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FDIs and Commercial Balance in CEE Countries - Special Focus on the Manufacturing Economic Sectors. A VAR Analysis

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ABSTRACT

Purpose:
Some empirical findings of the role of foreign direct investment (FDIs) in a host country's export performance was found by many researchers, since exports have been for a long time viewed as an engine of economic growth. But exports and imports are inter-correlated and some works proved that sometimes, the foreign-owned companies import more than they export in some economic sectors. The paper aims to establish the relation between total FDIs and the commercial balance (goods) and between FDI stocks in the manufacturing economic sectors and the commercial balance of manufactured goods in 11 Central and Eastern European countries during the crisis period and post-crisis period (2009-2018). We have tested the causality using Granger causality test to see if there is a uni-directional or bi-directional causality between those variables. We have tested for co-integration and we haven't found a long-term relationship between those variables and we have applied the VAR technique. Our results have proved a bi-directional causality between FDI stock-exports-imports and a stronger impact of FDIs stock on the trade balance of manufactured goods than the impact of total FDI stock on the commercial balance of goods in CEE countries.

Design/methodology/approach:
Granger causality tests, cointegration test, VAR analysis

Finding:
We have found no cointegration in the long-run between FDIs stocks and exports and imports in the CEE countries. We have found a bi-directional causality between those variables. We have found a stronger impact of FDIs stock on export and imports of manufactured goods than the impact of FDIs stock on total exports and imports in the CEE countries.

Research limitations/implications:
This research can be extended analysing a longer period of time and including more exogenous variables in the analysis such as labour productivity, labour cost and GDP growth. It can also be performed a panel analysis. The CEE countries should design adequate policies in order to attract more FDIs in the manufacturing sectors, given the strong impact of FDI stock for these sectors and given the large share of the manufactured goods of the total exports of the CEE countries.

Originality/value:
This research is important for CEE region because of the large share of the manufactured good of the total exports of these economies.

1. Introduction

Foreign Direct Investment (FDI) plays a pivotal role in supporting the development of countries' economic development process (Raeskyesa and Suryandaru, 2020). FDI was the principal source of flows to the developing countries in 1990. Unlike other capital flows, FDI has a fewer degree of volatility and does not follow a pro-cyclical behaviour.

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The simulative effects of FDI on exports of the host country come from the additional capital, technology and managerial know-how of the multinational corporations, but also from the access to global, regional and home-country markets (UNCTAD, 2002).

By processing components and assembling the imports of the unfinished and intermediate goods, China became a dominant exporter of labour-intensive products (toys, shoes, clothes and sporting goods) and some technology-intensive products (machinery and equipment, including electronic circuits, automatic data-processing machines and mobile phones) (UNCTAD, 2002). Many studies have demonstrated that growth in the manufacturing sector is a key driver in the economic growth in China (Haruchi, Smeet, & Chen, 2017). Using a regression analysis, Karanja (2019) found there is a very high correlation between the level of FDI and manufacturing industry productivity in China and, thus, China needs to attract more FDIs. Not only China developed a lot based on the export's growth of the manufactured goods. Another „Asian Tigers" (in terms of economic growth) greatly developed as a result of large FDI inflows and important exports growth of the manufactured goods. Many previous studies focused on „Asian Tigers" and, especially, on China.

Sekkat (2015) found that deeper integration with the EU area increased manufactured exports and FDIs to a greater degree compared to other cases of the regional integration.

Krstić (2014) has shown that economic models allow us to improve the level of understanding of the economy and not only of the economy.

This paper aims to find out what is the correlation between the FDIs stock and total exports and imports in the CEE countries and what is the correlation between FDI stock in the manufacturing sectors and exports and imports of the manufactured goods in this specific region that attracted large FDI inflows in the 2000s' and reached high economic growth rates (based on exports) comparing to the rest of EU countries. Of course, the positive correlation between the FDI inflows and exports growth of the manufactured goods depends on the productivity in the manufacturing sectors and on the level of the domestic supply on the internal market. An insufficient domestic supply or a low productivity in the manufacturing sectors can't support important positive spillovers of FDIs on exports or an increase of the exports of the manufactured goods.

There are many studies focused on the relation between FDI stock and total exports growth, but only few of them have dealt with European countries or with the Central and Eastern European countries and have studied the relation between FDI and exports and imports in the same time.

2. Literature Review

Camarero and Tamarit (2004) studied the relationship between foreign trade with manufactured products (both exports and imports) and FDI inflows and outflows for 11 European Union countries, USA and Japan using quarterly data between 1981 and 1998. The authors found a positive and significant relationship between FDI and foreign trade.

Damijan et al. (2008) studied the export performance in the CEE countries, focusing on the transition countries. The authors found that higher levels of FDI contributed to increasing exports, due to their involvement in restructuring the manufacturing sector.

A GMM analysis for EU countries during 1999-2012 (Popovici, 2018) found that the foreign investments seem to have a higher impact on increasing exports in the new EU member states than in the old ones, irrespective of the economic sector. Instead, in the old EU member states, the domestic investment is the main factor of the export development. Both foreign and domestic investments have a positive impact on the exports. More exports in manufacturing or services will draw a higher volume of exports in the following year. Their previous trend is more important than the developments of the domestic or foreign investments. The exports in the manufacturing sector are more sensitive to the impact of foreign investments than the service sectors that depend more on the domestic investments.

Zaman et al. (2011) have demonstrated in their research that in Romania only FDI inflows in the manufacturing industries (cars industry and metallurgy) and in the agriculture sector generated positive results for the commercial balance, while FDI inflows in the commerce sector and extraction industry generated some high negative results for the Romanian external trade. This can be explained by a high share of imports with high added value in those sectors and an important share of exports with low added value and very low processed. Other researchers (Mishal şi Abulaila, 2007) have stressed a bi-directional relation between FDI, exports and imports. Some other studies have demonstrated that, on average, the impact of FDI on exports and imports is negative, meaning that the foreign-owned firms import more than they export (Borensztein E. et al., 1998).

Bouras and Raggad (2015) have stressed whether export and FDI substitute or complement each other for 10 countries in Africa and Europe. Their random effect model used data for the manufacturing and non-manufacturing sectors in ten developing and non-developing countries. The results show there is a complementarity effect between total exports and total FDI. Similar results were found between manufacturing exports and manufacturing FDI and between non-manufacturing exports and non-manufacturing FDI. The estimated results show that exports have a significant positive impact on FDI. The results show that the complementary effect on exports is predominant at the macro level for manufactured exports relative to non-manufacturing exports. Moreover, if FDI is mainly directed towards the exploitation of natural resources, they should lead to more concentrated export (oil-exporting countries). Results suggest that exports in these countries generate additional FDIs flows from investing countries (a complementary relationship).

Selimi et al. (2016) analysed empirically the foreign direct investments and exports performance during the period of 1996-2013 in 9 Western Balkan countries (former-Yugoslavia countries and Albania, Romania and Bulgaria). The paper also investigates for the fixed effects and individual heterogeneity across countries and years. Based on the panel regression techniques, Least Square Dummy Variable (LSDV) regression method and a pooled OLS, the authors proved that FDIs positively affect export performance. They have used as exogenous variables FDI, real exchange rate, real GDP growth, added value in the industry, savings and gross capital stock. The fixed effects of FDI on exports are higher in Slovenia, Bulgaria and Macedonia, while they are lower in other 4 SEE countries and even negative in Albania and Serbia.

Jevcak, Suardi and Setzer (2010) analysed FDI inflows in 10 new EU member countries (EU enlargement from 2004). They found that FDI in the mentioned countries does not have higher contribution to productivity growth and export potential.

Mitic si Ivic (2016) have proved a positive relation between FDI and total exports (1993-2013) in the last two decades for 11 CEE countries (demonstrating a strong relation in some CEE countries such as Bosnia and Herzegovina, Bulgaria, Czech Republic and Slovakia) and between FDI and exports of manufactured goods based on high technology (1996-2012) in the European transition countries (a very strong relation in countries such as Polonia and Slovenia), using a correlation analysis (Pearson correlation coefficient) and including one lag in their analysis. They stressed a tighter correlation between FDI and exports based on high technology than the correlation between total FDI and total exports for the CEE region.

There is evidence of a positive relationship between FDI, the level of specialization and changes in export structure in favour of products with higher value added (Lovrinčević et al., 2004). EU membership was a key factor for attracting FDI and for foreign trade development of countries in transition, including the shift of exports towards higher stages of production- higher added value products (Kaminski, 2000). In an analysis of Mitic (2009) during 1994-2009, including 15 European transition countries, the FDI inflows and exports are positively correlated and complementary; the correlation coefficients has slightly higher values than in the case of the relationship between FDI and GDP. A negative correlation that was found in the case of Bulgaria and Croatia (Mitic, 2009). Regarding the impact on industrial exports, the results of an UNCTAD study indicate there is a positive and significant correlation between FDI and industrial exports. The conclusion of this study is that the impact of FDI is more obvious on the technology intensive exports (UNCTAD, 1999).

Anghelache (2016) has demonstrated a linear relation between exports and FDI in Romania using correlogram with a dataset between 1990 and 2015. The linear regression results stressed a positive relation between FDI and exports developments.

Kostoska and Mitrevski (2008) showed in their study for 9 CEE countries during 1985-2006 that the low-income CEE transition economies have developed more slowly comparing to the early reformers in the CEE area (Czech Republic, Hungary and Poland) which have received almost 60% of the total FDI inflows. The analysis suggests that there have been few or no important positive productivity spillovers of FDI in the analysed transition CEE economies. In other words, the foreign owned firms determined a low productivity growth for the local firms, because of the impulsive domestic competition for the foreign firms and the lack of financial possibility for local firms to adapt well. FDI concentration into non-tradable sector in some CEE countries undermines the export competitiveness. The empirical findings suggest that countries which have attracted more FDI in manufacturing sectors have reached an improvement in export competitiveness against those that attracted FDI flows in the services area (70% of manufacturing sales in Hungary were due to foreign investment in late `90s, so the country tripled the exports at the beginning of the following decade). The FDI composition in Czech Republic was divided between services and manufacturing sectors, thus the exports growth was weaker than the increase of the FDI inflows. The same situation was in Bulgaria where manufacturing sectors attracted 1/3 of FDIs, while in Hungary, the foreign owned firms largely participated within the Hungarian exports. The premature reformers such as Poland, Hungary and Czech Republic have allowed a high technology transfer while receiving the most FDIs in the manufacturing sectors. They have increased the R&D composition of their exports, even they still produced low added value products in the high technology sectors. Croatia also faced smaller effects on exports competitiveness, despite large FDI inflows in this country, because the FDIs were attracted mainly in retail and financial intermediation, so the export structure didn't change widely and immediately (there were low technology transfers and less changes in value added composition of their exports). Kersan-Skabic and Zubin (2009) found no significant effect of FDI on exports for the Croatian economy, because of a low share of greenfield investments in Croatia.

Mahmoodi and Mahmoodi (2016) examined the causality relationship between FDI, exports and economic growth in eight European developing countries for 1992 through 2013, and eight Asian developing countries over 1986 to 2013. Panel unit root tests indicated that all variables are I(1) integrated. Panel co-integration tests proved the existence of co-integration in both panels of European or Asian countries. The Panel-VECM causality was performed for both panels, which indicated a unidirectional causality from GDP and FDI to exports in the short-run for the European developing countries. There is evidence of long-run causality from economic growth and export to FDI for both of the European and Asian developing panels. Countries in the two considered panels, especially the European ones, can stimulate the economic growth by attracting FDI inflows. Moreover, countries of these two panels, especially Asian developing countries, can reach higher economic growth by increasing exports of goods and services (by decreasing the export taxes and trade barriers, encourage the industrial-based export and improve quality control).

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3. FDI inward stock and exports/imports developments in the CEE countries

If we consider data in Table 1, we can see that in Bulgaria and Croatia, exports increased until 2012 and after that they decreased until 2016. In the last analysed years, they have increased again at similar level of the year 2012 when they reached their peak during the entire analysed period. The same situation can be seen in Estonia, Latvia and Lithuania. For Czechia there was a steady increase almost the entire analysed period of time (except two years of a slow decrease) and the same trend can be observed in Hungary, Poland, Slovakia and Slovenia.

Table 1. Export unit value index (2015=100) – total products, all countries of the world

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bulgaria	85,4	94,6	104,0	107,5	103,5	101,4	100,0	97,6	103,2	106,8
Czechia	84,7	88,9	94,5	97,1	96,2	97,0	100,0	99,7	103,6	107,3
Estonia	86,6	93,7	102,0	104,2	103,0	101,9	100,0	99,6	103,0	107,3
Croatia	89,5	94,7	103,5	106,2	102,7	101,6	100,0	98,0	102,5	105,1
Latvia	84,9	92,6	99,8	103,0	103,4	102,2	100,0	97,7	101,6	107,5
Lithuania	80,7	90,6	102,9	108,3	107,1	104,7	100,0	95,6	101,4	106,9
Hungary	86,8	93,2	97,7	99,1	99,4	98,5	100,0	99,6	104,6	107,1
Poland	85,8	91,8	96,5	98,7	98,4	98,1	100,0	98,9	103,5	106,0
Romania	82,6	89,4	98,0	100,4	99,2	98,7	100,0	99,3	102,2	108,3
Slovenia	91,3	95,7	101,2	103,0	101,5	100,1	100,0	98,5	102,4	105,5
Slovakia	96,3	99,1	103,5	103,7	101,9	98,0	100,0	101,8	107,3	111,3

Source: Eurostat database 2009-2018

In Table 2 we can see the development of the imports of CEE countries during 2009-2018. In Bulgaria, Baltic States and Croatia the decrease of exports was also accompanied by a decrease of imports during 2013-2016. The other analysed CEE countries also faced a small decrease of their imports during 2013-2014 and even in 2016.

