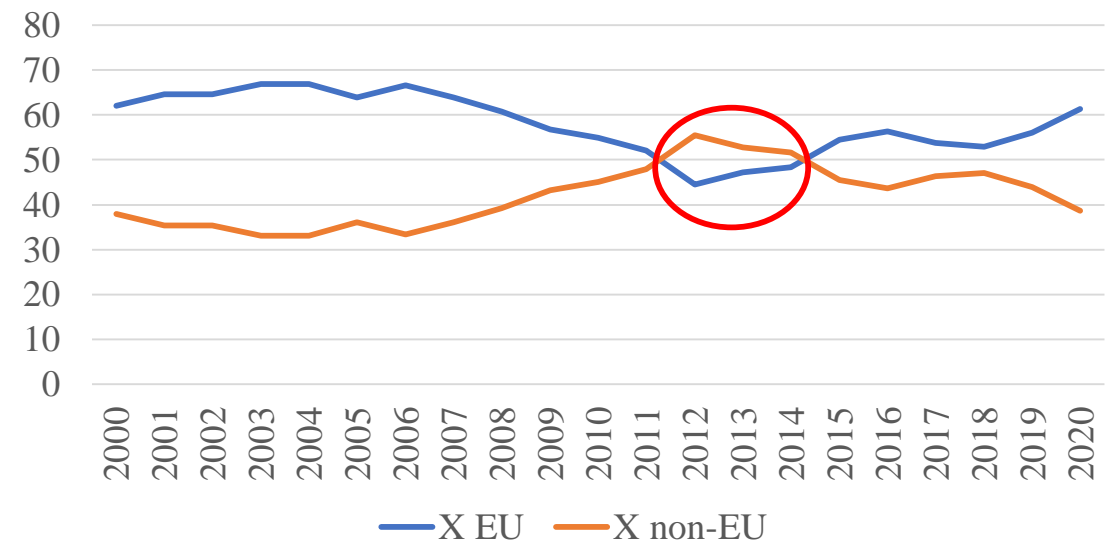
- Non-EU exports exceeded those to EU in the first years of the crisis
→ shift of the productive system to less demanding markets

Figure 2. Greek exports (million €), 2000-2020



Source: own elaboration using data from EUROSTAT (2023)

Figure 3. Share of exports (over total), 2000-2020

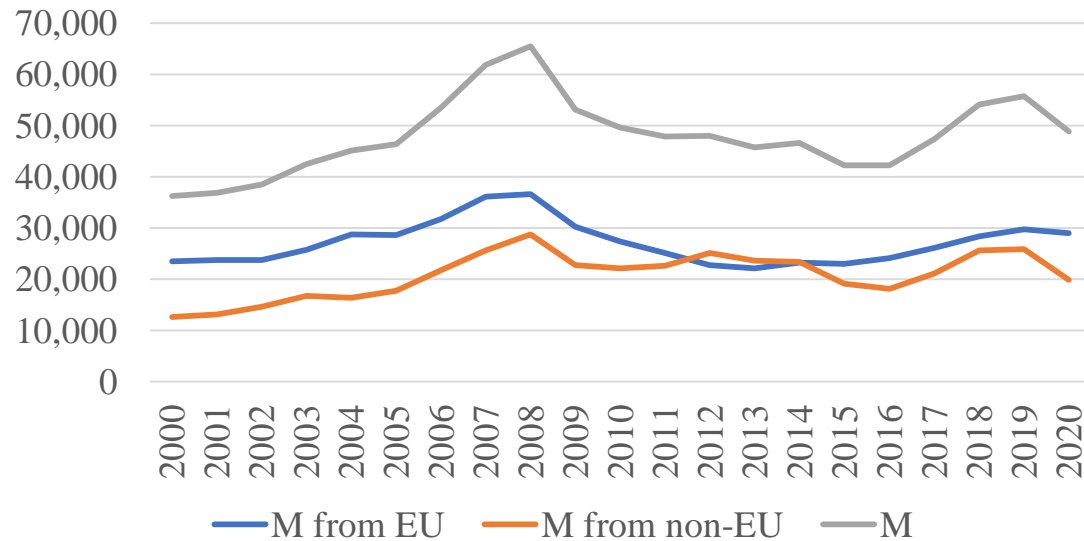


Source: own elaboration using data from EUROSTAT (2023)

Examination of trade relations: imports

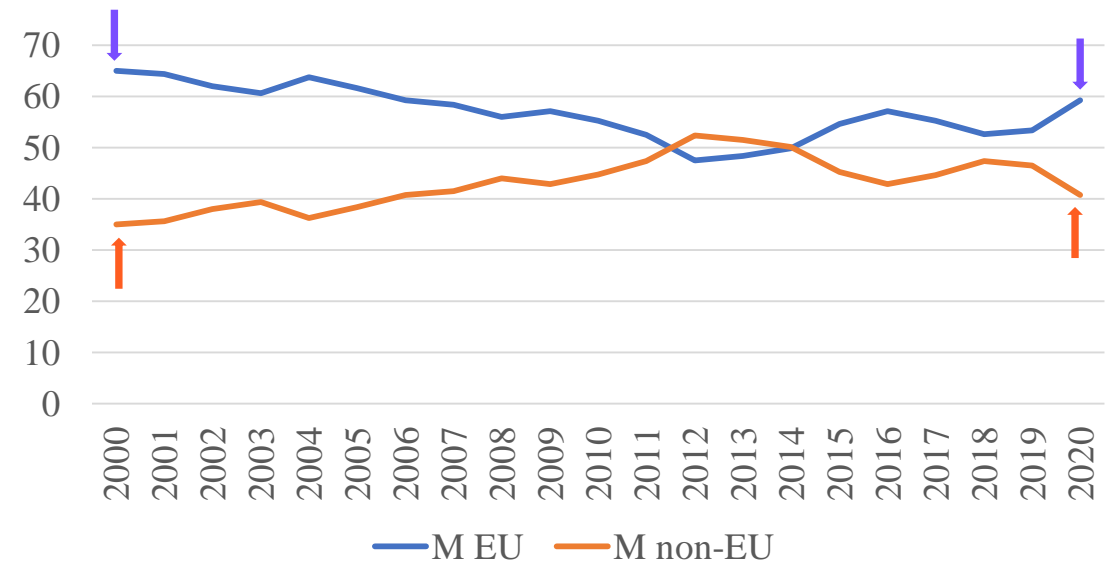
- Imports from EU have declined for several years before regaining an upward trend, but their relative share is lower at the end of the period
- Imports from non-EU were also affected by the crisis, but increased their relative share at the end of the period

Figure 4. Greek imports (million €), 2000-2020



Source: own elaboration using data from EUROSTAT (2023)

Figure 5. Share of imports (over total), 2000-2020

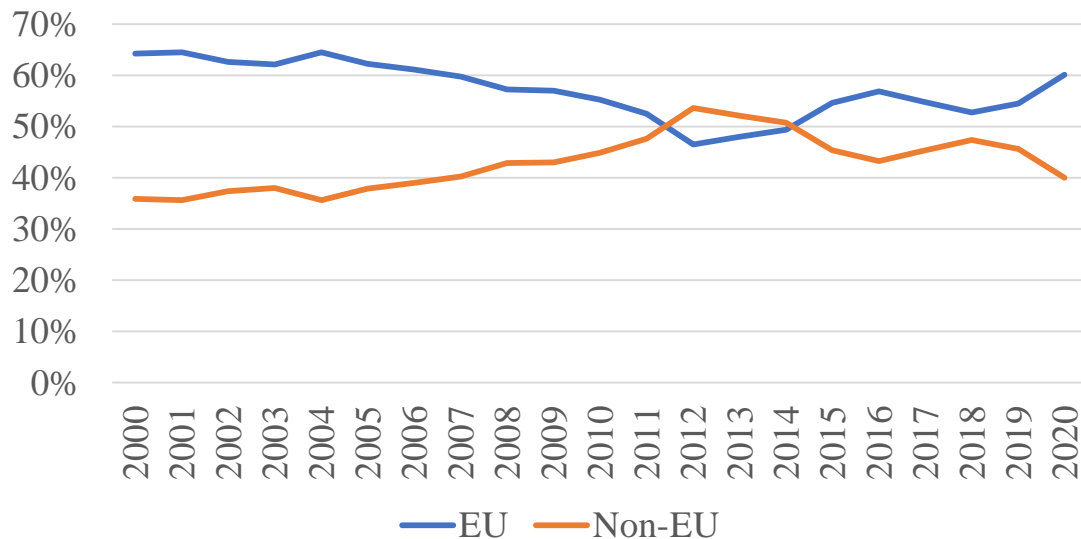


Source: own elaboration using data from EUROSTAT (2023)

Integration dynamics: two parallel and overlapping processes of integration

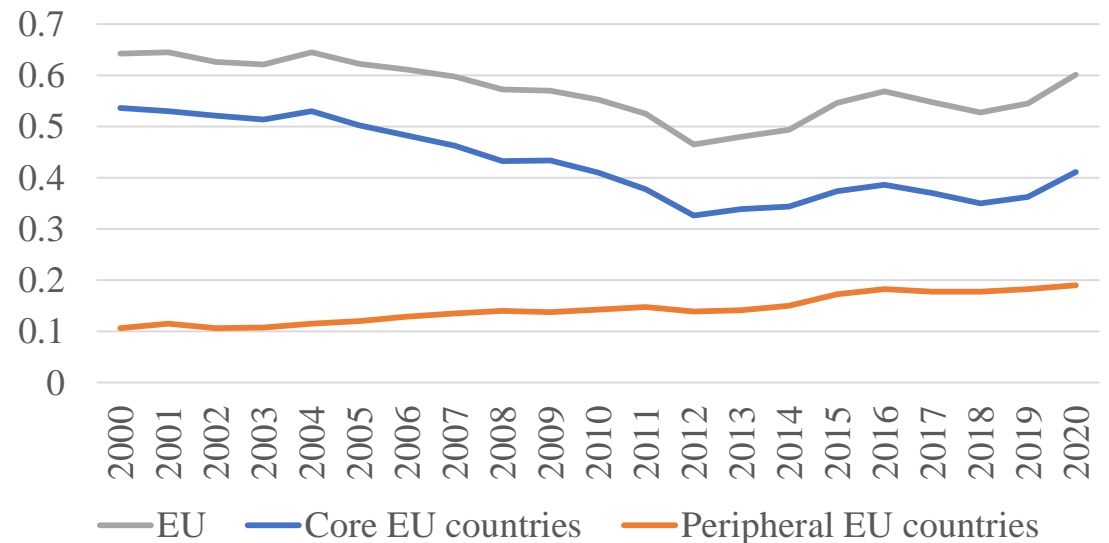
- The crisis has led to a significant reduction of the share of trade with the EU for a period, which may leave a permanent impact on the direction of Greek trade
- The production system of Greece is gradually moving from trade with Core to trade with Peripheral EU countries in an effort to better adapt to competition

Figure 6. EU and non-EU Trade Integration Index, 2000-2020



Source: own elaboration using data from EUROSTAT (2023)

Figure 7. Intra-EU Trade Integration Index, 2000-2020

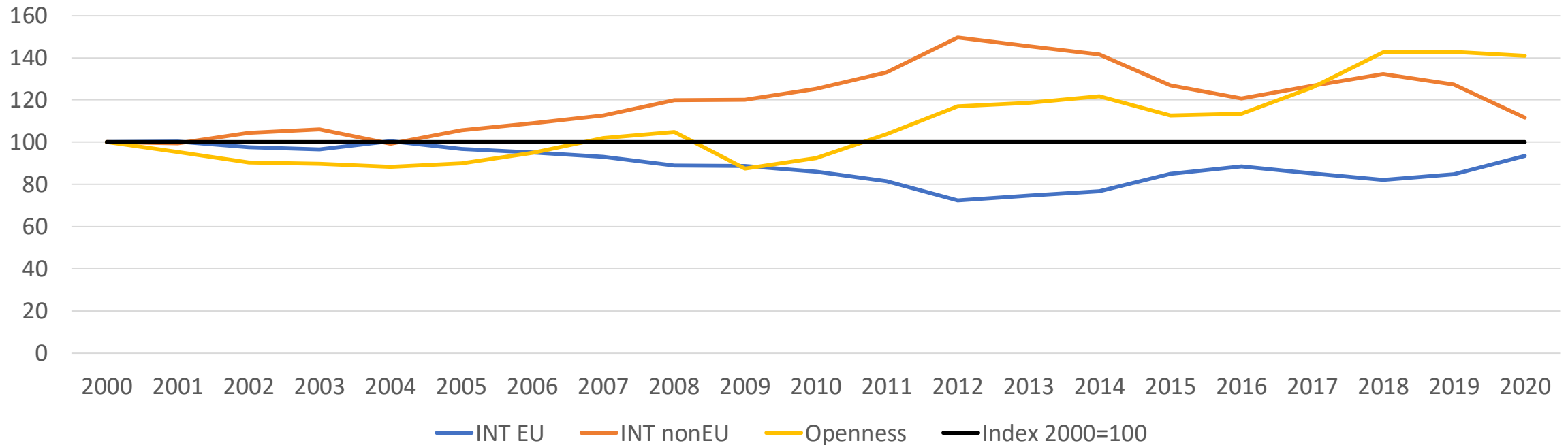


Source: own elaboration using data from EUROSTAT (2023)

The processes of globalization and integration

The globalization (openness) process has been stronger than the integration process during the period under examination, even though Greece is an EU member for over 40 years.