Table 2. Import unit value index (2015=100) – total products, all countries of the world

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bulgaria	88,9	97,7	108,7	112,0	108,5	105,4	100,0	96,5	103,9	108,7
Czechia	83,7	89,5	95,6	99,2	97,9	97,7	100,0	98,6	104,1	107,6
Estonia	82,8	90,2	99,4	104,0	102,3	101,9	100,0	97,9	102,3	106,3
Croatia	90,0	94,3	102,9	107,0	104,4	102,6	100,0	99,1	104,7	109,0
Latvia	86,2	91,7	100,0	106,2	105,2	103,7	100,0	96,1	101,1	105,1
Lithuania	82,2	94,4	107,9	113,8	111,8	106,9	100,0	94,8	101,2	107,2
Hungary	92,1	96,6	100,7	102,6	100,7	99,5	100,0	98,5	102,6	105,4
Poland	82,5	90,3	97,3	101,2	100,1	99,7	100,0	98,6	104,8	108,2
Romania	84,0	90,2	98,2	101,2	100,6	100,6	100,0	99,2	104,3	110,7
Slovenia	88,4	95,8	102,9	105,5	103,0	101,1	100,0	98,2	103,3	107,4
Slovakia	91,5	98,1	104,0	105,4	103,8	97,4	100,0	100,7	104,3	108,3

Source: Eurostat database 2009-2018

In Table 3 we have presented the data for FDI inward in CEE countries (% of GDP) and we can stress from the data-series that Slovenia displays the lowest share of FDI inward of GDP (but it is an increasing trend), followed by Lithuania, Poland and Romania. The highest share of FDI inward of GDP can be seen in Estonia, Bulgaria (with a decreasing trend), Czechia, Hungary and Croatia.

Table 3. FDI inward stock share of GDP (2009-2018)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bulgaria	94,8	88,8	79,5	90,2	90,5	80,0	86,7	80,7	87,6	76,0
Croatia	52,5	52,6	45,2	52,4	51,3	50,2	52,4	53,4	60,6	54,2
Czechia	61,0	61,9	52,9	65,8	64,0	58,4	62,4	62,4	72,2	64,1
Estonia	80,5	79,7	70,5	82,1	87,8	79,9	84,0	84,5	92,1	82,5
Hungary	75,7	69,3	60,6	81,3	80,3	71,0	68,9	64,0	64,8	57,0
Latvia	44,4	46,0	42,5	48,1	52,7	48,1	54,6	51,4	57,5	49,6
Lithuania	35,4	36,1	32,7	37,2	37,8	31,8	35,4	34,1	37,3	33,3
Poland	38,0	39,1	31,1	39,7	44,2	38,7	38,9	40,0	45,3	39,5
Romania	40,7	41,2	37,7	44,4	43,1	36,6	39,4	39,3	42,9	39,1
Slovakia	59,0	56,2	52,9	59,0	58,9	49,2	52,4	52,9	58,4	53,6
Slovenia	22,4	22,2	22,4	26,3	25,5	24,8	29,3	30,6	33,8	31,0

Source: UNCTAD database

Although it displays the lowest share of FDI inward stock of GDP, Slovenia display a high share of exports of GDP and a high share of imports of GDP, together with Slovakia and Hungary. Poland and Romania display low shares of exports and imports of GDP and low share of FDI inward stock of GDP, while Croatia display large FDI inflows and stock, but a low share of exports of GDP and a low share of imports of GDP in the CEE region (Tables 4 and 5).

Table 4. Total exports share of GDP (%)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bulgaria	42,3	50,1	59,0	60,8	64,8	64,9	64,5	64,7	68,1	66,9
Croatia	32,6	36,1	38,8	39,5	40,4	43,3	46,3	47,6	50,0	50,5
Czechia	58,6	66,0	71,3	76,1	76,8	82,5	81,0	79,5	79,7	78,3
Estonia	60,5	74,4	85,8	85,5	84,0	81,3	76,8	77,4	76,1	74,2
Hungary	74,4	81,7	86,5	86,3	85,5	87,4	87,9	87,1	87,1	84,9
Latvia	42,4	53,5	57,7	61,2	60,2	61,2	60,7	60,4	62,1	61,3
Lithuania	51,9	64,1	73,0	78,4	78,9	72,3	68,8	67,5	73,6	75,6
Poland	37,1	40,0	42,5	44,4	46,3	47,5	49,5	52,2	54,3	55,6
Romania	26,0	32,4	37,0	37,4	39,8	41,1	41,0	41,1	41,4	41,6
Slovakia	68,0	77,3	85,0	91,0	93,6	91,5	92,0	93,7	95,1	96,1
Slovenia	57,2	64,2	70,2	72,9	74,2	76,1	77,1	77,9	83,1	85,3

Source: World Bank database

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Table 5. Total imports share of GDP (%)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bulgaria	50,6	53,0	58,7	64,0	65,3	65,8	63,5	59,7	63,7	64,3
Croatia	38,2	38,0	40,8	41,2	42,5	43,6	46,1	46,5	49,4	51,3
Czechia	54,8	62,9	67,4	71,3	71,1	76,1	75,0	71,8	72,2	72,0
Estonia	55,5	68,0	80,0	83,9	81,3	77,8	72,9	73,5	71,8	70,7
Hungary	70,3	76,4	80,4	79,5	78,6	81,0	79,9	78,4	79,8	80,5
Latvia	44,0	55,0	62,7	65,6	63,8	63,2	61,6	59,4	61,9	61,4
Lithuania	53,6	66,1	75,7	77,8	77,3	70,5	69,8	66,8	71,2	73,6
Poland	38,0	42,0	44,5	44,8	44,3	46,1	46,4	48,1	50,1	52,1
Romania	32,4	38,8	42,8	42,5	40,6	41,6	41,6	42,1	43,6	44,8
Slovakia	68,2	77,6	84,3	85,5	88,0	86,7	88,9	90,7	92,9	94,0
Slovenia	55,8	63,2	69,0	69,5	69,5	69,4	69,1	69,4	74,3	77,0

Source: World Bank database

Large deficits of the foreign trade with goods can be seen in Croatia, Latvia and Romania. Bulgaria faced large commercial deficits until 2013, but after then, it faced a decreasing trend of its commercial deficit. Czechia and Hungary display a high surplus of their commercial balance for goods and, during the last analysed years, we can see surplus of the trade balance for goods also in Slovenia and Slovakia (Slovakia displays a descending trend of its commercial surplus). Poland also reduced its commercial deficit and even faced three years of surplus during 2015-2017 (Table 6).

Table 6. Trade balance (goods) share of GDP

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bulgaria	-11,13	-9,37	-6,51	-9,51	-7,00	-6,48	-5,79	-2,04	-1,48	-4,12
Croatia	-16,61	-13,15	-14,41	-14,74	-15,25	-14,93	-15,12	-15,83	-15,77	-18,18
Czechia	1,64	0,99	1,87	3,04	4,08	5,10	4,079	5,15	5,10	4,14
Estonia	-5,12	-2,75	-2,10	-7,13	-4,88	-5,02	-4,33	-3,60	-3,54	-3,88
Hungary	2,81	2,64	2,89	2,93	3,27	2,01	3,65	4,02	1,54	-1,05
Latvia	-8,38	-8,59	-12,26	-12,04	-11,49	-10,06	-9,03	-7,52	-8,53	-8,72
Lithuania	-4,33	-5,87	-6,59	-3,301	-2,63	-2,55	-5,30	-4,55	-4,62	-5,86
Poland	-2,43	-3,02	-3,49	-2,08	-0,08	-0,79	0,51	0,68	0,30	-1,04
Romania	-7,26	-7,63	-7,06	-6,93	-4,03	-4,34	-4,85	-5,47	-6,48	-7,28
Slovakia	-0,36	-0,11	-0,053	3,44	3,92	3,62	1,32	2,01	0,81	0,05
Slovenia	-1,16	-2,06	-2,63	-0,22	1,95	3,14	3,79	3,80	3,63	2,50

Source: UNCTAD database

Hungary, Slovenia and Slovakia display the highest share of FDI stock in the manufacturing sectors. That is why, Slovenia display a high share of its exports of GDP, although the share of FDI inward stock of GDP is the lowest in the entire CEE region. Hungary displays a high share of FDI inward stock of GDP as well as the share of FDI stock

in the manufacturing sectors and that boosts its exports and generally its foreign trade with goods. Slovakia also displays a high share of its exports of GDP, due to its important share of FDI stock in the manufacturing sectors. Latvia, Estonia, Bulgaria and Lithuania display the lowest share of FDI inward stock in the manufacturing sectors. This low share explains the low share of the exports of GDP of those countries (Table 7).

Table 7. FDI stock in manufacturing sectors in Romania, Bulgaria (% of total FDI inward stock)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bulgaria	16,3	17,7	17,6	17,4	18,2	17,6	17,9	18,0	18,4	18,8
Croatia	23,2	21,9	29,2	27,7	27,1	25,3	25,9	24,1	25,2	24,7
Czechia	31,4	29,8	31,6	33	32,3	33,4	32,8	31,5	29,1	29,5
Estonia	14,7	14,8	16,7	15,2	12,9	12,1	13,7	13,5	13,2	12,9
Hungary	25,1	25,4	15,1	20	21,4	24,8	10,8	29,6	41,9	39,3
Latvia	11,4	12,5	11,9	11,7	12,1	12,1	11,3	11,8	11,2	11,7
Lithuania	22,3	22,9	25,1	24,9	21,4	18	19,4	16,1	17,9	17,2
Poland	31,7	31,2	31,5	31,6	29,3	29	32,2	31,2	32,2	31,3
Romania	31,1	32	31,5	31,2	31,1	32	31,8	32	32	30,9
Slovakia	34,4	34,3	30,7	32,8	32,3	33,4	33,2	32,2	32	32,3
Slovenia	31,4	29,4	28,2	30,2	33,3	32,7	34,2	32,5	33,2	35,8

Source: OECD database, National Banks sites, UNCTAD publications, WIIW FDI Database

High shares of FDI stock of GDP and high shares of FDI stock in the manufactured sectors are associated with high share of exports of manufactured goods of total exports in Czechia and Hungary that also display commercial surplus, but also in Slovakia where the commercial surplus is lower than in Czechia and in Hungary. Although Bulgaria display a high share of FDI stock of GDP, the share of FDI stock in manufacturing sectors is low and the exports of manufactured good is also low, so they are positively correlated. In Croatia, Estonia, Latvia and Lithuania we can also see low shares of FDI stocks in the manufacturing sectors and a low share of manufactured goods, too (Table 8). These last 4 countries display the highest commercial deficits in the CEE region (Table 6).

Table 8. Exports of manufactured goods (% of total exports of goods)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Bulgaria	53,1	54	51,3	50,2	50,3	54,7	57,8	59,2	57,2	58,9
Croatia	76,7	75,4	74	71	68,4	68,6	72,5	80,1	71,3	79,7
Czechia	97,3	99,2	104,1	102,1	103,9	105,6	108,9	112	113,4	113,9
Estonia	88,1	80,3	79,3	83	84,5	78,2	76,2	75,8	74,7	75,1
Hungary	85,8	89,2	90,9	92,1	95	96	98,6	100	101,5	101,6
Latvia	61,6	57,8	58	54,9	53,8	54,5	59	60,1	60,9	63,5
Lithuania	59	57	55,2	53,8	54,3	59,6	60,7	63,7	63,5	63,8
Poland	82	79,4	79,6	75,8	78,9	79	80,2	80,3	77,6	82,4

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Romania	95,9	89,4	87,4	87,1	85,3	85,5	86,5	87,6	87,8	90,2
Slovakia	90,5	89,7	87,3	86,9	88,5	90,7	93,2	93,8	93	93.5
Slovenia	85,9	84	82,5	82	81,7	83	83	84,5	83,9	83,1

Source: authors' calculations based on data from UNCTAD database

Imports of manufactured goods are high in Czechia, Hungary, Slovakia, but also in Romania where the FDI inward stock in manufactured sectors is low. In Romania there are high commercial deficits because of high imports of manufactured goods. In Bulgaria and Lithuania, the share of the imports of manufactured goods are the lowest in the CEE region, but the share of manufactured exports is also low because of a low share of FDI inward stock in the manufacturing economic sectors (Table 9).

Table 9. Imports of manufactured goods (% of total imports of goods)

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Bulgaria	61,7	59,1	57,3	57,2	57,8	63,2	64,5	68,6	65,4	66,1
Croatia	75,7	72,8	68,4	66,6	66,4	69,2	72,7	78,6	72,5	77,5
Czechia	84,4	85,5	89	85,5	87,1	90,9	96,4	99,8	101,8	102,5
Estonia	81,3	81,1	79,8	79,7	80,4	79,8	80,5	80	82,1	77,6
Hungary	73,9	74,9	75,4	77,5	80,8	80,7	85,4	86,7	88,9	88
Latvia	57,6	60,6	60,6	56,8	57,2	60,5	65	66,5	67,8	70,9
Lithuania	57	53,2	52,7	50,7	53,1	60,1	61,7	65,6	63,8	62,7
Poland	77,6	75,5	73,7	69,6	74,6	74,4	77,8	76,7	74,4	78,4
Romania	88,7	83,2	82,4	80,8	82,5	82	85	84,4	83,1	85,4
Slovakia	80,7	78,7	74	77,3	77,8	80,8	84,9	86,6	84,5	84,3
Slovenia	74,3	71,6	68,2	67,7	70,7	72,1	73,7	76,6	76	76

Source: authors' calculations based on data from UNCTAD database

Czechia, Slovenia and Slovakia display large commercial surplus both for total commercial balance of goods, but also for the commercial balance of the manufactured goods. Hungary and Poland display surplus for the trade of the manufactured goods, but they faced deficits for the trade of total goods in 2018, although in the previous years, all 5 countries faced surplus both for the balance of the manufactured goods, but also for the commercial balance of total goods. Romania, Lithuania and Croatia display commercial deficits both for the entire commercial balance of goods and for the balance of the manufactured goods. Latvia and Bulgaria display large deficits for its commercial balance of manufactured goods, but also for the commercial balance of total goods (Table 10).

Table 10. Trade balance in manufactured sectors (% of total trade balance in goods)

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Bulgaria	85,9	79,6	99,8	91,8	112,5	127,9	120,3	290	357,3	154
Croatia	74,8	69,3	61	60,9	63,8	70,3	73	76,4	74,5	74,6
Czechia	467,6	851,8	577,3	435,9	355	294,7	306,2	259	254,4	286,2
Estonia	32	94,9	95,9	53	31,9	97,5	132,2	142,5	190,4	111,2
Hungary	328,7	435,5	455,2	428	374	606,5	341,5	319,3	654,3	-785,2
Latvia	45	73	69,3	63,7	70	86,3	93,1	101,9	102,3	105,5

Lithuania	37,8	19,3	29	-12,4	22,5	73,6	73,6	88,8	67	51,5
Poland	23,6	33,9	14,8	-36,6	-1843,4	-150,2	264	289,7	524,2	-86,7
Romania	69,7	62,1	61,4	54	61,7	57	76	66,7	61,4	65,4
Slovakia	1703,1	-6330,4	-19998	306,3	307,9	306,3	599,5	381,4	969,4	1507,2
Slovenia	-373,2	-237,1	-241,6	-3689,4	407,7	283,6	226	205	220	268

Source: authors' own calculations based on data-series from UNCTAD database

4. Data, Methodology and Empirical Results

Statistics of the data series we have worked with for total FDI stock inward, total exports of GDP and total imports of GDP are presented below in Table 11. FDI as share of GDP is the most volatile series, while import as share of GDP is the least volatile among these three analysed series. Skewness alludes the tendency of a distribution that determines its symmetry about the mean. The graphs of those three analysed series show the symmetry from the mean of the dataset.

Kurtosis means the measure of the respective sharpness of the curve, in the frequency distribution. It ascertains the way observations are clustered around the centre of the distribution. Total exports and total imports data are highly dispersed against the mean of those data series, while FDI stock shows a normal distribution.

Table 11. Descriptive statistics of total FDI stock as share of GDP (FDI_GDP), total exports as share of GDP (EXP_GDP) and total imports as share of GDP (IMP_GDP)

	FDI_GDP	EXP_GDP	IMP_GDP
Mean	54.42636	65.08182	63.38364
Median	52.55000	66.45000	65.70000
Maximum	94.80000	96.10000	94.00000
Minimum	22.20000	26.00000	32.40000
Std. Dev.	18.76473	17.73506	15.12512
Skewness	0.377787	-0.221362	-0.148967
Kurtosis	2.185970	1.929448	1.994669

Source: E-views estimations

We have tested FDI stock of GDP, total exports of GDP and total imports of GDP for unit root with ADF-Fisher individual root tests and we found out that all of them are I(0). According to the Granger causality tests, the null hypothesis is rejected, thus there is a bi-directional causality between total FDI stock and total exports. There is a bi-directional causality between total FDI and total imports, and a bi-directional causality between total exports and total imports (Table 12).

Table 12. Granger causality tests between total FDI stock of GDP, total exports of GDP and total imports of GDP

	F-Statistic	Prob.
EXP_GDP does not Granger Cause FDI_GDP	0.80985	0.4484
FDI_GDP does not Granger Cause EXP_GDP	0.19704	0.8215
IMP_GDP does not Granger Cause FDI_GDP	0.54194	0.5837
FDI_GDP does not Granger Cause IMP_GDP	1.16019	0.3185
IMP_GDP does not Granger Cause EXP_GDP	0.15474	0.8569
EXP_GDP does not Granger Cause IMP_GDP	8.58431	0.1104

Source: E-views estimations
Null Hypothesis: No causality

We have estimated a VAR for each variable: total FDI inward stock of GDP, total exports of GDP and total imports of GDP. VAR model is a multi-equation system where all the variables (Y_t) are treated as endogenous (dependent) and are expressed according to their lags (Y_{t-1}), constant term (a) and error term (ε_t) (Equation 1).

$$Y_t = a + A1Y_{t-1} + A2Y_{t-2} + \ldots + ApY_{t-p} + \varepsilon_t \quad (1)$$

We can see from the results that total FDI stock is positively correlated with total exports and total imports. The coefficients are higher for the correlation between total FDI stock and total imports. Total imports are positively

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correlated with total exports. Exports with 1 lag are positively correlated with total imports, but exports with 2 lags are negatively correlated with total imports (Table 13).

Table 13. VAR estimations for FDI stock of GDP, total exports of GDP and total imports of GDP

	EXP_GDP	FDI_GDP	IMP_GDP
EXP_GDP(-1)	1.533018	0.526946	0.617160
	(0.17248)	(0.42563)	(0.16575)
	[8.88789]	[1.23803]	[3.72346]
EXP_GDP(-2)	0.556464	0.429819	-0.425087
	(0.16590)	(0.40939)	(0.15942)
	[3.35419]	[1.04990]	[-2.66640]
FDI_GDP(-1)	0.021866	0.473827	0.042514
	(0.04462)	(0.11011)	(0.04288)
	[0.49003]	[4.30312]	[0.99147]
FDI_GDP(-2)	0.015501	0.459864	0.042956
	(0.04396)	(0.10848)	(0.04224)
	[0.35260]	[4.23912]	[1.01686]
IMP_GDP(-1)	0.084871	0.394955	0.862730
	(0.16507)	(0.40734)	(0.15862)
	[0.51415]	[0.96960]	[5.43881]
IMP_GDP(-2)	0.083194	-0.253768	0.109786
	(0.16281)	(0.40175)	(0.15645)
	[0.51100]	[-0.63165]	[0.70173]
C	2.251613	1.653750	3.041053
	(1.38474)	(3.41710)	(1.33068)
	[1.62601]	[0.48396]	[2.28534]

Source: E-views estimations

Statistics of the data series we have worked with in analysing the manufacturing sectors are presented below in Table 14. FDI stock in the manufacturing sectors as share of total FDI stock inward is the least volatile series, while exports of manufactured goods of total exports is the most volatile among these three analysed series. The graphs of all these three analysed series show the symmetry from the mean of the dataset. FDI in the manufactured sectors are highly dispersed against the mean of those data series, while exports and imports of the manufactured goods shows a normal distribution.

Table 14. Descriptive statistics of FDI stock in the manufacturing sectors of total FDI inward stock (FDI_MANUF), exports of the manufactured goods of total exports (EXP_MANUF) and imports of manufactured goods of total imports (IMP_MANUF)

	FDI_MANUF	EXP_MANUF	IMP_MANUF
Mean	24.89000	78.94545	74.63182
Median	27.40000	81.00000	75.85000
Maximum	41.90000	113.9000	102.5000
Minimum	10.80000	50.20000	50.70000
Std. Dev.	8.078491	16.07747	10.89848
Skewness	-0.332044	-0.053645	-0.046003
Kurtosis	1.773819	2.223131	2.777547

Source: E-views estimations

We have tested FDI stock in the manufacturing sectors of total FDI stock, the exports of manufactured goods of total exports of goods and total imports of manufactured goods of total imports of goods for unit root with ADF-Fisher individual root tests and we found out that all of them are I(1). According to the Granger causality tests, there are bi-directional causality between FDI stock in the manufacturing sectors of total FDI stock, exports of the manufactured goods of total goods exports and imports of manufactured goods of total goods imports (Table 15).

Table 15. Granger causality tests between total FDI stock in the manufacturing sectors of total FDI stock inward, the exports of manufactured goods of total exports of goods and the imports of manufactured goods of total imports of goods

	F-Statistic	Prob.
EXP_MANUF does not Granger Cause FDI_MANUF	2.14493	0.1235
FDI_MANUF does not Granger Cause EXP_MANUF	0.08483	0.9187
IMP_MANUF does not Granger Cause FDI_MANUF	1.40286	0.2517
FDI_MANUF does not Granger Cause IMP_MANUF	0.28328	0.7540
IMP_MANUF does not Granger Cause EXP_MANUF	1.69263	0.1903
EXP_MANUF does not Granger Cause IMP_MANUF	1.83488	0.1660

Source: E-views estimations
Null Hypothesis: No causality

We have tested those three variables for co-integration, using Kao co-integration test. According to the results of the estimations, there is not a co-integration between total FDI stock in the manufacturing sectors, exports of the manufactured goods and imports of the manufactured goods (Table 16).

Table 16. Kao co-integration test for FDI stock inward in the manufacturing sectors of total FDI stock inward, exports of the manufactured goods of total exports of goods and imports of manufactured goods of total imports of goods

	t-Statistic	Prob.*
ADF	-2.522005	0.0058

Source: E-views estimations
*Null Hypothesis: No cointegration at a significance level of 0,01

As a consequence of no-cointegration for these series that are I(1) we have estimated a VAR using the first differences of these three series. We can see from the results that total FDI stock in the manufacturing sectors is positively correlated with exports of the manufactured goods and negatively correlated with imports of the manufactured goods. The imports of the manufactured goods are positively correlated with the exports of the manufactured goods. Exports of the manufactured goods with 1 lag are negatively correlated with imports of the manufactured goods, but exports of the manufactured goods with 2 lags are positively correlated with imports of the manufactured goods. Previous lags of the exports of the manufactured goods are negatively correlated with the actual trend of the exports of the manufactured goods (Table 17).

Table 17. VAR estimations for FDI stock in the manufacturing sectors of total FDI stock, exports of manufactured goods of total exports of goods and imports of manufactured goods of total imports of goods

	DEXP_MANUF	DFDI_MANUF	DIMP_MANUF
DEXP_MANUF(-1)	-0.471846	0.004125	-0.251884
	(0.19483)	(0.25348)	(0.20281)
	[-2.42180]	[0.01627]	[-1.24194]
DEXP_MANUF(-2)	-0.099612	0.074722	0.076996
	(0.15575)	(0.20263)	(0.16213)
	[-0.63958]	[0.36876]	[0.47491]
DFDI_MANUF(-1)	0.003298	0.194380	-0.040382
	(0.08166)	(0.10624)	(0.08501)
	[0.04039]	[1.82959]	[-0.47505]
DFDI_MANUF(-2)	0.073383	0.243260	-0.114721
	(0.08750)	(0.11384)	(0.09109)
	[0.83864]	[2.13678]	[-1.25945]
DIMP_MANUF(-1)	0.337575	0.157429	0.109954
	(0.17517)	(0.22790)	(0.18234)
	[1.92717]	[0.69079]	[0.60301]
DIMP_MANUF(-2)	0.279299	-0.080058	0.076601
	(0.15625)	(0.20328)	(0.16265)
	[1.78756]	[-0.39383]	[0.47096]
C	0.446564	0.139742	1.074904
	(0.31971)	(0.41596)	(0.33281)
	[1.39676]	[0.33595]	[3.22974]

Source: E-views estimations

According to our empirical results, we can emphasize that an increase of total FDI stock supports both the increase on the total exports and total imports, but the imports increase more, so the commercial imbalance worsen on average in

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the CEE region. The FDI stock in the manufacturing sectors supports the increase of the exports of the manufactured goods, but an increase of the FDI stock in the manufacturing sectors doesn't support the increase of imports, so the commercial balance of the manufactured goods improves. That is why, the CEE countries displaying high shares of FDI stock in the manufacturing sectors also display high share of exports of the manufactured goods and commercial surplus of the trade balance of the total goods and of the manufactured goods.

The positive correlation between total FDI stock and total exports is weaker than the positive correlation between the FDI stock in the manufacturing sectors and exports of manufactured goods. An increase of total FDI stock increase also the total imports, but decrease the imports of the manufactured goods and supports the improvement of the trade balance of the manufactured goods. Thus, the CEE region presents an advantage in the manufacturing sectors for their external trade and should aim to attract more FDI inward in the manufacturing sectors by designing adequate economic policies. The CEE countries should aim attracting FDI especially in the manufactured sectors that produce manufactured goods incorporating high-technology and a high value-added. This could improve the entire trade balance in all these CEE countries.

These results indicating a stronger relationship between FDI and exports in the manufacturing sectors than the relation between total FDI and total exports are in line with the findings of Popovici (2018), Damijan et al. (2014), Kostoska and Mitrevski (2008) and Camarero and Tamarit (2004). Our results also point out that FDI represent a weaker factor for exports and imports comparing with the previous developments of these two variables. This relation was also found by the above-mentioned authors. Mahmoodi and Mahmoodi (2016) found for 8 European countries until 2013 a uni-directional causality running from FDI to exports, while we have found a bi-directional causality between total FDI-exports-imports or for FDI in the manufacturing sectors and exports and imports of manufactured goods. Also, they have found that these variables are co-integrated. We have applied Kao co-integration test and the null hypothesis of no-cointegration between those variables was accepted.

5. Conclusion

Many FDIs were attracted in the CEE region as a result of a rapid economic growth, a low tax climate and a low labour cost comparing to other European developed countries, but this situation reversed in the last years, because of a serious tax competition worldwide and low wages, especially in the Asian countries. FDI inflows can be stimulated by expanding free trade zones, decreasing foreign trade tax and increasing security in economic and political areas in the CEE countries. The developments of FDIs inflows in the CEE region during the last years show their stronger orientation toward the service sectors and that can undermine their exports competitiveness, given the fact that the domestic investments are insufficient in many CEE countries and these investments don't benefit of large fiscal facilities as the foreign companies do. The authorities should stimulate the production of goods in all of CEE countries, granting fiscal facilities for both categories of investors, domestic or foreign. Financial constraints represent important barriers for the domestic investors to develop and for large technology spillovers from FDI to the domestic investments.,

Hungary, Poland and the Czech Republic, the top leaders of the CEE region in terms of economic development represent an example of an impressive economic growth based on exports of manufactured goods. Slovakia and Romania also made important progress on this path, but in Romania, where the most important exporter is Dacia-Renault, a car factory, the poor infrastructure represent a serious barrier for a future development in the car industry. The authorities of all CEE countries should allocate more for R&D purposes in the manufactured industrial sectors to invest more in producing goods that incorporate high-technologies and for producing goods with high-added value. The investors should also be stimulated to allocate more funds for R&D purposes for the same aim, for producing goods with high-added value.