Figure 10. Indices of EU and non-EU integration and openness (2000=100), 2000-2020

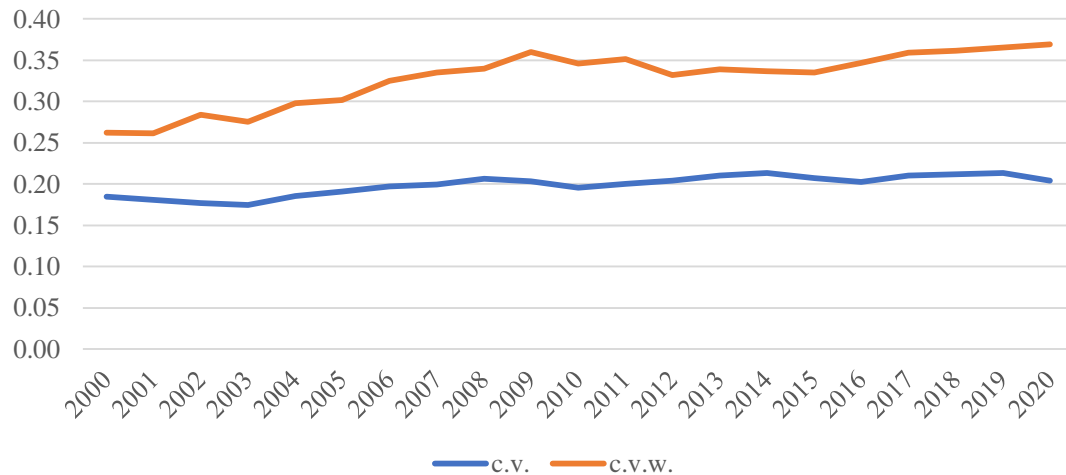


Source: own elaboration using data from EUROSTAT (2023)

The spatial pattern of inequality

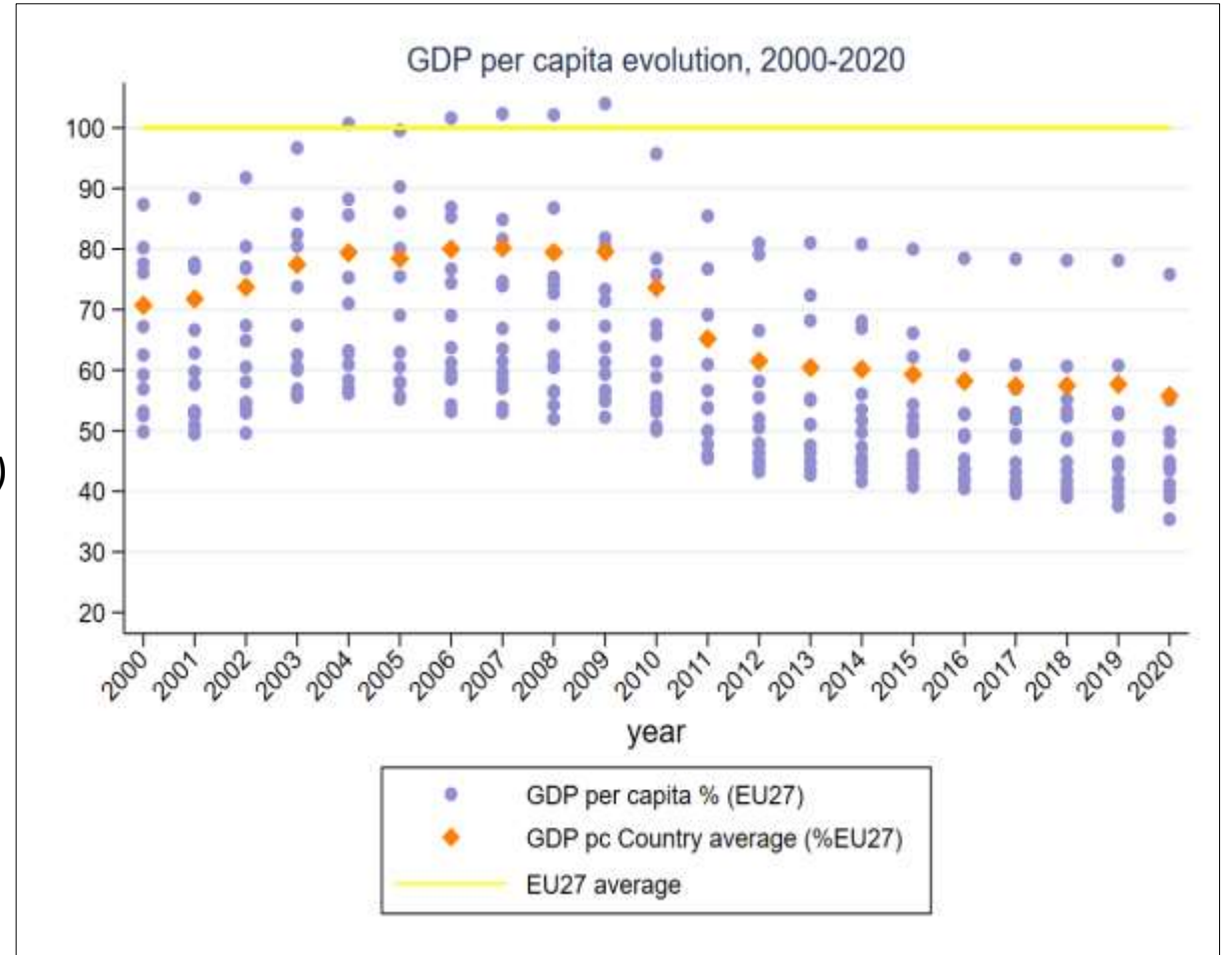
- The impact of the crisis increased the distance of all regions from EU average
- In the years after the crisis the dominant role of Attica is more evident
- Regional inequalities have increased

Figure 12. Evolution of regional inequalities (2000-2020)



Source: own elaboration using data from EUROSTAT

Figure 11. Regional GDP per capita evolution as a share of EU (constant prices 2015), 2000-2020



Source: own elaboration using data from the Annual Regional Database of the European Commission's Directorate General for Regional and Urban Policy

Data and methodology

13 Greek NUTS II regions

Time Period: 2010 – 2018

Conditional convergence models

Panel fixed effects

Variables of analysis

Dependent variable	Annual growth of GDP per capita	Change (%) of real GDP per capita	g	ARDECO - EC
Key regressors	Level of development	Real GDP per capita	Y	ARDECO - EC
	EU integration	Ratio of trade with the EU over total trade	INT	ESPON Program "Interregional Relations in Europe"
	Interaction of GDP p.c. with EU integration		Y*INT	
Control variables	High-skilled employment	Ratio of high-skilled employment over total employment	HS	EUROSTAT
	Public investment per capita	Ratio of gross fixed capital formation of the public sector over population	PUB	EUROSTAT
	Population density	Ratio of regional population to the land area	DEN	EUROSTAT
	Annual change of public investment per capita	Change (%) of public investment per capita	Δ PUB	EUROSTAT
	Annual change of impartiality of government	Change (%) of impartiality, as a dimension of the Quality of Government Index	Δ IMP	DG-REGIO
	Interaction of GPD p.c. with density		DEN*Y	

Econometric models

$$g_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 INT_{it} + \beta_3 Y_{it} * INT_{it} + \beta_4 HS_{it} + \beta_5 PUB_{it} + \beta_6 DEN_{it} + \varepsilon_{it}$$

$$g_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 INT_{it} + \beta_3 Y_{it} * INT_{it} + \beta_4 HS_{it} + \beta_5 \Delta PUB_{it} + \varepsilon_{it}$$

$$g_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 INT_{it} + \beta_3 Y_{it} * INT_{it} + \beta_4 HS_{it} + \beta_5 \Delta PUB_{it} + \beta_6 \Delta IMP_{it} + \varepsilon_{it}$$

$$g_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 INT_{it} + \beta_3 HS_{it} + \beta_4 PUB_{it} + \beta_5 DEN_{it} + \beta_6 \Delta PUB_{it} + \beta_7 \Delta IMP_{it} + \beta_8 Y_{it} * DEN_{it} + \varepsilon_{it}$$

Preliminary results

Model (1)

$$\theta_g/\theta_{INT} = -0.3403942 + 0.0000271*Y$$

$$\theta_g/\theta_Y = -0.0000155 + 0.0000271*INT$$

Model (4)

$$\theta_g/\theta_{DEN} = -0.0007725 - 3.41e-08*Y$$

$$\theta_g/\theta_Y = 9.67e-06 - 3.41e-08*DEN$$

Independents

GDP per capita (Y)

EU Trade Integration (INT)

Interaction Y*INT

High skill employment (HS)

Public Investment per capita (PUB)

Population Density (DEN)

Public Investment per capita annual % change (Δ PUB)

Impartiality annual % change (Δ IMP)

Interaction DEN*Y

Constant

Thresholds

Y*

INT*

DEN*

R²

Obs.

FE

F

Prob > F

Dependent: annual growth of GDP per capita (g)

	(1)	(2)	(3)	(4)
GDP per capita (Y)	-0.0000155**	-0.000018**	-0.0000187**	9.67e-06*
EU Trade Integration (INT)	-0.3403942***	-0.3150569**	-0.3117515**	0.0476022**
Interaction Y*INT	0.0000271***	0.0000256***	0.0000253***	
High skill employment (HS)	2.076306**	2.312712**	2.219568**	2.332961***
Public Investment per capita (PUB)	0.0706887***			0.0628969***
Population Density (DEN)	-0.0017296***			-0.0007725***
Public Investment per capita annual % change (Δ PUB)		0.0373997**	0.0385314**	0.0045792
Impartiality annual % change (Δ IMP)			0.0039329***	0.0019549***
Interaction DEN*Y				-3.41e-08***
Constant	0.3343277***	0.1945619*	0.2059918*	-0.0700654
Thresholds				
Y*	12.560,67€	12.306,91€	12.322,19€	-22.653,96
INT*	57,20%	70,31%	73,91%	
DEN*				283,58
R ²	0.379	0.280	0.299	0.356
Obs.	104	104	104	104
FE	YES	YES	YES	YES
F	313.30	9.77	458.45	906.46
Prob > F	0.0000	0.0007	0.0000	0.0000

Main empirical findings

- The impact of integration on regional growth depends on the level of development of Greek regions:
 - driver of growth for the more advanced
 - serious threat for those with weak productive bases
 - The level of regional inequalities is affected by the participation of the country in the EU:
 - regions with more advanced productive base are favored
 - the weaker ones face serious difficulties to compete
 - Regions with a higher share of knowledge/technology intensive firms have a better growth performance
 - Public policy can play a critical role in promoting regional growth and convergence by allocating funds to regions in serious need of investment
 - Improvements in the quality of government have direct effects on the prospects of regions to grow
 - Diseconomies of agglomeration are probably in force – current population imbalances are a permanent source of divergence.
-

Conclusions

The productive system of Greece continues to experience difficulties to compete in the advanced EU market

- Downward trend of the level of integration with the EU
- A gradual but steady shift of trade from the core EU countries to non-core and peripheral EU markets, in search of a more favorable international environment

The effect of integration on regional growth is conditional on the development level of the regions

Spatial irregularities: the prospects of growth of the weaker regions are inversely affected by high levels of integration

Verification of findings of previous studies for the role of public investment and productive structure in regional growth and regional convergence



Thank you for
your attention



Conscription and University Performance: Evidence from the Republic of Cyprus

Ružica Savčić

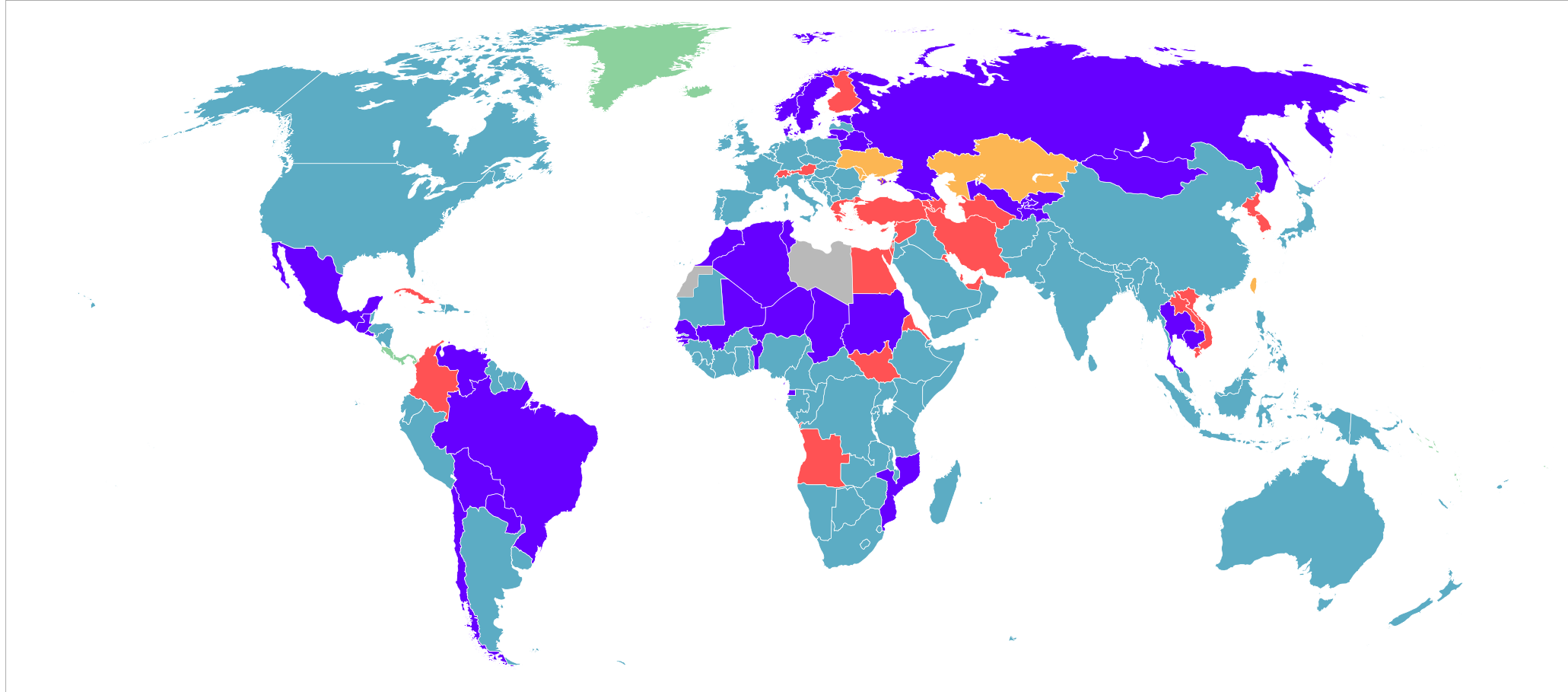
5th year PhD student

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Military service across countries

- No armed forces
- No enforced conscription
- Active draft system, but less than 20% of the whole age group are conscripted
- Plan to abolish conscription in the near future
- Conscription
- No information



Source: respective militaries

“Military service is the only remaining example in modern societies of forced labor that is legal outside the criminal justice system.”

Bingley, Lundborg and Vincent Lyk-Jensen (2020)

Previous research findings on effects of CMS

Authors	Data	Findings
Hjalmarsson and Lindquist (2016)	Swedish register data	Increased post-service crime, significantly lower income and higher probability of receiving unemployment and welfare benefits for individuals from disadvantaged backgrounds.
Imbens and van der Klaauw (1995)	Dutch statistics	10 years after the CMS, draftees had lower earnings than non-draftees.
Torun and Tumen (2016)	Turkish LFS	Abolishment of CMS reduced years of schooling.
Maurin and Xenogiani (2007)	French LFS	Abolishment of CMS produced a significant decline in the relative education and the relative entry wages of men coming from a low socioeconomic background.

Previous research findings on effects of CMS

Authors	Data	Findings
Bauer, Bender, Paloyo and Schmidt (2012) Bauer, Bender, Paloyo and Schmidt (2014)	German register data	No long-run impact on the labor-market performance of conscripts. Increased the likelihood of completing higher education
Grenet, Hart and Roberts (2011)	British longitudinal data	No long-run impact on real earnings of conscripts.
Bingley, Lundborg and Vincent Lyk-Jensen (2020)	Danish administrative data	A negative mean impact on earnings: no effect among low-ability men, but negative effects for high-ability.
Card and Cardoso (2012)	Portuguese longitudinal data	Large positive effect on wages of low-educated men.

Possible issues

- Self-selection,
- Endogenous timing, and
- Omitted variables bias.

Institutional setup – CMS in Cyprus

Possible issues

- Self-selection,
- Endogenous timing, and
- Omitted variables bias.

Possible solutions

- Compulsory military service
- Service cannot be postponed
- Two CMS reforms (2010 and 2016)

Institutional setup – UCY

- Nation-wide university entrance exams – pankypries
- In 2019, for instance:
 - 3300 students went to study abroad
 - 2800 students enrolled into the public universities in Cyprus
- Students do not pay fees

Data

All UCY students enrolled since 2008

- Personal information: coded ID number, sex, year of birth, age on admission, district of residence, citizenship;
- Academic information: level of studies (under- or postgraduate; 1st, 2nd or 3rd degree; ...), school and department within the school, term of admission, entrance exam scores, all the exams the students took, school term when the course was taken, grades they received on each exam taken; and
- CMS information: number of academic terms (i.e. semesters) served in the army.

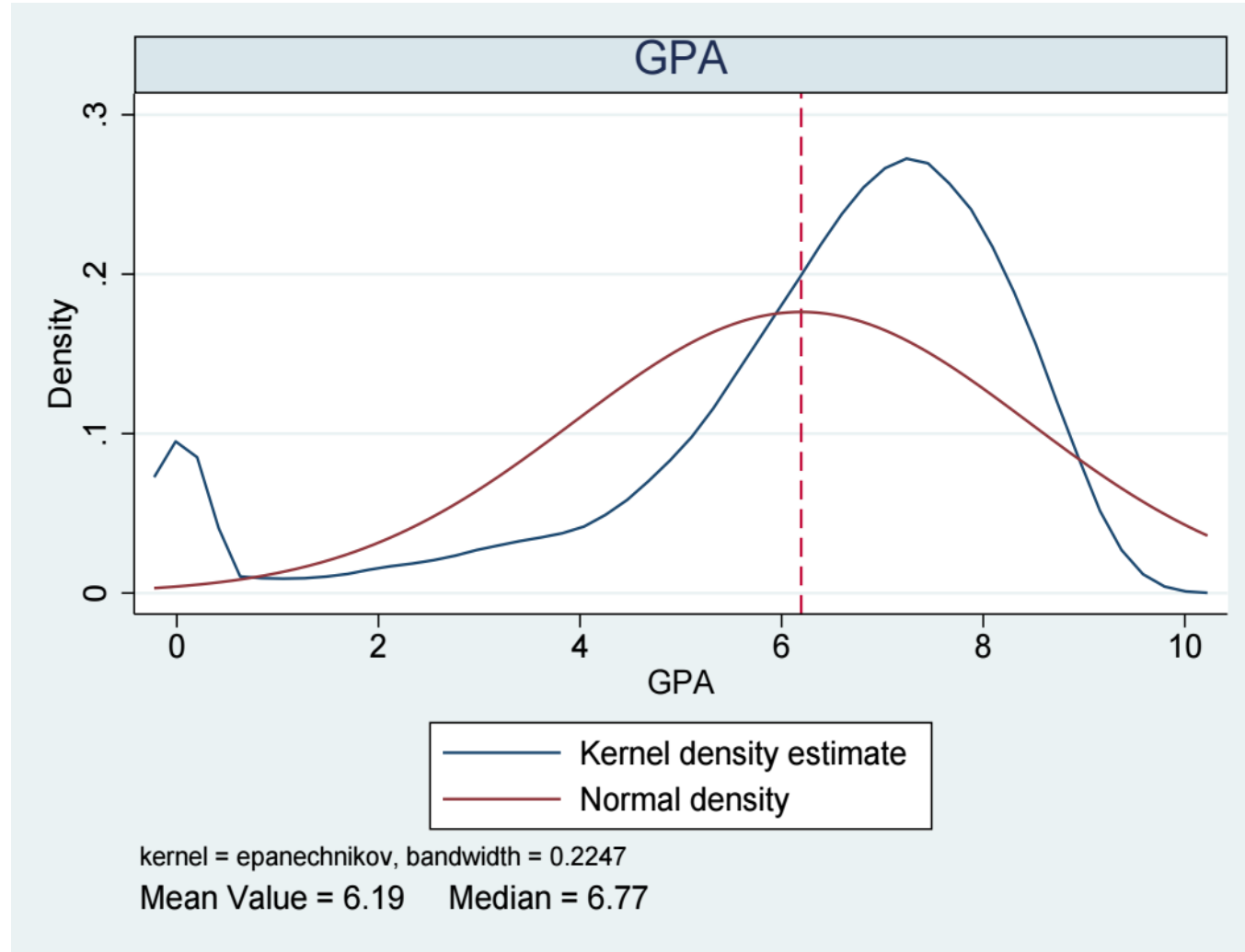
Data

- Only students of Greek Cypriot nationality,
- who attended a public secondary school,
- were between 17 and 21 years of age on admission,
- studying for their first degree at the undergraduate level,
- excluding the Medical school,
- leaving us with
 - 407,336 student-course level observations
 - relating to 12,008 students that we observe
 - from 2008 to 2019.

Data

Year of admission	Admission grade			
	Overall	Male	Female	Diff (F-M)
2008	18.061	17.336	18.112	0.776*
2009	17.752	17.270	17.859	0.589*
2010	18.010	17.901	18.043	0.142
2011	18.060	17.792	18.144	0.352*
2012	17.952	17.835	17.992	0.157
2013	17.868	17.820	17.889	0.069
2014	17.799	17.775	17.812	0.037
2015	17.915	17.977	17.883	-0.094
2016	17.668	17.679	17.662	-0.017
2017	17.758	17.789	17.742	-0.047
2018	17.589	17.778	17.490	-0.288*
2019	17.301	17.251	17.328	0.077

Data



Methodology

Direct approach

$$GPA_i = a + X_i \beta + u_i$$

X_i : sex, army term count, admission term dummies (Model 1)

+ admission grade (Model 2)

+ age on admission (Model 3)

+ YoB (Model 4)

+ area dummies (Model 5)

Results: direct approach, OLS regression

	(1)	(2)	(3)	(4)	(5)
<i>Male</i>	-0.492*** (-8.017)	-0.104* (-1.768)	-0.188*** (-2.724)	-0.260*** (-3.197)	-0.277*** (-3.406)
<i>Army term count</i>	0.258*** (11.802)	0.079*** (3.736)	0.067*** (3.127)	0.068*** (2.977)	0.076*** (3.304)
<i>Admission grade</i>		0.494*** (38.447)	0.497*** (38.635)	0.496*** (38.437)	0.499*** (38.996)
<i>N</i>	12008	12008	12008	12008	12008
<i>adj. R²</i>	0.019	0.125	0.126	0.126	0.133

t statistics are in parentheses. Levels of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Robust standard errors.