A direction for a future research should be testing the relation between the FDIs stock inward and exports in the sectors of manufactured goods with high added-value and incorporating high-technology for the CEE region. We should also estimate a panel regression to stress the impact of FDI on imports and exports of manufactured goods, but also the impact of taxation, real GDP growth, labour productivity and labour cost on the exports and imports, because these also represent important factors in attracting FDI inflows, supporting exports growth and improving the trade balance situation.

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Exploitation of Mineral Resources and Economic Growth in CEMAC: The Role of Institutions

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ABSTRACT

Purpose:
The objective of our study is to determine on one hand the effect of the exploitation of mineral resources on economic growth of CEMAC member countries, and on the other hand to examine the role of institutions in the transmission of these effects.

Design/methodology/approach:
To achieve our goals, we formulated an econometric model in panel data concerning countries of this economic community. Using the fixed effects method and two stage least squared method over the period 2002 to 2016, a period during which we observed not only a surge in the prices of natural resources in the markets but also a fall in the prices of basic resources following two large exogenous shocks. First, the "subprime" crisis and the 2015 oil crisis.

Finding:
From our findings, mineral rent has a positive and significant effects on economic growth. Subsequently, when we control our model with all the variables capturing institutions of governance (Voice and responsibility, Political stability and absence of violence / terrorism, Government Effectiveness - Regulatory quality, Rule of law, and Control of corruption), the results of our regressions were robust. In effect, good governance ensures the proper distribution of mineral rent throughout the economy and contributes to economic development. We came to the conclusion that these institutions of governance do not play a role in the transmission of the positive effects of mineral rent on economic growth.

Research limitations/implications:
The following where limitations encountered in our study. Firstly, the temporal dimension of our study (15 years). Secondly, the failure to take into account certain institutional variables such as democracy or the type of political regime.

Originality/value:
Our study enriches the literature of natural resource curse; it is in line with those who have shown that abundance in basic commodities or natural resource is not necessarily a hindrance to economic development.

1. Introduction

The exploitation of natural resources has favored economic development of countries such as Great Britain and Northern Ireland during the first Industrial Revolution in the 18th and 19th centuries. Natural resources also played an important role during the early stages of development in countries such as the United States of America, Canada and the Netherlands. Jevons (1865) predicted the depletion of natural resources during the industrial revolution following excessive exploitation.

The first study on natural resources focused on the characteristics and rate of extraction of natural resources (Hoteling, 1931). At that time, the prevailing idea was to define an optimal rate of exploitation or extraction of these resources since some of them had renewable characteristics.

After the first petroleum shock in 1973, studies gradually moved away from those of the 1930s. In the 70s, the depletion of natural resources and an inter-generational allocation of resources caught the attention of researchers.

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Hartwick (1977) evoke the idea of substituting different forms of capital which according to him, it is possible that a natural resource that has run out completely can be replaced by artificial capital.

In addition, the second petroleum shock of 1986 really opened up the debate on the relationship between natural resources and economic development. It was then that the concept of "natural resource curse" was introduced in economic literature by Auty (1993).

After the 1970s and 1980s shocks, which significantly affected the global economy in the years 2008 and 2010, economies were hit again by two major crises. The first being the financial crisis of 2008 caused by the poor financial policies of the United States of America and which quickly affected the global economy. CEMAC countries suffered particularly due to the fact that the 2008 financial and economic crisis affected the main drivers of growth in Africa in general. There was a fall in the demand and prices for African raw materials and promises to increase official development assistance made by developed countries could not be fulfilled (ADB, 2009).

The second crisis occurred in 2016 where the price of crude oil after having fluctuated for several years between 80 and 110 US dollars began to fall in the second half of 2014. A slight increase was observed in spring 2015, passing thus to 60 US dollars per barrel, a rise due to seasonal increase in American demand ("driving season" from April to September), during which Americans use their vehicles massively for trips. Prices fell further at the end of summer where WTI (West Texas Intermediate) fell below 40 US dollars per barrel in late August 2015 and stood at 45 US dollars per barrel on September 9, 2015 (DGRIS, 2015).

These crises unveiled the vulnerability of CEMAC countries to exogenous shocks. The economic vulnerability of countries of this community can be observed through the fall in GDP during and after the crisis.

Table 1: Evolution of the growth rate of GDP before, during and after the crisis in the CEMAC countries

Countries	CMR	CHAD	CONGO	RCA	GABON	EQUATORIAL GUINEA
Growth in GDP 2014	5.88	6.89	6.77	1.04	4.31	0.41
Growth in GDP 2015	5.65	1.79	2.69	4.79	3.87	-9.08
Growth in GDP 2016	4.45	-7	-1.86	4.53	2.26	-8.93

Source: Built by authors based on WDI (2017)

In 2014 before the crisis, GDP growth in Equatorial Guinea stood at 0.41. In 2015, a drop of dropped to - 9.08; because its economy is mainly supported by the exploitation of petroleum resources. Likewise, Chad and Congo observed a drop in their growth from 2014 to 2016, going from 6.89 to -7 and 6.77 to -1.86 respectively. CEMAC countries which suffered less during this crisis were Cameroon, Gabon and CAR.

In fact, despite the decline in growth, Cameroon and Gabon remain positive over the period. In addition, the growth of CAR remains in progression passing from 1.04 in 2014 to 4.53 in 2016; because the latter does not exploit petroleum resources. Likewise, CEMAC states are ranked among the least developed in the world. According to UNDP (2018), the most developed CEMAC country after the crisis in 2015 was Gabon with HDI of 0.702, but the latter is only ranked 110th in the world. Gabon is followed by Congo with HDI of 0.606 and is 137th in the world. Two CEMAC countries namely Chad and CAR are among the top 5 least developed countries on planet with human development indicators of 0.404 and 0.367 respectively. These countries are ranked 186th and 188th in the world ranking.

In addition to the low level of growth and development, CEMAC countries also observed a high level of poverty rate. In fact, 45% of CEMAC population lives on less than 1 US dollar per day. Cameroon, Gabon being the only countries in the sub-region where one-third of the population earns less than a dollar a day. This economic community also has the largest population living below the poverty line of any African sub-region (UNDP, 2018).

On social level, indicators of CEMAC countries are very weak, but have progressed in recent years. In Cameroon, within the early 2000s, schooling rate was 40%. In 2016 it progressed and stood at more than 50%. In Gabon the situation is almost similar to that of Cameroon because in the early 2000s we observed a proportion of around 55% of the total population being educated and in 2016; this proportion was more than 62%. CAR and Chad are considered to be the least educated countries in CEMAC with an education enrollment rate of less than 30% of the total population.

In addition, literacy rate of Central Africans aged 15 to 24 was less than 40% in 2015, about 48% among men and 27.0% among women. This secondary school enrollment rate was only around 13% in 2012. Girls are significantly disadvantaged compared to boys as their secondary school enrollment rate was 17.93% in 2012, close to double that of girls, which stands at 9.34% (UN, 2016). This economic and social excess of countries depending on natural resources is known in the literature as "resource curse" Sachs and Warner (1995, 1997). The natural resource curse highlights the fact that economies depending on natural resources are less developed than those without these resources.

In effect, the work of Sachs and Warner (1995, 1997 and 1999) has shown that the exploitation of natural resources negatively affects economic growth. Their results have been questioned by Lederman and Maloney (2007), Brunnschweiller and Bulte (2008) and Brunnschweiller (2008) Furthermore, natural resources curse was not limited to the negative effects of these resources on growth given that the exploitation of natural resources is inversely linked on one hand, to institutions (Ross; 2001, Brunnschweiler; 2008, Omgba; 2015, Philippot; 2009) and on the other hand

to human capital (Gylfason; 2001). Yet institutions and human capital occupy an important place in economic analysis and constitute an explanatory base for several economic failures (Ghamsi et al., 2019).

The exploitation of natural resources can be considered a double-edged sword because, it certainly provides significant financial income, contributes to the fight against unemployment by increasing employment; but it promotes the establishment of bad institutions, encourages rent-seeking behavior and is the source of grievances, civil wars and rebellions.

The persistence of poor indicators of governance over time in CEMAC countries can be explained by the desire of political leaders, administrators, bureaucrats and parliamentarians to capture part of natural rent. These key actors in decision-making, in the design and implementation of economic policies, are aware of the fact that natural resources provide significant income to states. As a result, they formalize, adopt, implement economic policies and take administrative decisions favorable to their rent-seeking activities. Similarly, when decisions are favorable to the development of all citizens, administrators and bureaucrats who have no particular interest will hinder their application (fake reports, administrative bottlenecks, slowness in the execution of tasks and development projects). Thus, there is collusion between the legislator, politicians and administrators as these groups generally belong to the presidential majority. Bills tabled to the parliament are generally adopted without proper study and as such limiting the role of parliament in overseeing government action. In addition, there is no real separation of powers in these economies as judges and other court workers are recruited and paid by government. This situation prevails because it favors a group of elites who monopolize natural resource rents, to the detriment of the rest of the population. Likewise, several social projects such as the construction of schools, hospitals and roads are neglected as they are lead to the development of a large number of people and require significant financial means.

According to Torvik (2009), countries with good institutions make better use of income from natural resources. The establishment of good institutions is aimed at controlling and coordinating the exploitation of natural resources and to promote the use of income to increase the level of development given that one of the causes of poor economic performance of CEMAC countries in particular is poor governance. Mehlun et al. (2006) show that poor quality institutions are due to the exploitation of natural resources. More specifically, dependency on natural resources favours the establishment of bad institutions.

This study has as first objective to determine the effect of the exploitation of mineral resources on economic growth of CEMAC countries, and secondly, to examine the role that institutions of governance plays in transmitting these effects. The results show that mineral rent has a positive effect on growth per capita. Likewise, institutions have no role in transmitting these effects. The rest of the paper is organized as follow section 2: Literature review, section 3: Methodology, Results and Discussion: section 4: Conclusion.

2. Literature Review

The term "resource curse" was first used by Auty (1993), but it was popularized by the works of Sachs and Warner (1995) as the main theoretical anchor of the Dutch Disease. Sachs and Warner (1995) started from the observation that economies depending on the exploitation of natural resources grow less rapidly than economies without natural resources. Their principal question was that of knowing whether the exploitation of natural resources is disadvantageous for countries rich in it or not. The main limitation of their study was the theoretical explanation of resource curse.

In the same vein, Sachs and Warner (1999) explain why certain countries do not benefit from the exploitation of their resources. They put forward the idea of a big push of natural resources according to which, poor and resource dependent countries need a large demand in order to be able to recover costs. An important question in their studies is whether the increase in prices of natural resources have been beneficial for resource-rich countries. In a study of a group of Latin American countries they show that soaring prices of natural resources is generally accompanied by low growth rate per capita.

The work of Sachs and Warner was followed by Papyrakis and Gerlagh (2004). Unlike Sachs and Warner, they empirically determine thetransmissionchannels of resource curse while examining the direct effects and the abundance of natural resources on growth. Using a growth model, they study the transmission channels through which the abundance of natural resources affects growth. The authors find that the abundance of natural resources has a negative effect on economic growth. However, this negative effect no longer appears when the model is controlled for investment, corruption, openness, terms of trade and education. These variables prove to be the main transmission channels of the curse.

Furthermore, Papyrakis and Gerlagh (2004) measure the indirect impact of the exploitation of natural resources on these transmission channels. Their findings show that investment rate is the most important channel of the curse, accounting for almost 41% of the indirect effect of natural resources on growth. The authors conclude that natural resources can be a lever for economic growth, if the negative effect on these main transmission channels is taken into account.

The works of Sachs and Warner (1995, 1997 and 1999) have been questioned by Hausmann and Rigobon (2003), Shaxson (2005) Van der Ploeg and Ploelhekke (2008, 2010) and Avom and Carmignani (2009). These authors explain the resource curse by the volatility of resources and find that the variable used by Sachs and Warner (the intensity of resources) suffers from endogeneity. In fact, according to Hausmann and Rigodon (2003), countries whose economy is based on the exploitation of natural resources in general and hydrocarbons in particular have a tendency of specializing in the production of non-commercial goods. These countries have a volatile exchange rate, which leads to volatile interest rates, to the point where entrepreneurs can no longer borrow to finance production. This results in a drop in production of the non-tradable goods sector to the extent that the sector is almost non-existent. Similarly,

Shaxson (2005) affirms the volatility of commodity prices, more precisely the volatility of oil prices as the cause of the curse. The volatility of the price of this resource can, in fact, distort the forecasts of political leaders, thus leading to social conflicts in non-democratic states where the government has no regard for the citizen

However, volatility leads to poor economic planning, leading to a budget deficit which encourages governments to go into debt. Countries whose economies are based on the exploitation of natural resources tend to go into debt because it offers solvency guarantees on the financial markets (Omgba, 2010).

In another angle, Van der Ploeg and Ploelhekke (2008) highlighted the volatility on the growth of per capita GDP as the cause of the curse. It is said to be a very important and long neglected factor in the natural resource curse of Sachs and Warner (1995, 1999). In their empirical analyzes, they show that countries with high volatility in annual growth in GDP per capita, generally have low economic growth, as the case for sub-Saharan countries, Latin America, and the Caribbean, whose economy depend on basic commodities. As for Avom and Carmignani (2009), they evoke volatility, openness and inequality as potential channels for transmitting the curse. They determine the role of nature ("mother nature") on development. According to them, economic development is not just an effect of income growth even if growth is an important condition for development and poverty reduction. More importantly, they believe that the effect of natural resources on development goes beyond the effect on per capita product. Access to basic infrastructure and to health and education services depends on how services are made available to the public. Natural resources qualified as "mother nature" are the sum of agricultural raw materials, food and drink, hydrocarbons, metals and minerals as a percentage of total merchandise exports. The development measure used is social development composed of variables such as life expectancy, vaccination and education. They come to the conclusion that two channels of transmission of the curse can be highlighted: volatility and income inequality.

However, the economic explanation for the resource curse is not unanimous among researchers, as others have pointed to political failures to explain the curse. Dependence on natural resources deteriorates the political climate in a country since the exploitation of natural resources cause civil wars (Collier and Hoeffler, 2000, 2005).

Collier and Hoeffler (2005) argue that armed conflict and civil war need to be motivated and several causes can be identified. The costs and benefits of war are important determinants of civil war. This hypothesis had been raised by Collier and Hoeffler (2000). However, they recognized that their postulates are not satisfactory enough since the rebel groups, in most cases, had enough to cover the costs of the conflict. In their previous analysis, institutions, political conflicts and the duration of the rebellion were associated. But in this case, they treated these elements separately. According to Collier and Hoffler (2005), some rebel groups are not concerned with the common good, but with a special interest and are motivated by greed and selfishness. In their analyzes they define a civil war as an internal conflict having caused the death of at least 1000 people where in which 5% of rebel or government forces have left their lives. They conceive this definition so that civil war and rebellion are not confused. Furthermore, Fearon and Laitin (2003) exposed the fact that countries depending on petroleum resources are more exposed to the risk of conflict than countries not depending on other types of natural resources. According to these authors, the exploitation of natural resources would favor clientelism. Here, income from the exploitation of petroleum resources encourages political powers to be interested in the supply of collective goods for the benefit of clientelism practiced for personal ends. However, this practice may be limited by institutions that hold political powers. In general, one can observe that countries plagued by civil wars, rebellion and armed conflicts are those with poor quality institutions.

Mehlum et al., (2006) show thatpoor quality institutions are the main cause of natural resource curse. They start on the basis that certain countries are “winners” in natural resources (profit or gain their development on the basis of their endowment in natural resources) and that others, “losers” in natural resources (who are losers or who earn nothing from their endowment in natural resources). They refer to countries such as Australia, Norway, and Botswana as "winners" among the countries in the world rich in natural resources. Studies carried out by the World Bank show that 5 out of 82 natural resource -rich are from the top 8 of the richest countries on the planet and from the top 15 of countries with high GDP per capita.

Furthermore, Brunnschweiller (2008) shows the importance of quality institutions for growth and economic development. The regression made in this regard shows a positive and significant relationship between economic growth and institutions (rule of law and government efficiency). Similarly, there is a positive relationship between the abundance of natural resources and institutions (rule of law and efficiency of government), but these results are not robust because, when control with initial income (GDP in 1979) institutions are no longer significant,

In the same vein, Brunnschweiler and Bulte (2008) set three objectives in their study. Firstly, the relationship between dependence on natural resources and quality of institutions; secondly, alternative measures of the abundance of natural resources on growth and quality of institutions and thirdly, how the constitutional variables interact to create a vicious or virtuous cycle of development. Poor quality institutions are one of the major causes of natural resource curse. Brunschweiler and bulte (2008) show that by considering only extractive resources, the measures of resource abundance proposed by Sachs and Warner (1995) positively influence the quality of institutions. Also, governance system (parliamentary or presidential) is more efficient than the electoral system. They show that it is easier for extractive companies to put pressure on elections than on the design of economic policies. Institutions become effective when they improve the living conditions of the population. For this, it is necessary that all citizens participate in the designation of their representatives at the local level and through free and transparent elections. However, the exploitation of natural resources may hinder democracy.

According to Omgba (2015), the level of democracy in oil exporting countries tend to be positively correlated with the length of time between the beginning date of oil production and the date when the countries reached political independence. He formalizes a variable called "distance" where Distance = T-production- T-independence. T-production represents the date a country began oil production; and T-independence the date the country obtained its

independence. He hypothesizes that the greater T-production is compared to T-independence, there is a high probability that this country will be more democratic compared to other oil-producing countries, all other things being equal. Note also that the most important in the analysis of Omgba (2015) is not the distance (T-production - T-independence), but the institutional dynamics that this distance reveals. Because, it is clear in the analysis that time is necessary for the establishment of a true democracy.

The institutional dynamic in the work of Omgba (2015) concerns the dynamics of institutional policy. Among the formal institutions, we can distinguish economic institutions from political institutions. Economic institutions define the rules for human interaction in the economic field (e.g. property rights) and political institutions define the rules in the political arena, including democracy. In other words, the nature of the resources exploited during the colonial period influenced the nature of the political institution created by the settlers. These institutions were maintained after independence because it benefited the ruling national political elite.

In a more specific setting, Torvik (2009) questions the reasons why some resource-rich countries thrive, while others do not. His study is based on the fact that natural resources have led to the prosperity of certain countries such as Norway and Botswana and the stagnation of other countries such as Nigeria and Venezuela. In other words, some countries are more prosperous (the winners) in the exploitation of natural resources and others less prosperous (the losers). However, Trovik (2009) identifies six dimensions in which the winners and losers can be different:

- saving of income from resources: We can just take the fictitious example of a country which markets non-renewable natural resources and places the product on the financial market. There is a reduction in the natural capital of this country; although there is an increase in financial capital, the wealth of this country is unchanged. If the country decides to consume all the income from the marketing of its resources, it is quite clear that its savings rate will be negative. But then, it will be noted in his national accounts that his savings are equal to zero, which does not reflect reality.

- Presidential versus parliamentary regimes: research shows that political regimes have an effect on the curse of natural resources. Andersen and Aslaksen (2008), show that the curse is more common in presidential systemsthan in parliamentary ones.

- Quality of institutions: countries which have good institutions make better use of the income derived from the marketing of these resources.

- Type of resources: natural resources do not have the same effect on growth. Soil and subsoil resources have different effects on economic growth. For Brunnschweiler (2008), petroleum and mineral resources are of great value on the markets, which is not the case for agricultural resources.

- "Offshore versus onshore oil": countries which exploit sea resources run less risk on the attacks of rebels and armed groups than the countries exploiting the oil resources on the continent.

- The first industrialized countries / the last industrialized countries: at the beginning of the 1900s, Norway which was one of the poorest countries in Europe is today classified among the developed. This remarkable transition is due to the exploitation of natural resources. Norway started with wood, then with mineral resources; then it continued in the hydroelectric sector and at the beginning of the 70s, it launched out in the exploitation of oil and gas resources, unlike some countries like Nigeria or Angola which have a weak experience in the industrial and energy sector and who still find it difficult to convert their natural wealth into economic development.

3. Data, Methodology and Empirical Results

Our study focus on CEMAC and this economic community includes six countries; among them, four (Cameroon, Congo, Gabon and Tchad) are exporters of mineral resources in general (oils and petroleum) and only one of these countries exploits exclusively petroleum resources (Equatorial Guinea) and another essentially oils (CAR). However, the variables use is from the World Bank database (WDI, 2017 and WGI, 2017).

3.1 Model Specification

Firstly, to determine the effect of the exploitation of mineral resources on growth and secondly the role of institution of governance in the transmission of these effects on the other hand, we formulate an econometric model inspired from that of Papyrakis and Gerlagh (2004) and Aoum (2008). The model identifies the different transmission channels for natural resource curse:

$$Y_{it} = \alpha_i + \mu Rent_{it} + \beta Open_{it} + \sigma Invest_{it} + \theta Educ_{it} + \lambda Govt_{it} + \rho Employers_{it} + \delta Z_{it} + \theta_{it} \quad \ldots\ldots\ldots\ldots (1)$$

Where; "Open" is economic openness; "Invest" stands for investment; "Educ" is education, "Govt", government spending and "Employers" the employment rate. Z is the set of control variables in terms of education, and institutional variables.

Taking into consideration our control variables, the final model will become

$$Y_{it} = \alpha_i + \mu Rent_{it} + \beta Open_{it} + \sigma Invest_{it} + \theta Educ_{it} + \lambda Govt_{it} + \rho Employers_{it} + \delta 1 control\_corrup_{it} + \delta 2 rule\_of\_law_{it} + \delta 3 regul\_quality_{it} + \delta 4 govt\_effec_{it} + \delta 5 pol\_sta\_viol_{it} + \delta 6 voice\_{it} + \theta_{it} \quad (2)$$

3.2. Choice and justification of variables

The dependent variables are differentiated from the independent variables.

- **Dependent Variable**

- Y: Growth of GDP per capita: GDP is the sum of gross value added by all resident producers in the economy, increased by taxes on products and reduced by subsidies not included in the value of products. It is calculated without

deducing the depreciation of assets produced and the depletion and degradation of natural resources. Data is in current US dollars. Generally, developed and emerging countries, with sustained and continuous GDP growth, enjoy good quality institutions contrary to developing countries.

- **Variable of Interest:**

- Mineral rent (Rent): Mineral rents correspond to the difference between the value of production of a stock of minerals at the world (oils) or regional (petrol) prices and their total cost of production. The minerals included in the calculation are: petroleum, tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite and phosphate.

- **Macroeconomic Variables: determinants of economic growth**

- Economic openness (open): Generally, openness is measured by the ratio of exports and imports to GDP. CEMAC member countries are generally trade intensive due to the commercialization of natural resources which represent the largest proportion of exports and import of manufactured products. In effect, income derived from the exploitation of raw materials is subject to less home consumption against foreign consumption. Moreover, according to the Dutch disease theory, the exploitation of natural resources results in an increase in real exchange rate, and hence, the populations will choose to consume imported products which cost less than domestic products. According to Gregory (1976), there is no effective way to reduce this tendency. But to him, investing the income from natural resource exploitation abroad could prevent the business sector from declining. In this case, the marketing of commodities would not benefit the national economy.

- Government expenditure (Govt): represents consumption by the government and administrations. The state budget is generally made up of the investment budget and the consumption budget. Consumption includes consumption of public services. Government consumption is considered to be a determinant of institutions insofar as it promotes the proper functioning of public services.

- Invesment (invest): it is investment made by the public authorities and the private sector. This variable includes land improvements, factories, machinery and equipment purchases, road construction, railways, schools, offices, hospitals, private residential housing, and commercial and industrial buildings.

These different variables have been used in various research studies like those of Mabali (2016), Phillipot (2009) and Brunnschweiler (2008) as determinants of institutional quality "Employers": represents the proportion of people of working age who are in formal employment.

- Education enrollment rate (educ): This measures the proportion of a country's population that is in school or the proportion of the population that has attended primary, secondary or higher level. The exploitation of mineral resources can be an obstacle or a gateway to the development of the education sector in a country in the sense that, part of the income derived from the exploitation of mineral resources can be used for investment in the education sector by building schools and recruiting more teaching staff into the civil service. On the other hand, the exploitation of mineral resources can also be an obstacle to education insofar as the exploitation of these resources leads to wars, rebellions and terrorist attacks, pushing the populations with no choice than to abandon school and seeking refuge in more secure places.

- Employers: it represents the proportion of people of working age who are employed. The exploitation of natural resources generates many jobs in both the artisanal and industrial sectors. Through employment, part of the income derived from this activity is redistributed to households.

- **Control variables**

The dependent variables used here are the set of institutional variables of the World Bank which capture the quality of governance. These are:

- Voice and responsibility (voice): It reflects perceptions of the extent to which the citizens of a country can participate in the choice of their rulers as well as freedom of expression, association and freedom of the media.

- Political stability and absence of violence / terrorism (Pol_sta_viol): Political stability and the absence of violence / terrorism, measures perceptions of the probability of political instability and or politically motivated violence, including terrorism.

- Government Effectiveness (Govt_effect): Reflects perceptions of the quality of public services, the quality of the public service and its degree of independence from political pressures, the quality of development and implementation policies and the credibility of the government's commitment to these policies.

- Regulatory quality (regul_qua) Reflects perceptions of the government's ability to formulate and implement sound policies and regulations enabling and encouraging the development of the private sector.

- Rule of law (rule_of_law): represents the capacity of public authorities to respect laws and court decisions.

- Control of corruption (Contro_corup): reflects perceptions of the extent to which public authorityis exercised for private ends, including minor and major forms of corruption, as well as the perception that elites and the private sector have of the state. Institutions are the product of a colonial heritage. Pre-independence territories that had hostile environment favourable for settlers inherited poor quality institutions which continued even after independence (Acemoglu et al., 2001). According to the rent research theory modeled by Torvik (2002) the exploitation of natural resources pushes economic agents to adopt counterproductive behaviour that weakened institutions of governance and rent seekers will take advantage of poor governance to increase their activity.

3.3 Strategy on the Estimation of Parameters

To determine the effect of the exploitation of mineral resources on growth, we first regress the macroeconomic variables and the variable of interest on per capita growth. Subsequently to examine the role of institution of governance, we introduce each of the control variables in the described regression, to study any disturbance in the transmission of the effects of mineral rent on per capita growth following the reaction of each of these variables.

In this case, we use panel data with it advantages, notably the increase in the number of observations which allows the procedures for comparing theories with observed facts, in other to guarantee better accuracy, estimators, a better match between the level of analysis of theoretical models and that of statistical observations and also reduce the risks of multi-collinearity between the explanatory variables due to the introduction of inter-individual differences (Pakes and Griliches, 1984) and lastly the inclusion of unobservable effects.

Furthermore, according to Van der Ploeg and Ploelhekke (2010), the variable used to capture the exploitation of mineral resources (Rent) is endogenous as the resource intensity variable of Sachs and Warner (1995). Consequently, the OLSand Generalize OLS technique generally used will provide biased results. Hence, Two-Stage Least Squares is more appropriate in this context. Note also that Brunnschweiller (2008) finds, on the other hand that this variable does not suffer from endogeneity problems.

The Two-Stage Least Squares, (2SLS) is a method of estimation by instrumental variables, introduced by Robert Leon Basmann in 1957 and Henri Theil in 1961. The principle of 2SLS consists in performing a regression by substituting the variable which, potentially suffers from endogeneity, by instrumental variables. It is also possible to control the heteroskedasticity of errors with this method.