Results: direct approach, quantile regression

	(1)	(2)	(3)	(4)	(5)
10 th percentile					
<i>Male</i>	0.036 (0.142)	0.219 (1.010)	0.005 (0.015)	-0.160 (-0.538)	-0.222 (-0.832)
<i>Army term count</i>	0.382*** (5.728)	0.174** (2.345)	0.158* (1.920)	0.163** (2.377)	0.214** (2.401)
<i>Admission grade</i>		0.619*** (13.467)	0.607*** (10.271)	0.593*** (10.805)	0.555*** (8.941)
90 th percentile					
<i>Male</i>	-0.432*** (-10.211)	0.008 (0.131)	-0.040 (-0.675)	-0.018 (-0.283)	-0.028 (-0.378)
<i>Army term count</i>	0.217*** (12.593)	0.049** (2.489)	0.045** (2.217)	0.049* (1.800)	0.044** (2.010)
<i>Admission grade</i>		0.427*** (42.009)	0.427*** (34.046)	0.425*** (44.377)	0.429*** (62.467)
<i>N</i>	12008	12008	12008	12008	

t statistics are in parentheses. Levels of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Robust standard errors.

Methodology

Difference-in-difference

$$GPA_i = a + \beta_1 male_i + \beta_2 reform + \beta_3 male_i * reform + \sum_j \beta_{4j} area_{ij}$$

2-year event windows*:

	Before	After
Reform 1	2008, 2009	2010, 2011
Placebo 1**	2010, 2011	2012, 2013
Placebo 2**	2012, 2013	2014, 2015
Reform 2	2014, 2015	2016, 2017

* Gruber (1994)

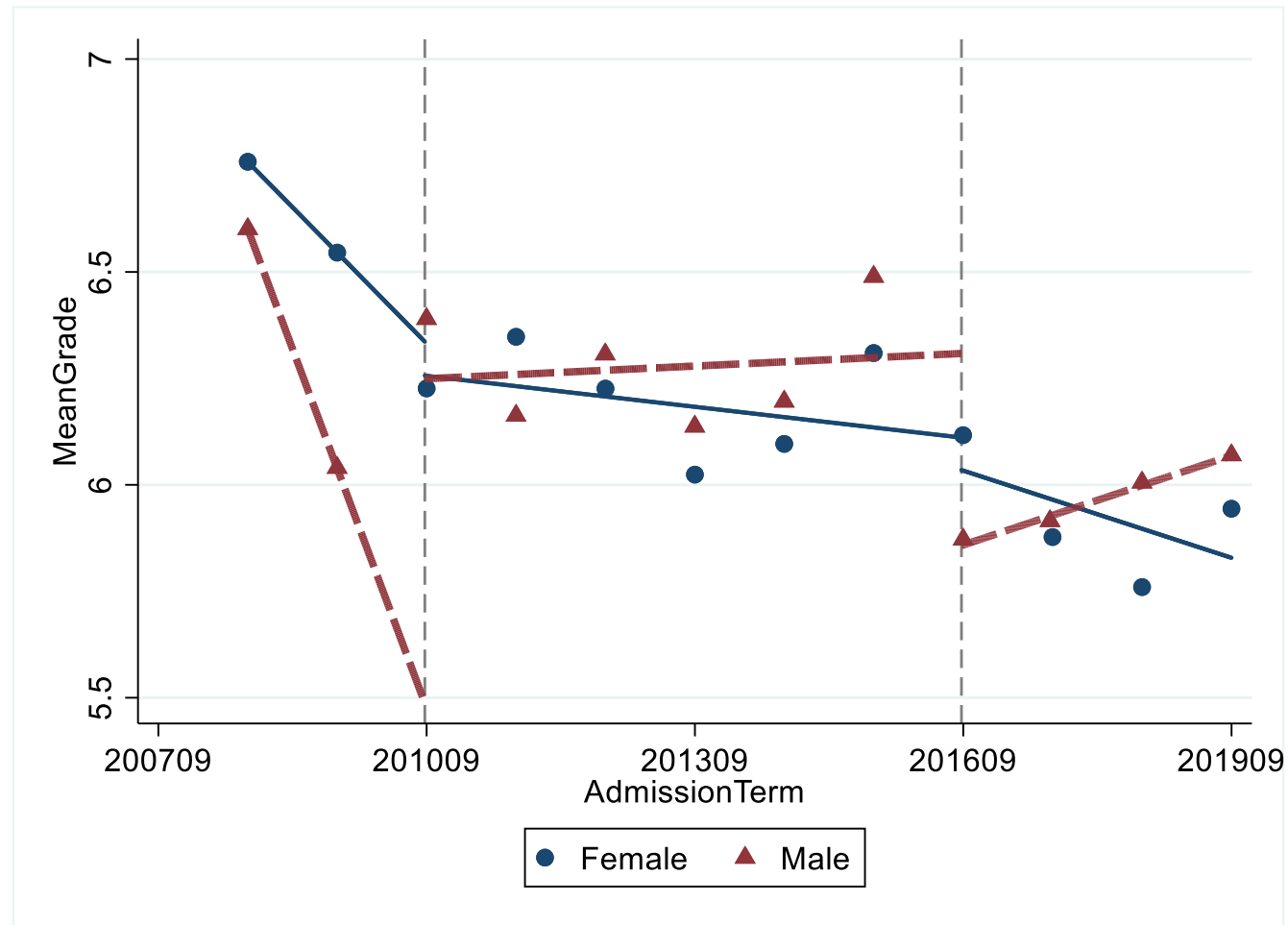
** Carletti, De Marco, Ioannidou and Sette (2020)

Results: difference-in-difference analysis

	(1)	(2)	(3)	(4)
Male × Reform 1	0.337** (2.273)			
Male × Placebo 1		0.106 (0.715)		
Male × Placebo 2			0.044 (0.295)	
Male × Reform 2				-0.265* (-1.793)
<i>N</i>	4486	4681	4398	4141
adj. <i>R</i> ²	0.007	0.008	0.006	0.010

Notes. We regress variable *mean grade* on *male*, *reform* and an interaction of the two binary variables, *male*reform* in 2-year windows about the corresponding reform, using individual level observations. We also include district fixed effects. Reform 1 = 1 if $t \geq 2010$ and zero otherwise, Placebo 1 = 1 if $t \geq 2012$ and zero otherwise, Placebo 2 = 1 if $t \geq 2014$ and zero otherwise and Reform 2 = 1 if $t \geq 2016$ and zero otherwise. *t* statistics are in parentheses. Levels of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Results: difference-in-difference analysis



Ideas for future research

- Effectiveness analysis: how does and to what extent army training encourage development of transferable skills.
- Qualitative analysis: which type of training programs may improve educational outcomes for students who lack skills necessary for academic success.
- Efficiency analysis: whether improvement in academic performance compensates for the delay in entering the labor market in the long term.

Thank you!

Conscription and University Performance: Evidence from the Republic of Cyprus

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Effects of minimum wage in a monopsonistic labour market: the case of Greece

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Abstract

The minimum wage level has been a central political issue in Greece during the past decade. At the same time there has been a growing literature regarding the monopsony power of employers on employees. In this paper we construct a monopsony labour market model and then we test it empirically in the Greek labour market. The results show that the overall employment effect from the increase of minimum wage is not negative and this indicate that in order to set a binding minimum wage the consideration of monopsony power is crucial. Moreover we expand our empirical analysis of the effects of minimum wage on the informal labour market in Greece to examine if there exists the lighthouse effect of minimum wage. With the use of a Difference-in-Differences and Kernel Density analysis on the employment and income effects of minimum wage in the informal labour market in Greece and conclude that there is a lighthouse effect.

Keywords: minimum wage, monopsony, lighthouse effect, informal labour

1. Introduction

Drastic reforms have transformed the Greek labour market since 2010. This, along with vast unemployment and erosion of wage bargaining changed the landscape of workers contracts and enlarged the importance of minimum wage in the labour market.

Conventional labour economics have been constructed in the assumption that firms are wage takers so that labour supply to the individual firm is infinitely elastic. As a result a wage reduction in a firm will make the workers of this firm to quit and find another job with a wage as high as the previous one. This process is described as “the clearance of the labour market” and is equilibrating the labour market. However could be stated that this description is far away from reality since in the most of the cases there are important frictions in the labor market and the employers have an augmented power in the wage setting (Manning, 2003:3). Under a monopsonistic labour market, if a minimum wage rate and centralized wage bargaining are binding will increase the level of employment and reduce the mark-down on wages (Manning 2003; Ashenfelter *et al.*, 2010). The arguments for the labour market institutions are enhanced with a microeconomically-based, and also macroeconomically embedded employment determination that turns the mainstream labor market arguments upside down. Following monopsony theory we can enhance the discussion regarding labour market institutions and the consequences of their erosion. Moreover there is research supporting, that in countries with high informal labour we can see a «lighthouse effect» where the increase in minimum wage improves the earnings of informal workers despite the promises of the dual labour sector (Boeri *et. al.*, 2011).

The focus of this paper is two-fold; the first objective is to present a theoretical model regarding the estimation of an increase in the minimum wage in the monopsony labour market and then evaluate it for the Greek case, while the second objective is to empirical estimate if there is lighthouse effect in the informal labour in Greece. We proceed as follows in section 2 we present a brief literature review regarding the effects of minimum wage in monopsonistic labour markets and informal labour. Then in section 3 we present the theoretical model, while in the fourth section we estimated it empirical. In the fifth section we estimated the lighthouse effect in the Greek labour market while in the sixth section we conclude.

2. Literature review: Effects of minimum wage in special cases of Labour Market

2.1 Monopsonistic labour markets and minimum wage

The term monopsony was first researched by Joan Robinson (1933) while she credited B. L. Hallward, the classic scholar of Cambridge for the invention (Thornton, 2004) of the term. While Joan Robinson referred to the «mining town» case and emphasized the single industry where the buyer of labour power is the owner of the mine and the workers have difficulty moving to another workplace, however her analysis of the monopsony power was very accurate in the sense of the wage discrimination and the role of decentralization of wage bargaining in a monopsonistic labour market, moreover the importance of a centralized wage bargaining in the case of monopsony labour market could be a feature from Joan Robinson’s expatiation of the elasticity of supply in the exploitation of labour (Robinson,1969:81).

Often, is featured that old monopsony theory could not describe the contemporary monopsonistic labour market, however once we carefully examine the Robinson’s models about monopsony power we can determine that even in these static attempts to picture the power of employers in the labour market, emphasis was given to the fact that supply elasticity of labour could be somewhat

inelastic. While the sophisticated empirical microeconomic models that arose later could enrich further this topic we dispute that modern monopsony theory firstly give the ‘somewhat inelastic labour supply elasticity’ approach.

While we still refer to monopsony in the labour market, we can consider the latest literature as oligopsony theory. Even if it is quite difficult to estimate the existence of monopsony power in the labor market, some remarkable papers evaluate the existence of monopsony power and the required policy mix that should be taken in order the employment and wages to be increased. Manning (2003) introduced the concept of "new" monopsony and utilized data from the UK to measure the job-to-job transitions when the wages changed. Naidu *et. al.*, (2016) have tried to estimate the monopsony power in immigrant labor market in United Arab Emirates. Generally, monopsony power is more important in the immigrant labor market due to specific restrictions that exist and do not allow the workers to change employers easily. As a consequence, after the visa reform, both the wages and the share of workers that stayed with the firm rose while both the wages and the employment of recruits are fallen. This research gives an example of how employment protection legislation could lower the monopsony power. Also, Azar *et. al.*, (2019) found that minimum wages have more positive effects in the case of a less competitive labour market, while Dusrmann *et. al.*, (2019) found that workers transit to more productive and better-paid firms after the implementation of minimum wage as monopsony could predict.

Dube *et. al.*, (2020) research the presence of monopsony power of employers in online markets. With this paper the concept of monopsony is disconnected from the idea that workers are tight with their ‘territory’ and for this reason, monopsony power exists.

2.2 The effects of minimum wage on informal and formal sector

Starting from ‘70s it has been the question regarding the wealth effect of minimum wage policy and more specifically if the low wage workers are better off after the increase or implication of minimum wage. The debate regarding the minimum wage has been enhanced with the question regarding the employment and wage rate of the workers in the informal sector, that are not covered by minimum wage or unemployment and other benefits,

The existence of a dual labour market complicates the total employment effects of the minimum wage as the two sectors are possibly affected oppositely. According to the standard case of economic theory, when there is a dual market of workers in a labour market than a minimum wage has not had a total negative employment effect because workers in the formal market are displaced to the informal market where the minimum wage is not enforced. As was first researched by Gramlich (1976), and Mincer (1976), Welch (1976), following a simple model of employment effects of the minimum wage, assumed a perfectly competitive labour market with homogeneous workers that exists two diverse segmented labour markets with two different wages and with different distributional and employment impacts of minimum wage. Moreover there is perfect labour mobility between the two sectors and flexibility of wages in the informal sector.

Contrary to most theoretical predictions, empirical studies in developing countries, where there is a particularly large informal sector have found that occurs an increase in wages also in the informal sector of the economy. While there are issues regarding the measurement of the informal sector, we can argue that this effect seems robust.

One explanation for this phenomenon is that under a different set of elasticities of the labor market, both wages of the informal and formal sectors may rise (Carruth and Oswald (1981), Hamermesh (1993), Lustig and McLeod, (1996)). While there is also the view that the relationship between the formal and informal sector is not only through the supply side of the economy, but

also through the demand side of the economy (Fiszbein (1992)). The explanation is that the products of the informal sector are mostly demanded by the consumers with low earnings, who are also the ones that would benefit from a minimum wage increase. Accordingly, when benefactors' welfare rises due to an increase in the minimum wage, the demand for the goods produced by the informal sector rises, which increases the demand for informal labor and pushes up the informal wages. The third one, and probably the most pronounced one, is the benchmark role of the minimum wage for the informal sector wages. In other words, minimum wage is thought to be a reference for informal sector wages (Maloney and Mendez, 2004).

This phenomenon called the lighthouse effect in the literature may emerge under different assumptions. "Teoria do Farol" (Lighthouse Effect) appeared first for the Brazilian labour market. By this time the effect of minimum wages on wages was a central issue in Brazil, because due to dictatorship wage bargaining through the activities of trade unions was restraint and instead implemented a centralized wage policy directed by the dictatorship that inter-indexed the minimum wage. In their seminal paper Souza and Baltar (1979) point out that while this was not that broad the scope of this policy, the minimum wage had a role in wage determination. Moreover it guided the wage bargaining in the small enterprises that was not inspected and the informal sector that is large in Brazilian labour market. Even self-employed workers used the minimum wage as a guide for the determination of the pricing of their services or product. The focus on the minimum wage came over again after the wage-price spiral brought reasonable minimum wage increases (Carneiro and Faria, 1997). By this time the main issue in the economy was the inflation and no one, either politicians or economists, were if minimum wage decrease firm's labour demand and has a negative employment effect. After mid 1990s when the inflation was stabilized (Lemos, 2009), the topic regarding the employment effect of minimum wage was again popular.

Another view with large research regarding minimum wage has pointed out that minimum wage acts as a numeraire for the wage setting procedure. Even workers whose wages are well above the minimum, workers in the informal sector, or even self-employed setting their payments in terms of minimum wage. This proposition was first seen by Gramlich (1976), which was referred also to in Card and Krueger (1995). Amadeo and Camargo (1989) and Neri (1996) showed for Brazil, while in Maloney and Mendez (2004) extended the results for other countries, that the numeraire role of the minimum wage is a phenomenon in a lot of countries in Latin America. With the above, we can conclude that in countries such as Brazil with high informal sector, the minimum wage in countries such as Brazil, the minimum wage acts as a benchmark in the collective bargaining, in the private sector, formal or informal and it is very common the workers to respond to their earnings as multiples of the minimum wage. From a different point of view, the use of minimum wage as numeraire or index of wage distribution has been discussed also from Cox and Oaxaca (1982) when they point out that labour unions put pressure on minimum wage implementations, while the labour union members themselves have established higher earnings than the minimum wage.

As we stated before the richest literature regarding the lighthouse effect of minimum wage has developed in Brazil, where the data are more reliable and also lighthouse theory had been first pointed out. Neri (1996) shows that after the increases in minimum wage during the 90's the fraction of workers that experiences increases was larger in the informal than in the formal sector. Moreover Neri Gonzaga and Camargo (2000), found that the percentage of workers whose earnings are exactly in the minimum wage is larger in the informal (15% in 1996), than in the formal (8%) sector.

Fajnzylber (2001) used longitudinal data in Brazil from 1982 to 1997 to investigate the effects of minimum wages on income and employment and they found significant minimum wage effects for both the formal and the informal sectors, while the employment elasticities are negative low-wage workers.

Lemos (2009) researched the same questions for Brazilian labour market. It first appeared as a non-parametrically approach, with a visualization of a kernel density estimation that there is quite large wage effects in both formal and informal sector, while there is a spike in the real minimum wage point where its depict with the red vertical line. This depicts that the minimum wage is paid in both sectors, while there is higher non-compliance in informal sector and this influence other aspects of labour contracts such as: benefits, flexible hours, social security taxes, and annual leaves. According to Lemos (2009) workers perhaps work with flexible hours take the same wage home and firms have lower labour cost because overhead costs are almost 100% in Brazil.

These researches have been extended to other developing countries as well. Gindling and Terrell (2004) used microdata on workers from Costa Rica from 1988 to 1999, to test whether minimum wages have an impact on informal and formal wages and employment. They found that increases in minimum wages raised the wages of workers in the urban formal sector, where the large enterprises are, along with workers in the informal sector in small urban enterprises, large and small rural enterprises. However, there are no significant results for the earnings of self-employed workers, both in rural and urban areas. Perez (2020) estimates the effect of minimum wages in Colombia during an unexpected increase that happened during 1999. The microdata was analyzed through unconditional quantile regressions with difference-in-difference approach. It found that the minimum wage increases responses on wages for formal and informal workers, but are larger in the formal sector where the wages increased around 3 percent for a 10 percentage points minimum wage increases, while in informal sector the increase was around 1 percent. These evidence shows that employers partially comply with the minimum wage and use it as a reference. Moreover they found small negative employment effects on the informal sector but not on the formal sector, but these effects are not driven by cross-sectoral effects. Almost identical results were found by Maloney and Nunez (2004), in plenty of countries in Latin America such as: Mexico, Argentina, Uruguay, Brazil, Chile, Honduras, and Colombia, where the influence of minimum wage is more significant in the wages in informal sector than in the wages in formal sector.

The interpretation that arises from the empirical literature, is that minimum wage has spillover effects on wage setting in the informal sector and acts as a kind of signaling in wage bargaining. Moreover in the case that firms have monopsonistic power both in the formal as in the informal sector then minimum wage could increase the informal sector wage. This gives us the motive to search if lighthouse effect exists in the Greek labour market.

3. Theoretical Model: the employment effect in a monopsonistic labour market

To develop a model for the labour market we follow Weintraub (1957) and Heise and Pusch (2020) and the originality here is that we consider the labour supply elasticity to formulate the monopsonistic framework. The model consists from seven functions. While this model it seems simple compare with dynamic monopsonistic models (Manning, 2003) it consider demand and supply of the economy with a sectoral setting.

The demand function is constructed from nominal wages w , nominal (given) private investment I , given investment multiplier m , given governmental spending G and labour employed L that

depend from the wages.

$$D = \alpha(w, I, \bar{m}, \bar{G}, L_t(w)) \quad (1)$$

While the Supply function is constructed from wages, the given technology rate and labour Supply

$$Z_t = \beta(w, \bar{T}, L_t) \quad (2)$$

Then, the equilibrium condition is

$$D_t \equiv Z_t \quad (3)$$

Price level depends from wage level, given technology and given mark up¹

$$p_t = \gamma(w, \bar{T}, \bar{\pi}) \quad (4)$$

While the real income depicts as

$$Y_t = \theta(\bar{K}, L_t, \bar{T}) \quad (5)$$

As we state before labour function is consisted from level of wage and an expected price level

$$L_s = \lambda(p_e, w) \quad (6)$$

Also in order to achieve the equilibrium we extend the model

$$p_e = p_t \quad (7)$$

While the equilibrium in the market is simple $D=Z$, equilibrium employment L_t that arisen from an equilibrium in the aggregate demand-aggregate supply section does not necessarily elucidate that the aggregate employment demand made by firms are met either that the labour supply is found the way to employment. In order to understand whether the equilibrium employment it means that the demand matches the supply of labor provided by households, we have to introduce the meaning of labour demand and labour supply in order to find the employment effect of a change of wage.

For this reason in a question, what will be the employment effect in a rise of the minimum wage on x% (or in an introduction of the minimum wage if this does not exist) then we have to find the relative rate of change of the D and Z functions. Suppose that we have two sectors with employment share k and (1-k) respectively the average wage in sector A was below the new

¹ Blair and Harrison (1992) attempt to reformulate Lerner Index in the case of monopsony power, however here we will consider the mark up as given.

minimum wage while in sector B above, then the change in wage in sector A would be x% while in sector B, will not change.

We specify equation (1) and (2) in order to analyze sector A and B. We take the first derivative of (1) and (2):

$$\frac{dZ_A}{dw_A} = \frac{\pi_A}{\omega_A} \frac{dN_A}{dw_A} w_A + \frac{\pi_A}{\omega_A} N_A = \frac{\pi_A}{\omega_A} N_A \left(\frac{1}{\lambda_A} + 1 \right) \quad (8)$$

$$\frac{dD_A}{dw_A} = c_{A,A} N_A(w_A) + c_{A,A} w_A \frac{dN_A}{dw_A} = c_{A,A} N_A \left(\frac{1}{\lambda_A} + 1 \right) \quad (9)$$

To define the change of employment effect with respect of the change of the nominal wage depends on the relative change of the functions D and Z. We define $c_{i,j}^o = \eta_{i,j}$, $\varepsilon_i = \pi_i^o - \omega_i^o$ and k =the share of employment in sector i, while λ_i = labour supply elasticity in each sector. The final employment effect of sector A and B is:

$$N^o = k \left(1 + \frac{1}{\lambda_A} \right) (\eta_{A,A} + \eta_{B,A} - \varepsilon_A - 1) w_A^o + (1 - k) \left(1 + \frac{1}{\lambda_B} \right) (\eta_{B,B} + \eta_{A,B} - \varepsilon_B - 1) w_B^o \quad (10)$$

Where ε_i = absolute value of the price elasticity of demand for commodities of sector i, $\eta_{i,j}$ = income elasticity of demand of wage earners of sector j for commodities of sector i,

When the minimum wage is increased x% then the wage of sector A is increased, while the wage of sector B it is unaffected. ² The employment effect in this case will be:

$$N^o | w_A^o = k \left(1 + \frac{1}{\lambda_A} \right) (\eta_{A,A} + \eta_{B,A} - \varepsilon_A - 1) x \quad (11)$$

The final result depend of the differences between the income effect and the substitution effect. Since the price elasticity is negative but the income effect positive, if the income effect is greater than the substitution effect due to price increased of the sector A then the overall result of the minimum wage increased will be positive, moreover due to the monopsony power of employers ($1+1/\lambda$), this result could be even heavier than the case of competitive case.

4. Empirical Estimations in the Greek labour market

Greek economy has been through vast changes since 2010, when Greek government asked for a Stand-by Arrangement from IMF. For this reason, the Financial Stability Fund was created and TROIKA (consisting of IMF, the European Central Bank and European Commission) composed a program for the Greek economy that contained structural reforms and targeted the so-called internal devaluation of the Greek economy.