The three hypotheses supporting 2SLS are:

- The error term must not be correlated with the instrumental variable.
- The variable supposed to be suffering from endogeneity must be strongly correlated with the instrumental variable, but not correlated with the error term.
- The instrumental variable must be a different variable from that assumed to be endogenous.

The Hansen and Sargan test verify the validity of instruments. Indeed, Sargan / Hansen test makes it possible to test whether the instruments are orthogonal to the error term or not, in other words, if there is correlation between the instruments and the error term, Hansen's test is robust to the presence of heteroskedasticity and autocorrelation of errors. If the probability of the Hansen test is greater than 0.1, we cannot therefore reject the null hypothesis (H0) of validity of the instruments. The model thus obtained is exactly identified (or over-identified) and the chosen instrumental variables are valid. However, before estimating the parameters of our model by these different methods, it is essential to present the variables of the model.

4. Results and Discussions

Table 2 presents the fixed-effects regression technique results.

Table 2: Regression results using the fixed-effects method

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Y	Y	Y	Y	Y	Y	Y
Rent	0.234***	0.236***	0.245***	0.265***	0.271***	0.271***	0.253***
	(0.0799)	(0.0810)	(0.0819)	(0.0805)	(0.0911)	(0.0923)	(0.0931)
Invest	0.265***	0.271***	0.251**	0.252***	0.251**	0.251**	0.217**
	(0.0909)	(0.0938)	(0.0968)	(0.0946)	(0.0956)	(0.0971)	(0.101)
Open	0.479	0.409	0.347	0.0784	0.0411	0.0404	0.278
	(1.128)	(1.162)	(1.166)	(1.147)	(1.179)	(1.252)	(1.263)
Educ	29.01	28.45	29.44	19.25	20.36	20.38	21.56
	(26.16)	(26.39)	(26.46)	(26.32)	(27.42)	(28.54)	(28.46)
Govt	-4.748**	-4.740**	-5.353***	-6.644***	-6.664***	-6.665***	-6.587***
	(1.844)	(1.855)	(1.993)	(2.042)	(2.059)	(2.084)	(2.078)
employers	-3.847***	-3.851***	-3.528***	-3.505***	-3.466***	-3.466***	-3.479***
	(1.083)	(1.090)	(1.156)	(1.130)	(1.164)	(1.174)	(1.170)
control_corrup		-1.777	-4.915	-2.762	-2.801	-2.798	-1.859
		(6.198)	(7.225)	(7.137)	(7.188)	(7.393)	(7.407)

rule_of_law			5.447	10.02	9.691	9.688	9.066
			(6.412)	(6.629)	(6.984)	(7.363)	(7.355)
regul_quality				-13.91**	-14.33**	-14.34**	-11.21
				(6.560)	(7.128)	(7.180)	(7.596)
gov_effec					1.198	1.199	0.745
					(7.631)	(7.709)	(7.692)
pol_sta_viol						0.00477	0.416
						(2.825)	(2.835)
voice_							3.048
							(2.488)
Constant	92.11***	89.94***	103.8***	128.3***	128.6***	128.7***	133.8***
	(32.13)	(33.20)	(37.03)	(38.02)	(38.32)	(38.82)	(38.92)
Observations	90	90	90	90	90	90	90
R^2-within	0.399	0.400	0.406	0.439	0.440	0.440	0.451
countriess	6	6	6	6	6	6	6

Note: The values in the parentheses are the standard deviations. ***, **, * significant at 1%, 5%, 10%
Source: authors

From the results, in regression (1) mineral rent has a positive and significant impact on per capita growth. This result is contrary to that of Sachs and Warner (1995), who had shown that the abundance of natural resources had a negative impact on growth per capita. This result rejects the natural resource curse hypothesis.

In the same regression, we also show that economic openness and education do not affect per capita growth.

On the other hand, government spending and employment negatively affect the growth in GDP per capita. This result is explained by the fact that governments expenditure of CEMAC member countries are allocated more to consumption goods and these goods are generally imported which does not benefit the national economy.

Likewise, the negative relation of employment to growth per capita can be explained by the fact that jobs are generally created in the less-productive sectors such as the public sector which remains the first employers in CEMAC whereas the informal sector with significant weight in the economy remain face with difficulties.

In regression (2) we introduce a control variable capturing corruption (control_corrupt). We observe that the latter has no effect on per capita growth. Likewise, the results remain unchanged. So introducing this variable into the regression has no effect.

In regression (3), the introduction of the variable "rule_of_law" has no effect. The results are almost identical. On the other hand, in regression (4) the variable "regul_quality", regulatory quality has a negative and significant effect on growth per capita. But this result is not robust because this variable loses its significance when we introduce the variable voice_ (regression 7).

The introduction of the variables govt_effet (government effectiveness) and pol_sta_viol (political stability and nonviolence) has no effect in regressions (5) and (6). The results of the first regression remain unchanged.

Taking all institution of governance variables into account in regression 6 confirms the hypothesis that institutions have no effect on the contribution of mineral rent in strengthening growth. The OLS regression has therefore confirm that institutions have no indirect effect on the positive relationship between mineral rent and growth per head. By this, it is necessary to confirm these results using the 2SLS technique.

Table 3 below presents the 2SLS regression results

VARIABLES	(1) Y	(2) Y	(4) Y	(5) Y	(6) Y	(8) Y	(9) Y
Rent	0.475***	0.490***	0.474***	0.486***	0.536***	0.536***	0.505***
	(0.137)	(0.140)	(0.134)	(0.131)	(0.153)	(0.151)	(0.154)
Invest	0.385***	0.404***	0.361***	0.357***	0.339***	0.342***	0.313***
	(0.108)	(0.112)	(0.109)	(0.106)	(0.103)	(0.104)	(0.109)
Open	-0.216	-0.408	-0.402	-0.677	-0.989	-0.862	-0.640
	(1.192)	(1.236)	(1.216)	(1.191)	(1.264)	(1.298)	(1.308)
Educ	47.79*	47.10*	46.37*	33.97	43.68	41.32	40.57
	(27.98)	(28.10)	(27.58)	(26.99)	(29.28)	(29.65)	(29.21)
Govt	-5.310***	-5.310***	-6.117***	-7.562***	-7.705***	-7.633***	-7.511***
	(1.895)	(1.902)	(2.022)	(2.069)	(2.097)	(2.097)	(2.070)
Employers	-4.488***	-4.518***	-3.983***	-3.937***	-3.546***	-3.526***	-3.530***
	(1.141)	(1.148)	(1.174)	(1.139)	(1.154)	(1.155)	(1.138)
Control_corrup		-4.236	-8.414	-5.797	-5.999	-6.417	-5.538
		(6.396)	(7.398)	(7.217)	(7.277)	(7.455)	(7.424)
rule_of_law			7.742	12.88*	9.665	10.31	9.858
			(6.493)	(6.707)	(6.919)	(7.247)	(7.158)
regul_quality				-15.94**	-19.81***	-19.69***	-17.26**
				(6.572)	(7.513)	(7.471)	(7.962)
gov_effec					11.32	11.04	10.03
					(8.925)	(8.806)	(8.770)
pol_sta_viol						-0.836	-0.506
						(2.804)	(2.792)
voice_							1.997
							(2.473)
Observations	90	90	90	90	90	90	90
R-squared	0.329	0.324	0.345	0.383	0.376	0.376	0.395
Countries	6	6	6	6	6	6	6
sargan(j-stat)	0.394	0.393	0.417	0.536	0.589	0.624	0.688

The values in the parentheses are the standard deviations. ***, **, * significant at 1%, 5%, 10%
Source: Authors

The table above presents regression results using the 2SLS technique. These results are almost identical to those of the OLS regression.

In regression (1), mineral rent has a positive and significant effect on growth per capita. In this same regression, investment has a positive and significant effect on growth per capita. Any increase in investment increases growth per capita. Furthermore, as in the OLS regression, government spending and employment had negative and significant effects on GDP per capita growth. Unlike the OLS regression, education measured by school enrollment rate has a negative effect on growth, but these results are not robust because in regression (5), when we introduce the variable regulation quality, the coefficient of education becomes insignificant. In this same regression we notice that economic openness has no effect on growth per capita.

In the other regressions, the introduction of the variables capturing institutions or governance does not affect the results. The exploitation of mineral resources captured by mineral rent has a positive and significant impact on growth per capita, contrary to resource curse thesis which shows that the exploitation of natural resources has a negative effect on economic development of countries which have them. In addition, governance and institutions also have no effect on the link between mineral rent and economic development in CEMAC countries.

5. Conclusion

The work of Sachs and Warner (1995 1997) opened a wide debate on the relationship between natural resources and development. Researchers are not unanimous on the effect of natural resource exploitation on economic development on one hand and on the transmission channels of these effects on the other. Our study is part of these broad debates between natural resources and economic development. The objective we are pursuing is to determine the effect of the exploitation of mineral resources (minerals and oil) on per capita growth of CEMAC countries, and on the other hand to examine the role of institution of governance in the transmission of these effects over the period 2002 to 2016 which is a period where these member countries experienced a sharp rise in commodity prices at the start of 2000s. This surge in prices has resulted in increased public and private investment together with government spending.

The rise in prices also contributed to the increase in the intensities of trade with the outside world. Moreover, these countries have not been able to withstand two major exogenous shocks. First, the subprime crisis which affected CEMAC economy through the commercialization of natural resources, the demand for which had declined. And a second shock at the end of 2015 due to the fall in oil prices, which fell from US $ 110 per barrel to around $ 40. Faced with these shocks, CEMAC countries adopted policies aimed at stabilizing their economies. Note that these two exogenous shocks are coupled with several social crises observed in the zone (the independence war in western Cameroon, the war against the Islamic sect Boko Harram around Lake Chad, attacks by armed gangs in the CAR and Cameroon coup d'état and attempted coup d'état recorded in Equatorial Guinea and CAR). According to Collier and Hoeffler (2005) All these observed grievances are also due to poor governance and inadequate functioning of political and economic institutions. However, to achieve our objectives, we formulate an econometric model in panel data of this economic community based on the literature. The results of our analyzes have shown by the fixed effects method that mineral rent has a positive and significant effect on economic growth. When we control the model by all institution of governance indicators (government efficiency, control of corruption, quality of regulation, political stability / non-violence, rule of law, freedom and responsibility), our results remain robust. This result is also confirmed when we estimated the parameters using 2SLS method. We can therefore conclude that institutions of governance play no role in transmitting the positive effects of mineral rent on per capita growth of CEMAC member countries.

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The Development of Small Enterprises During and After Crisis: Comparative Analysis of Greece and Poland

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ABSTRACT

Purpose:
The purpose of the paper is to offer a comparative analysis of the development of small enterprises in Greece and Poland in the period just after global financial crisis which turned into an economic and social crisis for some countries, as the Greek example. The paper aims to discuss differences and similarities of small enterprises in two countries that suffered to a different level of the economic crisis.
Design/methodology/approach:
The authors decided to adopt three quantitative measures determining the degree of development of these companies: the number of active enterprises, the number of employees and the contribution to the Gross Domestic Product (GDP). The above measures were analyzed against the background of changes in the economic growth rate.
Findings:
Both countries were affected by the economic crisis but to a different level. Especially Greek economy suffered from the consequences of the austerity policy applied as a consequence of the agreement to obtain the international financial support. Poland on the contrary did not have to apply such an austerity program. Crisis consequences had severe consequences on the economy and negative effects on the GDP of these countries.
Research limitations/implications:
It should be noted that the presented results are based on quantitative methods, while the economic development also covers qualitative issues. Nevertheless, the analysis of data suggests the existence of a relationship between the adopted measures of small enterprises development and the value of GDP. Therefore, it indicates the need for further research, using more advanced methods of analysis. It is also worth expanding the research using qualitative methods.
Originality/value:
The paper contributes to the market failure theory in the area of macroeconomic business cycles. As the downswings because of crises influence on activity of enterprises, there is a need of appropriate government intervention. The analyzed examples suggest that higher level of monetary and credit policy in Poland seems to have a positive impact on the development of small enterprises in the analyzed space time. On the contrary, the austerity program in Greece might negatively affect the small companies.

1. Introduction

Small and medium enterprises have a crucial role in the economy and the social cohesion. Their role is particularly important in periods of economic and even social crisis. Quite relevant are the examples for the countries that suffered of economic and social crisis. Greece is one of these examples for the decade of 2010. The purpose of the paper is to offer a comparative analysis of the development of small enterprises in Greece and Poland in the period just after global financial crisis which turned into an economic and social crisis for some countries, as the Greek example. The examination focused on the evolution of three parameters: the number small enterprises, the number of employees in small enterprises and the contribution of these enterprises to the country's gross domestic product, (GDP). The paper aims to discuss differences and

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similarities of small enterprises in two countries that suffered to a different level of the economic crisis. Further, one of them, Greece, participating to the Eurozone reduces its possibilities of monetary and credit policy; it not the case for Poland that has a higher degree of monetary and credit policy execution. In the Greek case, the austerity program limited further the possibilities of economy and social policy. Greece had to follow an austerity program due to the obligations of the financial assistance the country received on 2010 and later by International Monetary Fund, European Central Bank and European Commission. Consequences were very serious on the economic, social and financial level; see for example Karafolas, (2018), Karafolas and Kleanthous, (2019).

The economic consequences of the global financial crisis were much more serious in the case of Greece compared to Poland. In Greece a major economic downturn appears with the decline of the GDP, the public consumption and the investments although the public financial help through several programs as the LEADER initiative, (see Karafolas, (2013), for LEADER initiative); on the contrary the very important rising of the unemployment and the non-performing loans (NPLs) is observed, table 1. In the case of Poland a continuous growth of GDP and public consumption is observed while average unemployment rate remains, in average, almost the half compared to Greece and the NPLs remain very limited compared to Greek case the time period 2011-2017, table 1.