² However in the case of monopsony labour market, there are two cases that the mean wage of sector B could be increased also: some employers, that give wages near to (increased) minimum wages could increase the wages of their workers, also in the case of a monopsonistic informal labour market an increase of minimum wage could have the so-called lighthouse effect.

Implementation of labour market institutions changed rapidly through the collapse of industrial level wage bargaining, the suspension of the favorability principle and the introduction of non-union wage bargaining actors (Koukiadaki and Grimshaw, 2016). Also, the implementation regarding the setting of minimum wage changed. Starting from February 2012 the minimum wage would be set out by the members of Greek parliament and not through an agreement between the trade union and employers' associations as used to be until 2011. At the same time the Greek parliament following the recommendation of TROIKA decreased the minimum wage 22% for employees above 25 years old. Moreover through the creation of a subminimum wage for employees under 25 years old, the minimum wage decreased 32% for this category.

The erosion of labour market institutions resulted from the creation of a flexible and precarious workforce while the unemployment raised rapidly, the mean wage decreased, the informal labour remained high, and poverty and inequality raised. SYRIZA a center-left party won the election at 2015 promising, among others, to bring back some pro-labor implementations. From this point of view, a major increase of minimum wage and the abolition of subminimum wage were implemented at February 2019. While according to the mainstream economic theory, an increase of the minimum wage will have the consequence that the economy will lose competitiveness because the labour cost will increase, the results were positive for employment rate and the unemployment rate decreased.

We can argue that the Greek labour market is a monopsonistic one, at least for the time period that we research it, since there have been vast pro employers' legislations that along with the economic crisis bring very high unemployment and labour turnover because of dismissals, flexibility and informality. Workers could experience unpaid overtime, decreases or/and delays of their wages without moving to another company, this made their labour supply elasticity quite inelastic. For this reason, we proceed to estimate the previous model.

To find sectors A and B first we have to estimate the minimum hourwages as they were before the increase of minimum wage of 2019, this consists two main different categories: the craftsmen that got paid per diem and the rest that got paid per month. However these two categories are divided into several subcategories according to age, years of experience and marital status. We use the EU-SILC database and the corresponding hourwages presented in Table 1 to specify the minimum wage earners. Then we match the minimum wage earners with the corresponding sector, unfortunately, EU-SILC gives information only for 1-code NACE sector, but if we used another database for example EU-LFS it will be difficult to find the minimum wage earners because we do not have information for the 3-years working experience. To reveal the minimum wage earners we use the variable PL200 which refers to the number of years that the person have spent in work, however this gives us very limited information regarding the total formal workdays that the person has until 14 February of 2012, when the second memorandum implemented. However using PL200 variable and the age of each worker we attempt to identify the category that belongs according to the minimum wage earners. Another interesting fact is that while married workers could have a marriage benefit on the minimum wage, according to law this is an optional scheme for Greek companies, in this research however the marriage benefit has been taken into account for the married workers.

Table 2 reveal that Sector A (minimum wage earners) consisted from the sectors that have a percentage of minimum wage more than the average (average=7.69). Then to find the employment effect we have to find the elasticity of labour supply, elasticities of demand for sector A and the income elasticities of demand for sector A. In this paper, we do not consider the external sector, while it is important for both commodities and services because Greece has an important tourist

sector and low production on manufacturing commodities (Missos *et. al.*, 2021). Another issue that we can see from Table 2 is that despite the high concentration of minimum wage earners on certain sectors, even sectors with lower minimum wage earners that average have a considerable amount of minimum wage earners, for this reason our grouping of sector A and B has some bias. Also we have to point out that there is a considerable percentage of workers that get paid lower than the hour minimum wage because they are forced to do unpaid overtime, we consider also these in our sample because they are affected by the increase in the minimum wage.

To find the labour supply elasticity we use EU-LFS and we estimate the log-transformed hours worked with hour wage through different sectors. Unfortunately, we do not have a database that we can follow workers for consecutive years to exact the job-to-job transactions. We found that the labour supply elasticity is 0.565, so it is inelastic. We understand this result because in a period that the wages are decreasing and the dismissals are also very high, the workers are willing to keep their working hours. The labour supply elasticity was estimated with the use of weighted regression as:

$$\log(\text{working_hours})_i = c + \log(\text{hourwage})_i \quad i = \text{sector A, B}$$

To find the income elasticity for sector A of minimum and non minimum workers we use the Household Budget Survey and we categorized the product and the services to each sector, we use also the Harmonized Index of Consumer Prices to determine the quantity demanded of sector A for workers of minimum income and non minimum income (Table 4 and 5). The Household Budget Survey has limited information regarding the occupation and sector to which the member of each household belong, however there is adequate demographic and income information. In order to identify workers that belong to sector A and B we mainly use the income information and we identify workers on minimum and non minimum, then we regress the logarithm of wage to the logarithm of demand from the corresponding sector to find the corresponding income elasticity as it is shown above:

$$\log(\text{wage}_{i,j}) = \text{con} + \log(\text{quantity_demanded}_{j,j})$$

$i, j = \text{sector A, B}$

The price elasticities are estimated using the regression of the logarithmic prices and quantity of each sector. In this estimation we have to deal with two main problems: first each sector has not consisted of homogeneous price changes, however we used the average of differences of the price indexes that refer to each sector for the years 2018 and 2019, second the quantity demanded is not depicted in Household Budget Survey for the services, rather depict the amount of money that it has been spent for each service. In this case, we use the price index to estimate the demand of the services sector. Below, in the diagram we can see the price indexes for the main sector that minimum wage earners are employed (sector A) along with the General Price Index. We can notice that indeed despite the rise of minimum wage, the price index in the corresponding sectors has not risen substantially, while in some cases have decreased, and the General Price index slightly increased (Diagram 1). While the analysis of prices as a response to an increase in minimum wage is beyond the scope of this thesis, we can notice that the reaction of prices to minimum wage increases suits better to a monopsonistic labour market, where price cuts is a unique situation in the monopsonistic labour market and price data after the change of minimum wage could be used to show the labour market structure (Aaronson *et. al.*, 2007). The corresponding elasticities are shown together in Table 8.

Now we can evaluate the equation (11), with the use of elasticities in Table 8 and the fact that 35% receive the minimum wage or below it, a fact that also Passas (2020) has pointed out. We conclude that according to our model employment rate should have increased by 6.38% because of the increase of minimum wage.

From the above, we can argue that the increase of minimum wage in Greece was positive, for the employment rate and at the same time the unemployment rate decreased. However, from the estimation of the model we expected stronger results at least for the increase in the employment rate, while the decrease of the unemployment rate was in the line with the model (Table 9). For these reasons in the proceeding research, we have to make some changes and we should estimate the Frisch labour supply elasticity with the use of instrumental variables and for the price elasticity of sector A, we should consider the external sector.

5. Lighthouse effect in Greece

5.1. Definitions and Data

The most commonly accepted definition of the informal sector of the economy is that all economic activities which contribute to the officially calculated, or observed, gross national product, but do not detect in the official estimates of GDP” (Feige, 1989). The standard procedure of the literature is that classify as informal workers the ones that they have not a signed labour contract, excluding the self-employed that are recognized as a special category (Carneiro and Henley, 2001). This definition includes not only legal but illegal activities such as gambling, drug dealing, trafficking etc. However in this research we will include only legal undeclared work that is the one that reported in the survey microdata, since we will use EU-LFS.

Greek labour market characterizes by high informality, undeclared and precarious workers, a high percentage of labour turnover, and temporary job contacts, especially in important sectors of the economy such as accommodation and food service activities and retail trade. Unpaid overtime is an issue that while has not been emphasized in the literature has been addressed by trade unions but also is apparent from the survey data. Moreover one ‘trick’ that employers are doing quite often is to declare workers part time while they work full time. Informal workers are mainly in the sectors that an important part of workers got paid in or around the minimum wage, (sector A as we stated before).

In Greece, the informal labour has been recognized as a major problem, and for this reason, have been addressed in the European Stability Mechanism support program for Greece was approved by the Greek authorities and the European Commission, in August 2015. In the Memorandum of Understanding included the following passage: “The authorities will adopt an integrated action plan to fight undeclared and under-declared work to strengthen the competitiveness of legal companies and protect workers as well as raise tax and social security revenues” (Williams *et. al.*, 2019:3). However there is very limited literature around this issue and more specific very limited data that shows the number of informal workers in Greece.

According to the 2013 Eurobarometer survey, undeclared work in Greece is mainly concentrated in waged employees (67%) and from them, the larger percentage have been partially undeclared employees (54%), while 13.3% have been wholly undeclared employees, from the rest 10.2% is undeclared self-employees and 22.5% was paid favours. Undeclared work is associated with both the lower and upper part of the earnings distributions. Enforced informal workers are usually younger people, minorities and workers with financial difficulties while voluntary-oriented undeclared work is associated with specific professional groups such as lawyers and doctors who

gain large rewards and employ other undeclared workers to assist them in cleaning and maintaining their house, thus only 24% of unemployed people but 40% of self-employed and 34% of employed people purchase undeclared goods and services (Williams *et.al.*, 2019).

The main data for informal labour in Greece have been extracted from the results of labour inspections and more specifically from the data that the Hellenic Labour Inspectorate (SEPE) and Special Service of Insurance Inspections of IKA have released. From September 2013 to January 2016 SEPE found that 14.6% had undeclared employees which correspond to 17,058 employees and total fines of €178.8 million were imposed on these companies (Williams *et.al.*, 2019 :23). Kanellopoulos (2012) used 2009 social *insurance* data and found that while 4.5 million were insured for the pension system, 1 million were uninsured. IOBE (2012) argued that 2011 30% of enterprises in 2011 were inspected for informal workers, while Kapsalis (2015) reported that in 2013 40.5% of inspected enterprises had informal workers. Matzaganis and Flevotomou (2010) reported that in 2008 , 10% of the firms inspected by inspectors of IKA have not paid social contributions, while 27% of their workers were not had a work contract.

However the data released from the inspections have significant problems. First the inspections are targeted either after accusation or generally to sectors that are known for high informality such as hotels and accommodation, restaurants, arts and construction and in any case there are not follow any statistical protocol to translate them to the general population. Moreover there is not included information regarding the earnings of the informal labours. These problems could be solved with the use of microdata collected for the labour force. However the microdata in Greek labour market is very limited, as we have argued before. In this research, we rely on EU-LFS where there are two targeted questions regarding informality in labour market. Starting from 1999, in the questionnaire of EU-LFS there was the question regarding the ‘Organization of principal insurance’ with the uninsured person as an option, while from 2019 onwards this question have been more direct as «Are you insured in your current main job?» with Yes/No as an answer, while there are other questions that are well target different types of informality as we can see in Table 10. However we have detected that there is high non-answer rate to this question and this is the reason that probably the results are underestimated.

5.2 Descriptive statistics

From Diagram 7 we can notice, that only around 3% of workers report undeclared work, while this include only the workers that are not covered for any hour worked and not other types of informality. In Diagram 2 both self-employees , workers and employees in family business are included, while in Diagram 3 we have included only workers. Moreover we can notice from Diagrams 2 and 3, that after the increase in minimum wage, while undeclared employment is slightly increased, when we restricted to workers, the undeclared workers decreased.

Moreover from the Table 11 we can see that undeclared workers are concentrated in the sector where households act as employers, where the most of the workers are not covered. This is accordance with the report of ILO (2019). Also, important sectors for the minimum wage have high percentage of undeclared workers, such as accommodation.

Another aspect of informality is when the workers got paid with hourwage less than minimum hourwage. The non-compliance of minimum wage has been detected in literature from Gramlich (1976) and it is a considerable part of informality. This happens when employers enforce workers to work more than 8 hours or to work during Sunday, night shift etc and does not got paid extra. In EU-LFS there is the question for unpaid overtime, however due to small reported answers we

are not relied on this. We count the workers that earn less than net minimum hourwage without counting the ones that get extra payment for each three years experience that they got before 14 February of 2012. While this is an important issue, there are not retrospective questions in EU-LFS, to have this information. The results are shown in Diagram 4, and we could note that between 2018 and 2019 the non compliance rate increased.

Final, another very common aspect of informality in the Greek economy is when full time workers are enrolled as part time workers and employers are avoiding full time employers' contributions and benefits. In Table 12 we show the differences that arise when we compare the survey data with formal administrative data. While we recognize that may the survey data have certain errors we consider these differences as important evidence that there is a high percentage of undeclared working hours.

5.3 Kernel Density estimations

Next, we will examine with the use of Kernel Density, a visual non-parametric method, that can reveal how the distribution is changed. Kernel Density differs from a histogram because you can put different weighting schemes on points. We have used a Gaussian Kernel because the distribution of wages is visualized with the reference to Gaussian distribution and the bandwidths are chosen by Silverman rule.

We show Kernel for declared and undeclared workers for 2018 and 2019. We choose to restrict our data only to trimesters there is the implementation about minimum wage. Moreover we choose to show Kernel for workers under 25 years old separately because for them the implementation of minimum wage was more intense may the results differ. Kernel Density estimations reveal very interesting facts regarding the lighthouse effects. First indeed regarding the declared hourwage of workers both less than 25 years old and the total population minimum wage did not change rapidly the hourwage, while from the Kernel density we can notice some slight positive results in the hourwage of total population. However in the case of undeclared workers we can notice that in total undeclared workers is clear that the hourwage is increased and from Kernel density (Diagram 7), we can notice that there is a spike in minimum wage, while the hourwage of undeclared workers is concentrate around the minimum. However for the case of under 25 years old, hourwage of undeclared workers it is compressed, while after the implementation there is a spike in minimum hourwage (Diagram 6). The above results show that lighthouse effect exist in Greek labour market at least for the general case. However after the visualization we will proceed to a statistical analysis in order for our results to be more accurate.

5.4 Declared and Undeclared Employment: Difference-in-Differences Analysis

For conclusion regarding the lighthouse effect in Greece we will proceed to a difference-in-differences analysis and we will test if minimum wage implementation has act the increase of employment of declared or undeclared labour. As a treated group we set the workers of private enterprise, while as control group we set workers of public sector, Legal entities of public/private law controlled by state and public organizations, Municipalities/municipal or communal enterprises, Public enterprises, State banks or banks managed by the government, Enterprises managed by the government. While it seem impossible to be undeclared workers in the general public sector, indeed some workers report that under special conditions are undeclared. In any case, this is not changed with the implementation of minimum wage and for this reason we use

this group as control group. We name time $t=0$ the first trimester of 2019 that the law was passed. Then we run the difference-in-difference formula as follows:

$$\text{lm}(\text{formula} = \text{Worker_Status} \sim \text{treated} + \text{time} + \text{did})$$

As worker status we call 0 if the worker is undeclared and 1 if it is declared. From the results in Table 13 we can see that the did factor is positive and statistical significant. This enable us to conclude that: the relative change of employment of declared workers is more (6.78%) than the relative change of undeclared workers after the increase of minimum wage. This shows that there are not flows from formal to informal labour but possible the opposite. While we recognize that we should proceed with a more sophisticated type of Difference-in-Differences analysis, from this simple DiD model we can conclude that the two sector model does not hold in Greece but rather there are evidence that minimum wage acts as lighthouse for both the informal and formal sector.

6. Conclusion

In this paper we attempt to present the role of minimum wage in a monopsonistic market when traditional and more targeted tools for wage bargaining cannot be performed. Greek labour market after the economic crisis of 2009 has been a case of an eroded labour market with significant results in employment and earnings. We use the increase in minimum wage of 2019 as an event that can reveal the strength of the minimum wage in a monopsonistic labour market with high informality. While the availability of data has been an issue for our research, we can conclude that indeed a binding minimum wage could partially act as a tool that corrects the monopsonistic behavior of employers. Moreover minimum wage could act as a lighthouse for informal labour and partially intercept the flows to undeclared employment. However, we can also notice that the positive results are small, while employers push constantly to turn over pro-employees' labour measures, for example we show with the percentage of workers that got paid under the minimum hourwage increased after the increase of minimum wage. For this reason, we want to emphasize that a mix of wage bargaining with trade unions along with an active Labour Inspectorate, is needed to ensure the successful implementation of minimum wage policy.

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Tables and Diagrams

Tables

Table 1. Minimum hour wage salaried/craftsmen, 11/2012-01/2019

3-years working experience	Age	Hour wage with marriage benefits: salaried	Hour wage without marriage benefits: salaried	Hour wage with marriage benefits: craftsman	Hour wage without marriage benefits: craftsman
0	>25	4.03	3.66	3.6	3.27
3	>25	4.40	4.03	3.76	3.44
6	>25	4.76	4.40	3.93	3.6
9	>25	5.13	4.76	4.09	3.76
12	>25	-	-	4.26	3.93
15	>25	-	-	4.42	4.09
18	>25	-	-	4.58	4.25
0	<25	3.51	3.19	3.14	2.85
3	<25	3.83	3.51	3.28	3.00
6	<25	-	-	3.42	3.14

Source: Greek legislation 4093/2012, own calculation

Table 2. Percentage of minimum wage earner for each sector

NACE-01	Description	Percentage of minimum wage earners
a	Agriculture, forestry and fishing	1.02
b-e	Mining, water supply, electricity, manufacturing	9.22
f	Construction	3.92
g	Wholesale and retail trade	26.65
h	Transportation and storage	3.95
i	Accommodation and food service activities	25.30

j	Information and communication	3.71
k	Financial and insurance activities	1.05
I-n	Real estate activities Professional, scientific and technical activities Administrative and support service activities	7.69
o	Public administration and defence; compulsory social security	3.20
p	Education	3.03
q	Human health and social work activities	3.15
r-u	Arts, entertainment and recreation Other service activities	8.11

Source: EU-SILC, own calculations

Table 3. Labour supply elasticity of sector A, Greece, 2018

	Coef	Std Err	t	P> t	95% Conf. Interval
log(hourwage)	0.565	0.0002399	22804.95	0.000	0.6724145 0.673355
					R-squared = 0.9992
					Adj R-squared = 0.9992
					Num. of Obs = 6621

Source: EU-LFS

Table 4. Income elasticity sector A of workers on sector A, Greece, 2018

	Coef	Std Err	t	P> t	95% Conf. Interval	
logwage	0.505	0.2001	2.81	0.005	0.1693269	0.9603361
cons	0.0594	0.905	0.07	0.948	-1.721384	1.840286
					R-squared = 0.0290	
					Adj R-squared = 0.0253	
					Num. of Obs =267	

Source: EU-LFS, 2018**Table 5.** Income elasticity of demand of workers from sector A for goods from sector B, Greece, 2018

	Coef	Std Err	t	P> t	95% Conf. Interval	
logwage	0.9285	.1847	5.02	0.000	0.564662	1.292363
cons	-1.508	0.8324	-1.81	0.071	-3.147585	0.1307506
					R-squared = 0.0879	
					Adj R-squared = 0.0844	
					Num. of Obs =264	

Source: Household Budget Survey, 2018/2019**Table 6.** Price elasticity of demand for goods from sector B

	Coef	Std Err	t	P> t	95% Conf. Interval	
Q _B	-0.92	1.003	-0.92	0.359	-2.886967	1.045031
					R-squared = 0.01789	
					Adj R-squared = 0.01709	
					Num. of Obs =12682	

Source: Household Budget Survey, 2018/2019**Table 7.** Price elasticity of demand for goods from sector A

logprice _A	Coef	Std Err	t	P> t	95% Conf. Interval	
logQ _B	-0.001	.1847	-32.13	0.000	-0.0004178	-0.0002953
					R-squared = 0.8281	
					Adj R-squared = 0.8083	

					Num. of Obs =10613
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Source: Household Budget Survey, 2018/2019

Table 8. Reported elasticities,Greece 2018-2019

Elasticities	Coefficient
$\eta_{A,A}$; Income elasticity of demand of workers from sector A for goods from sector A	0.505
$\eta_{A,B}$; Income elasticity of demand of workers from sector B for goods from sector A	1.005
$\eta_{B,A}$; Income elasticity of demand of workers from sector A for goods from sector B	0.928
$\eta_{B,B}$; Income elasticity of demand of workers from sector B for goods from sector B	0.022
ϵ_A ; Price elasticity of demand for goods from sector A	-0.1
ϵ_B ; Price elasticity of demand for goods from sector B	-0.92
λ_A ; Labour supply elasticity from workers of sector A	0.565
λ_B ; Labour supply elasticity from workers of sector B	0.025

Source: EU-LFS, Household Budget Survey, Harmonized Index of Consumer Prices, own calculations

Table 9. Actual changes of employment and unemployment after the increase of minimum wage

	% change of employment	% change of unemployment
2018/2019	2.5%	-10,4%

Source: EU-LFS,

Table 10. Questions regarding undeclared labour in EU-LFS, 2019-2020

EU-LFS Code	Questions	Answers
AS2	When did you first work with insurance?	1)Insured up to 1992 2)Insured since 1993
AS3	Are you insured for heavy and arduous professions?	1)Yes 2)No 3)Did not answer
AS4	Are you fully covered by social security in your main job?	1)Yes, I am insured for all my work hours (full insurance) 2)No, I am insured for some of my working hours (partial insurance) 3)No, I have no insurance 4)Did not answer
AS5		1)The employer demanded it

What is the reason
you are not covered
by social security for
all your working
hours (or no insured at
all) in your main job?

2)It Is financially beneficial for me
3)Did not answer

Source: Codebook EU-LFS, ELSTAT

Table 11. Number of declared and undeclared workers allocated per sector in Greece

Code	Sector	Declared workers	Undeclared workers
01A	Agriculture, forestry and fishing	44,669	5,771
02B	Mining and quarrying	11,872	201
03C	Manufacturing	299,721	2,669
04D	Electricity, gas, steam and air conditioning supply	28,097	0
05E	Water supply; sewerage, waste management and remediation activities	31,804	0
06F	Construction	86,056	2,940
07G	Wholesale and retail trade; repair of motor vehicles and motorcycles	442,280	2,026
08H	Transportation and storage	144,312	1,446
09J	Accommodation and food service activities	267,146	4,792
10K	Information and communication	89,249	101
11L	Financial and insurance activities	72,535	333
12M	Real estate activities	2,473	0
13N	Professional, scientific and technical activities	96,689	562
14O	Administrative and support service activities	73,904	658
15P	Public administration and defence; compulsory social security	341,343	150
16Q	Education	290,704	1,116
17R	Human health and social work activities	290,704	1,304
18S	Arts, entertainment and recreation	199,063	946

19T	Other service activities	50,684	850
20Y	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	9,988	11,616
21Z	Activities of extraterritorial organisations and bodies	4,329	0

Source: EU-LFS, 2019

Table 12. Percentage of full time workers declare as part time workers

Year	% of part time workers EU-LFS	% of part time workers EFKA	Difference
2003	3.71%	14.11%	10.40
2004	4.36%	13.88%	9.52
2005	4.64%	12.90%	8.26
2006	5.03%	15.10%	10.07
2007	4.96%	14.23%	9.27
2008	4.48%	14.34%	9.86
2009	5.59%	14.60%	9.01
2010	6.11%	16.56%	10.45
2011	6.56%	18.40%	11.84
2012	8.32%	19.33%	11.01
2013	9.91%	25.93%	16.02
2014	11.32%	24.67%	13.35
2015	11.50%	25.65%	14.15
2016	12.58%	27.31%	14.73
2017	12.26%	27.46%	15.20
2018	11.49%	26.29%	14.80
2019	11.85%	25.53%	13.68
2020	9.77%	30.01%	20.24