Table 1. Evolution of macroeconomic indicators in Greece and Poland, (rate and annual change, %)

Greece	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Gross Domestic Product	-2,3	-4,2	-9,2	-7,3	-3,2	0,7	-0,4	-0,2	1,5
Public consumption	7,6	-9,0	-7,0	-7,2	-5,5	-1,2	1,6	-0,7	-0,4
Investments	-11,4	-17,4	-20,7	-23,4	-8,3	-4,4	0,7	4,7	9,1
Unemployment of the year	9,6	12,7	17,9	24,4	27,5	26,5	24,9	23,5	21,5
Non-performing to total loans (*)	9,5	14,1	21,5	31,3	31,2	43,5	48,1	48,5	47,2
Poland	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Gross Domestic Product	2,8	3,6	5,0	1,6	1,4	3,3	3,8	3,7	4,9
Public consumption	3,5	2,6	3,3	0,8	0,3	2,6	3,0	3,9	4,5
Investments	-12,6	9,4	1,8	-3,9	-1,9	12,8	4,9	-2,0	7,9
Unemployment of the year	10,4	12,9	13,1	13,2	14,2	13,9	11,9	10,2	8,5
Non-performing to total loans	7,2	7,8	9,0	8,3	8,9	8,6	8,2	7,6	6,9

(*) Including all commercial and cooperative banks
Source: Bank of Greece, 2016, Bank of Greece, 2019 and Bank of Greece, 2019a; Polish Agency for Enterprise Development and Central Statistical Office of Poland

The importance of small companies is crucial in the economy of both countries. Small companies form 0-49 employees are more than 99,5% of all companies in Greece, (Eurostat, 2019), and in Poland they are 99% of all economic entities (Raport o stanie sektora małych i średnich przedsiębiorstw w Polsce, 2018, pp. 10-11). In Greece small companies employed almost 70% of all employees during the decade 2008-2017, (Eurostat, 2019). In Poland they employ about 52% of employees and produce almost 38,5% of GDP (Raport o stanie sektora małych i średnich przedsiębiorstw w Polsce , 2018, p 11). During the examined period significant changes have occurred for the Greek example. Macroeconomic parameters such as the decline of GDP, the decline of public and private consumption, the growth of unemployment and in particular non-performing loans had significant influence on these companies. They have occurred earlier in the Polish case with accession of Poland to the European Union (EU) in 2004 concerning among others inflow of funds for state aid, competition on the single European market as well as legal changes. Moreover, the external factors influenced significantly on the development of small enterprises, mainly at the beginning of the decade for both countries. The paper is organized as follows. First, a literature review was conducted followed by research questions and methodology. Next, the development of small companies was analyzed, based on empirical data. Finally, conclusions and directions of further research are indicated.

2. Literature review, research questions and methodology

Research on the development of the SMEs is very common and results are disseminated in academic literature. That indicates the importance of this topic for economics. The European Commission publishes reports on SMEs. Reports show the recovery of SMEs for most of countries after the global crisis that appears on the employment as well, see

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Muller et al. 2015, 2016 and 2017. Criscuolo et al, 2014 on a study on 18 countries, mainly from OECD, concluded that that among SMEs, mostly young firms are job creators contrary to old SMEs who tend to destroy jobs. Annual report on European SMEs 2018/2019 concluded on the strong contribution of SMEs to the value added; more interesting is that the contribution is stronger the last years 2016-2018 compared to the longer period 2013-2018 and it is entirely due to micro SMEs, (Muller et al. 2019)

In Poland, the development began with the start of economic transformation and the appearance of small, private companies. Among many scientific centers that have taken up this subject, we should mention in particular Łódź, (see Piasecki, 1998, 2002; Matejun, 2015), Gdańsk, (see Daszkiewicz, 2005, 2007; Wasilczuk, 2005; Dominiak, 2005 and 2010) or Krakow, (see Bednarczyk, 2004; Borowiecki and Siuta-Tokarska, 2009; Wach, 2008). As a part of the latter, it is also worth paying attention to AGH University of Science and Technology, Faculty of Management, (including Peszko and Duda, 2004; Woźniak, 2012; Duda and Woźniak, 2018).

In the Greek case, the Union of Hellenic Chambers of Commerce (UHCC) and the General Confederation of Professionals and the Craftsmen of Greek Merchants presented works on SMEs as representative organizations of SMEs. On 2014 a policy document formulating policy proposals for SMEs in Greece was prepared by UHCC, (UHCC and the Task Force for Greece, 2014).

However, it should be noted that the conducted researches often included SMEs sector as a whole. However, it is worth mentioned the differences between small enterprises and medium-sized companies. Despite, the former was not usually the main topic of research or only in short time span. This indicates the existence of research gap. Meanwhile, the importance of small businesses for the Greek and Polish economy respectively, as mentioned earlier, is of great importance.

The adoption of three quantitative measures determining the degree of development of these companies was decided: the number of active enterprises, the number of employees and the contribution to the GDP. The above measures were analyzed against the background of changes in the economic growth rate. The period studied is therefore somewhat limited by data availability and covers the years 2010 - 2017.

It should be noted that for a relatively long time microenterprises were included into the sector of small companies. Therefore, it is not possible to separate their data for the adopted research period, especially in the case of the number of employees and the contribution to GDP. Given the number of active companies, the threshold of the basic criterion for separation of micro companies, which is the size of employment, has changed. In connection with the above, it was assumed in the article that the term: small enterprises also include microenterprises. Three research questions were set up:

a/ How the number of active small enterprises was changing?
b/ How the number of people employed in small enterprises was changing?
c/ How the contribution of small enterprises to GDP was changing?

The desk research method and data analysis was chosen. The research results can contribute to the area of economics and be of interest to entrepreneurs themselves. This can also be useful for decision-makers in the process of planning economic policy, including the allocation of EU funds to support small businesses.

3. Data analysis

3.1 Definition of small enterprise

Determining the exact term of small company has been necessary. In the EU countries, the official definition has been adopted on the recommendation of the European Commission issued in the year 2003 and supplemented in 2005. A small company must meet the following criteria: a/ staff headcount, b/ annual turnover or annual balance sheet total, (European Commission, 2016).

For the first criterion, a small enterprise can employ 10 to 49 persons. Due to the possibility of, among others hiring or dismissing/leaving employees as well as various working hours, the so-called Annual Work Units (AWU) was adopted. This measure covers those persons who worked full-time the entire reference year. For seasonal workers, part-time employees or those who have not worked all year, a fraction of the AWU is calculated, (Nowa definicja MŚP, 2006; Woźniak, 2012).

Second criterion, the financial situation, can take two forms: turnover or balance sheet. One of them must be below the equivalent of 10 million euros. Both indicators relate to the last accounting year, (Nowa definicja MŚP, 2006; Woźniak, 2012).

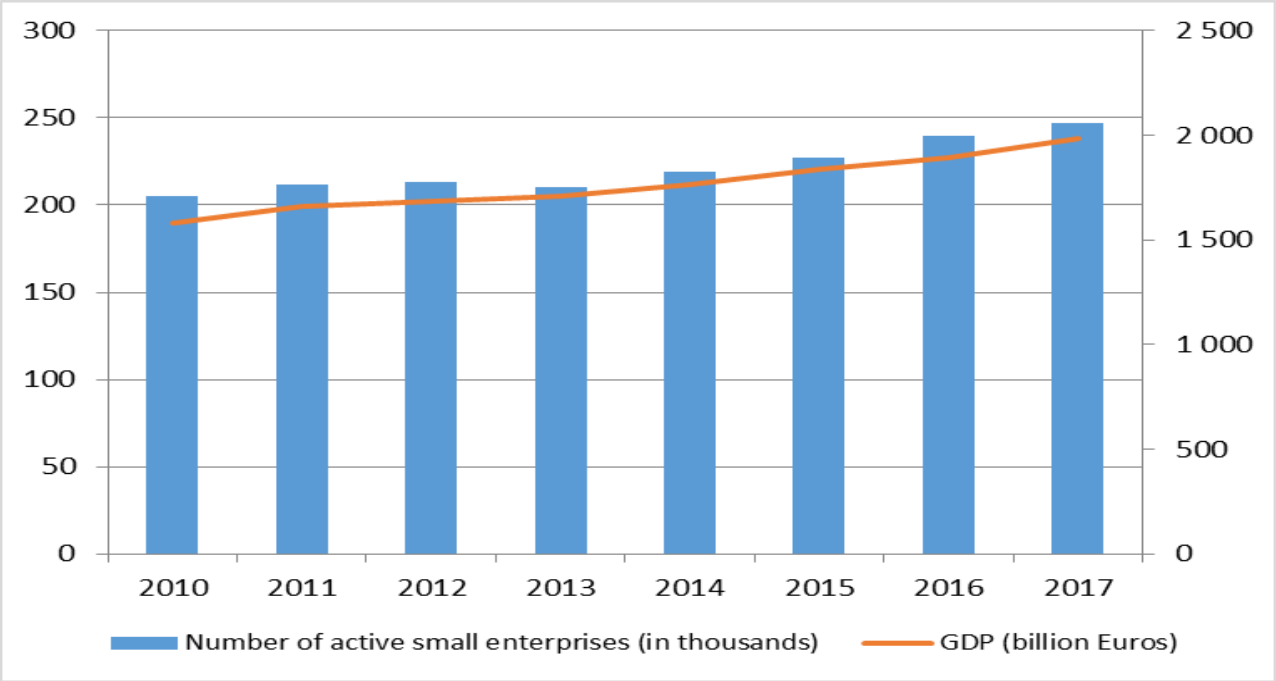
There is also additional criterion - independence, which was not used in earlier official definitions. In this case, three types of business entities were distinguished: autonomous, partner, linked. They are separated based on their share in the capital of a company or voting rights. In the case of a partner company, this means that the data must be proportionally added to the above mentioned criteria: employment and financial situation. For a related enterprise, 100% of the value of these measures should be added. There are, however, exceptions to the above rules. These include venture capital funds (Nowa definicja MŚP, 2006; Woźniak, 2012).

3.2 The Polish case

The statistics comes from two main sources. The first one is the Polish Agency of Enterprise Development (PARP), which provides data about the number of: active small companies, employed in small enterprises and their contribution to GDP. The second source is the Central Statistical Office (GUS) of Poland considering the value of real GDP in Poland.

After the accession to the European Union the number of active small companies began to rise, amounted nearly 1,9 million entities. At that time, the growth rate of Polish GDP also accelerated. However, the global economic crisis negatively affected the GDP, which coincided with a decrease in the number of small enterprises in 2009 to about 1,7 million. Nevertheless, from 2010 their number began to grow again, although at a slow pace, reaching at the end of the analyzed period almost 2 million entities, figure 1.

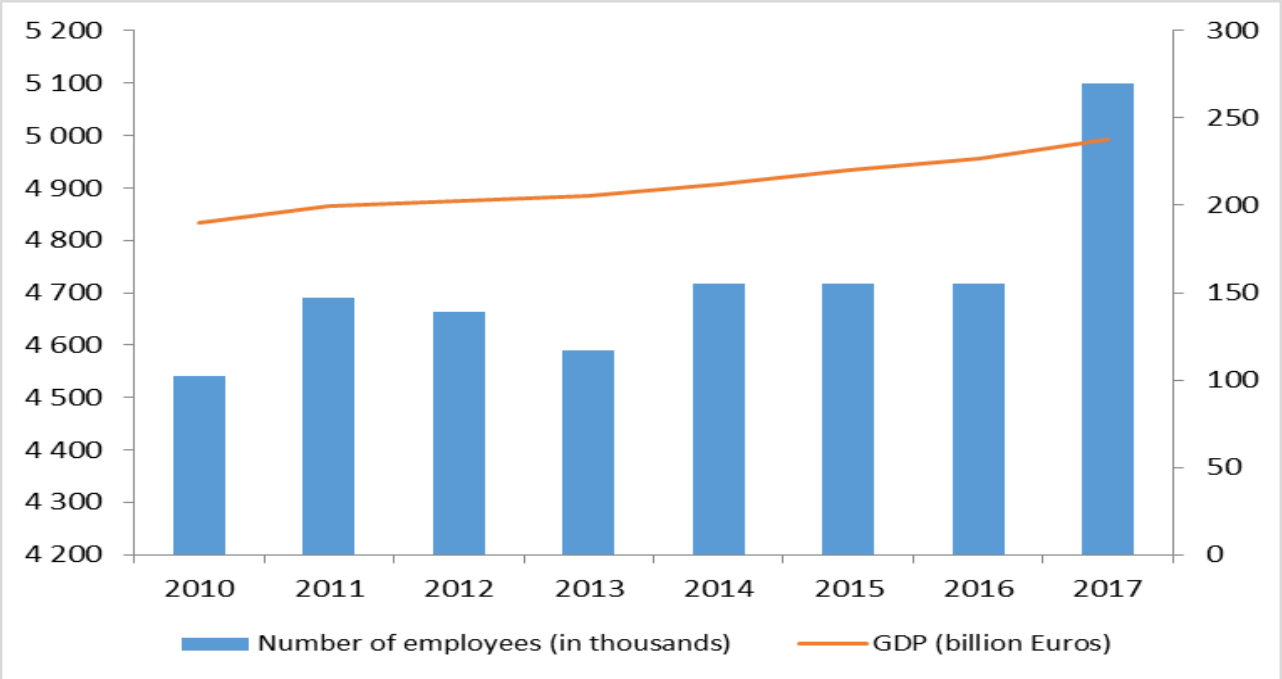
Figure 1. The number of active small enterprises and real GDP in Poland in the years 2010 – 2017



Source: Own study based on Reports on the data from PARP and GUS.

Taking the number of employees into consideration, the maximum point, almost 5 million, was reached in 2008, after the accession to the EU. However, in 2009 there was a slight decline, coinciding with the global economic crisis. Since then, the number of employees in small businesses changed a little, oscillating around 4,8 million employees, figure 2. The maximum point was reached in 2017. It should be noted that in those years there was quite stable GDP growth.