Source: EU-LFS, EFKA, own calculations

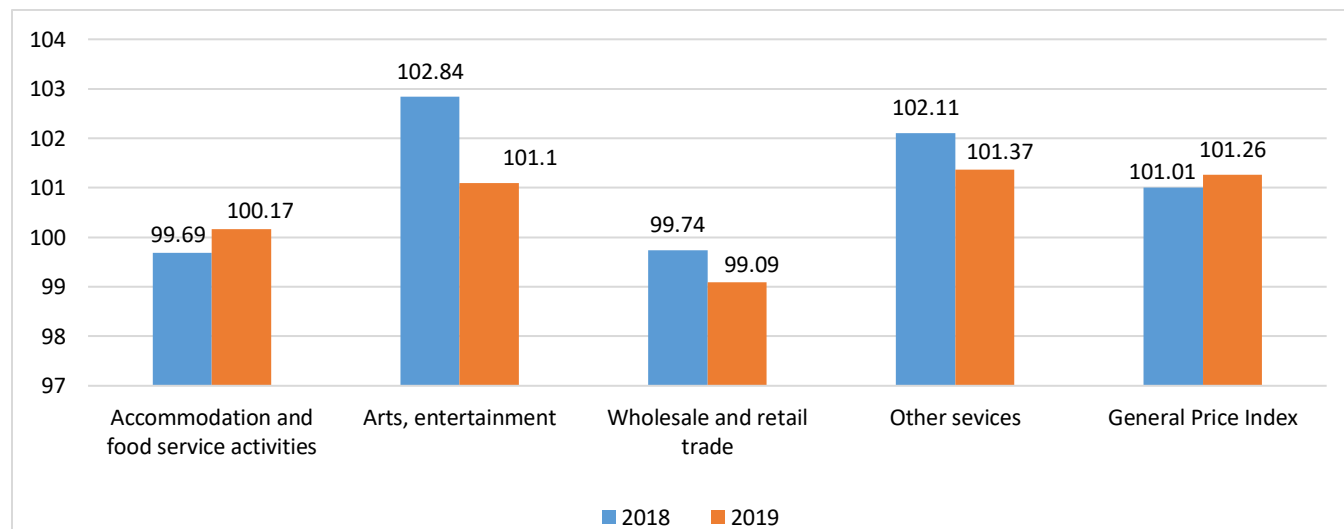
Table 13. Results of Difference in Difference Estimation

Residuals:				
Min	1Q	Median	3Q	Max
-0.99868	-0.03574	0.00132	0.03420	0.99914
Coefficients:				
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.998680	0.001268	787.867	<2e-16 ***
treated	-0.032884	0.001426	-23.057	<2e-16 ***
time	0.002178	0.001802	1.209	0.227
did	0.067766	0.002032	33.355	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Residual standard error: 0.1636 on 154723 degrees of freedom (308697 observations deleted due to missingness)				
Multiple R-squared: 0.03468, Adjusted R-squared: 0.03466				
F-statistic: 1853 on 3 and 154723 DF, p-value: < 2.2e-16				

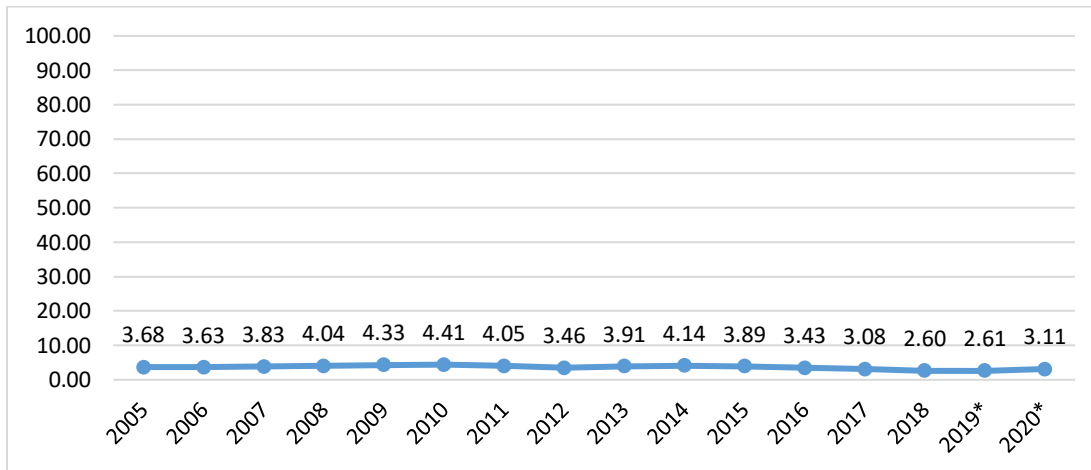
Diagrams

Diagram 1. Price indexes for sector A and the General Price Index, Greece, 2018-2019



Source: ELSTAT

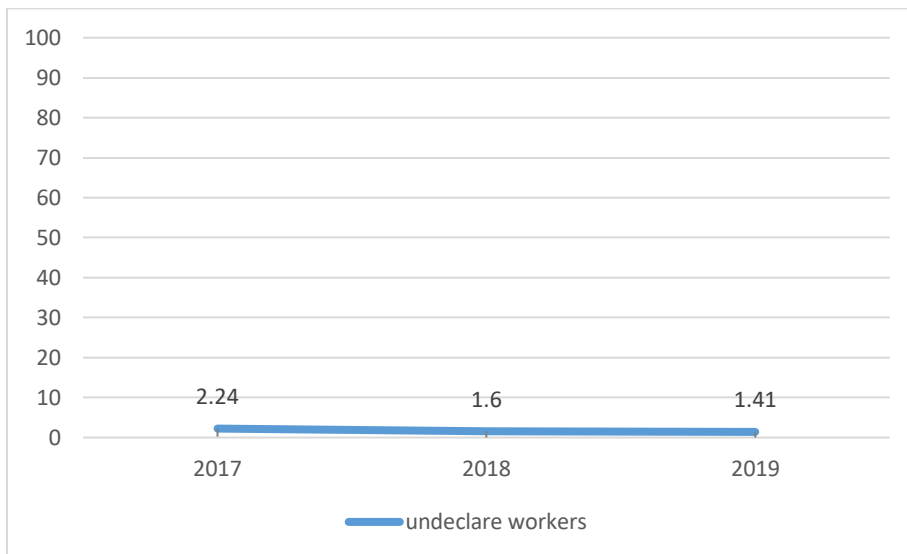
Diagram 2. Percentage of undeclared labour in Greece



Source: EU-LFS

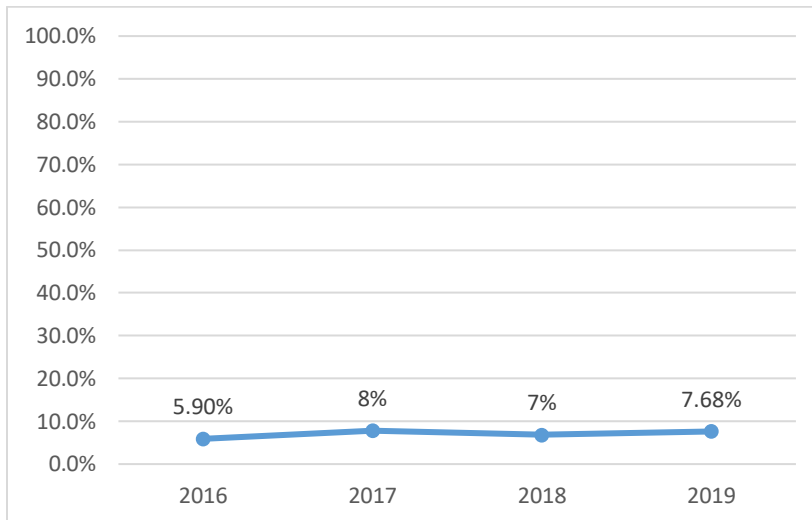
*Note: From 2019, the survey question regarding the undeclared employment have been changed

Diagram 3. Percentage of undeclared workers in Greece



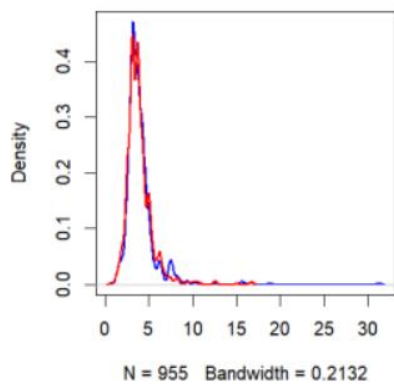
Source: EU-LFS

Diagram 4. Hourwage less than minimum hourwage, Greece 2016-2019



Source: EU-SILC

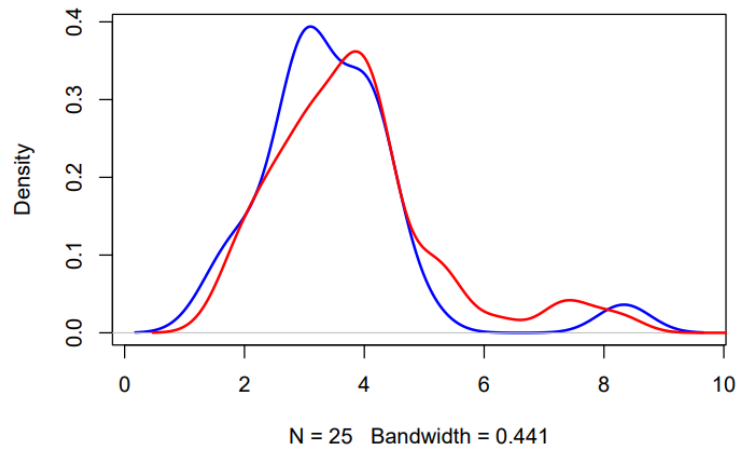
Diagram 5. Hourwage for declared workers under 25 years old in Greece



2:2018- 4:2018 :red line 2:2019- 4:2019 : blue line

Source: EU-LFS

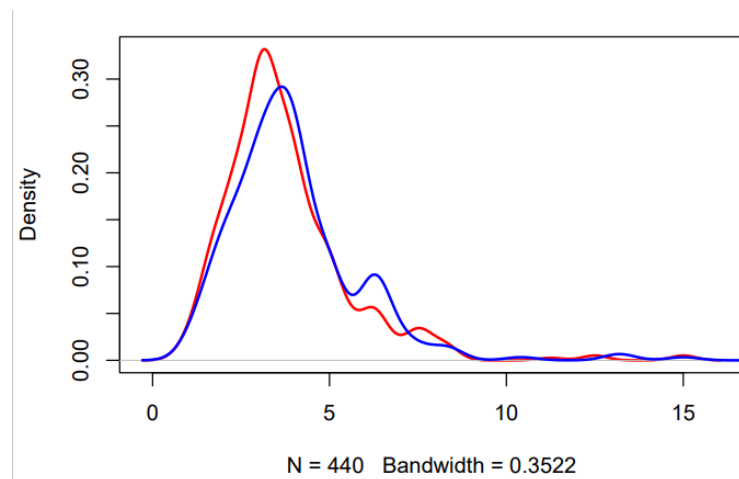
Diagram 6. Hourwage for undeclared workers under 25 years old in Greece



red line 2:2018- 4:2018 blue line 2:2019- 4:2019

Source: EU-LFS

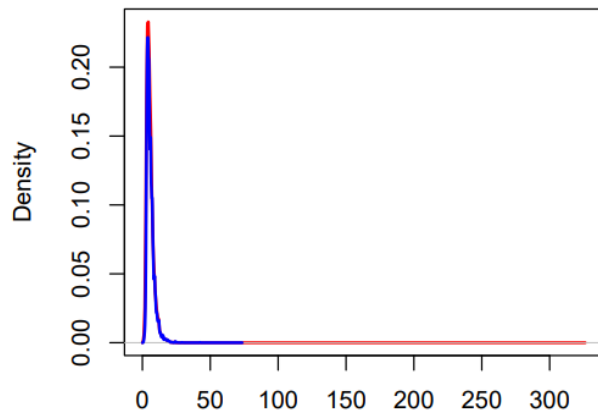
Diagram 7. Kernel density of hourwage of undeclared workers in Greece



red line 2:2018- 4:2018 blue line 2:2019- 4:2019

Source: EU-LFS

Diagram 8. Kernel density of hourwage of declared workers in Greece



N = 38463 Bandwidth = 0.2363

red line 2:2018- 4:2018 blue line 2:2019- 4:2019

Source: EU-LFS