Figure 2. The number of employed in small enterprises and real GDP in Poland the years 2010 - 2017



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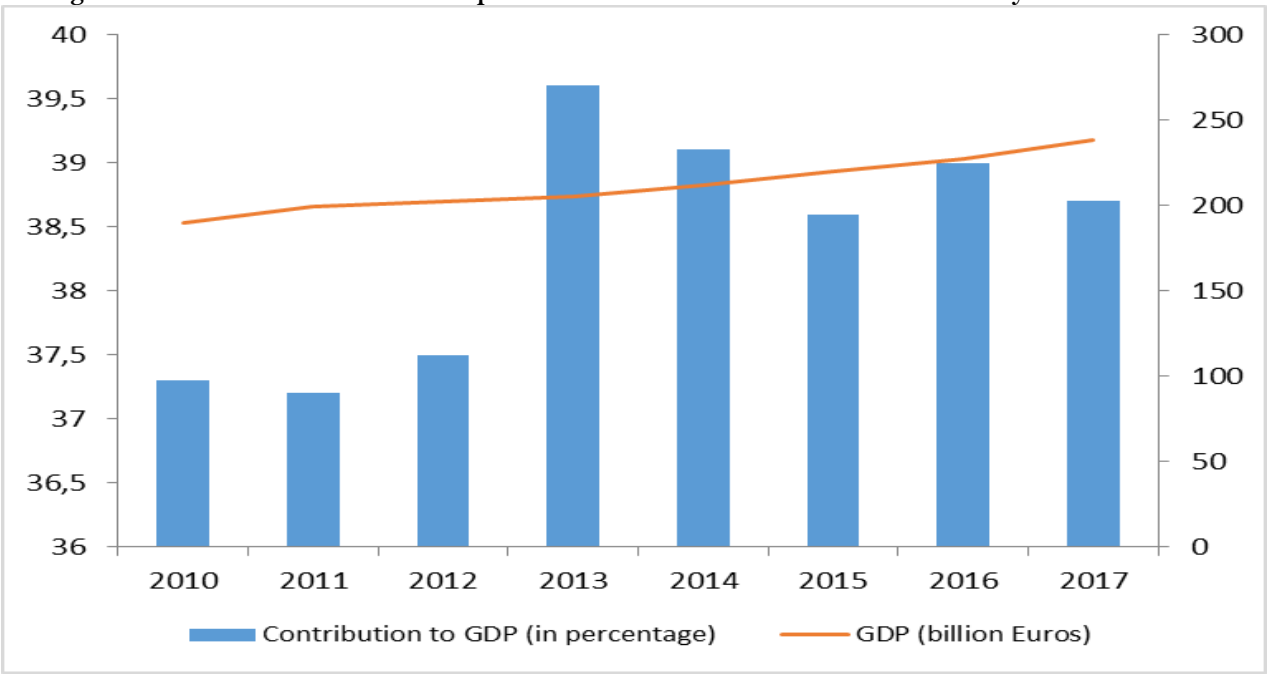
Source: As figure 1

The contribution of small enterprises to GDP at the beginning of the decade stabilized. The minimum point was reached in 2011, a little more than 37%. There was the slight rise in 2012, but then the indicator increased sharply in subsequent years, figure 3. It should be noted, however, that in this period there was a significant increase of Polish GDP. It means, therefore, that the value of GDP generated by small companies increased, although their percentage share was rather stable.

Figure 3. Contribution of small enterprises to GDP and real GDP in Poland in the years 2010 – 2017



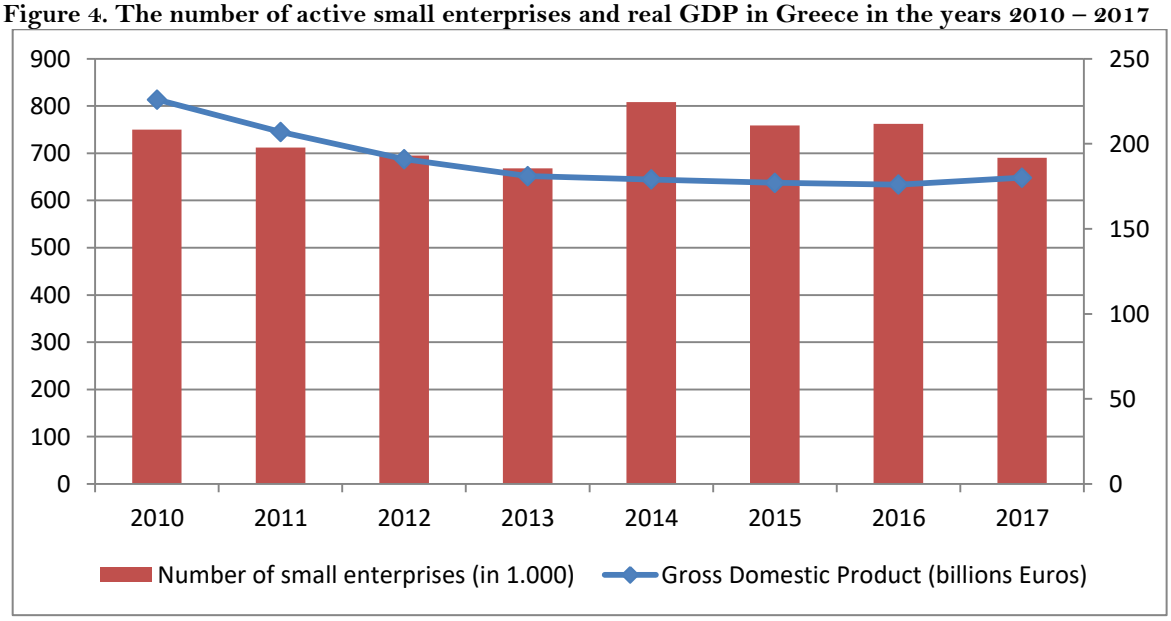
Source: As figure 1

3.3 The greek case

In the greek case, statistics had numerous problems regarding enterprises. One of them has been the growth of the number of companies in the sectors of agriculture, forestry and fishing for tax reasons (Decision on the Exemption from the obligation to keep books and issuance of data by the farmers of the specialist and established, Journal of Government, 3367B'/31/12/2013). Data used is provided from Eurostat Data Explorer, (Eurostat 2019). Data used is for the follow sectors: accommodation and food services, construction, information and communication, manufacturing, mining and quarrying, professional, real estate activities, repair motor vehicle and motorcycles, scientific and technical activities, transportation and storage, whole sale retail trade.

Consequences of the crisis and the adjustment program appear at the beginning of the period with the decline of the GDP. They appear at the number of small enterprises that decreased from 2010 to 2013, figure 4. Changes on the economy on 2014 as the growth, even limited, of GDP caused a growth of the number of enterprises that declined again after the capital control measures undertaken at the end of June 2015. The Greek government was forced to close Greek banks for three weeks, (from 29 of June 29 to 20 of July), and cash withdrawals were reduced to a total of 60 euros per day, in order to avoid an uncontrollable bank run and a complete collapse of the Greek banking system. Progressively the amount of withdrawals grew up. The complete abolition of capital controls was applied from September 2019. The growth of the GDP on 2017 was not followed by the growth of the total number of enterprises. The decline at the second period was influenced mainly by the sectors on construction, since this sector has experienced the largest decrease in its activity, followed by the manufacturing. On the contrary sectors such as accommodation, real estate, professional, scientific and technical activities presented a growth of the number of enterprises. The total number declined nevertheless.

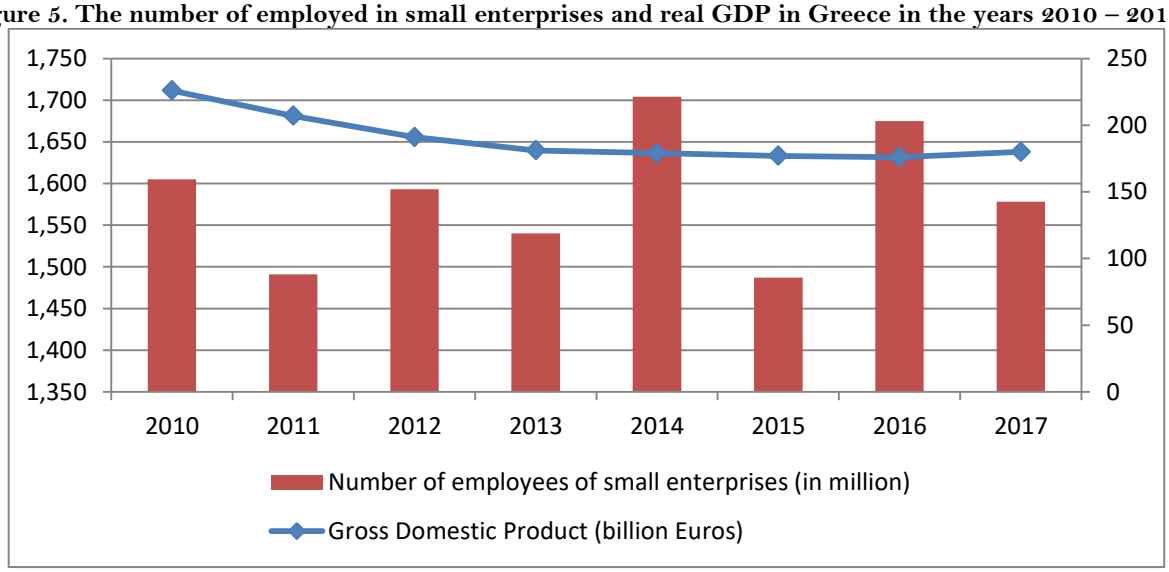
Figure 4. The number of active small enterprises and real GDP in Greece in the years 2010 – 2017



Eurostat, 2019, author's calculations

The number of employees seems to suffer more from the economic crisis and in particular the policy decisions. The years that followed the adjustment program caused the decline on the number of employees, figure 5. On 2014, the first year GDP had a limited growth, a strong growth of the employment is observed; the next year, the imposition of capital controls provoked a very serious decline of the number of employees in the small enterprises. The companies seem to suffer mostly from the capital controls.

Figure 5. The number of employed in small enterprises and real GDP in Greece in the years 2010 – 2017



Source: As figure 4

This phenomenon may indicate also that employment is the parameter the most influenced from any decision on economic and credit policy. One has to notice, however, that part of the unemployment is replaced by the undeclared work.

Small enterprises lost significant part on the country's GDP, by considering the added value produced. Their part to country's GDP was almost 15% on 2010, figure 6. Under the exception of 2012 and 2013 their part to GDP declined the examined period. Their share of the country's GDP was 12,4% on average the examined the period. The second half of the examined period this share was only 10,2%. This evolution characterized particularly the sector of

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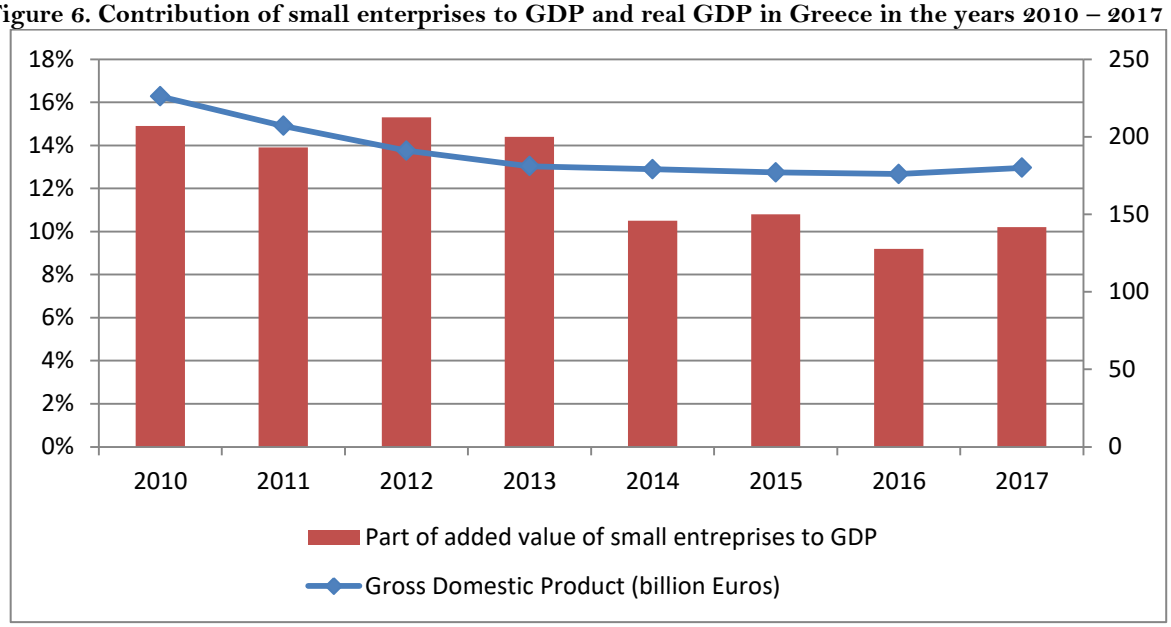
wholesales, the sector of construction, manufacturing and accommodation for the benefit of big companies, (having more than 250 employees).

Figure 6. Contribution of small enterprises to GDP and real GDP in Greece in the years 2010 – 2017



Source: As figure 4

4. Conclusion

Small enterprises are an important part of the economic structure in many countries both in Europe and in the world. Despite many publications on this subject, the authors have identified the research gap regarding the development of these companies. Therefore, they attempted to answer the following research questions:

a/ How the number of active small enterprises was changing this period?

The global economic crisis caused a slowdown in economic growth in Poland, which coincided with the decreased number of active small enterprises. In subsequent years, however, this number started to increase slowly again. It reached a maximum point in 2017, approximately 2 million of small enterprises. In the Greek case, the financial crisis and in particular the austerity programs influenced the evolution of the number of small enterprises. A significant relation appears between the growth of GDP and the number of small enterprises. The strong decline of GDP especially the first sub-period resulted to the significant decline of the number of small enterprises; they passed from 750.000 on 2010 to 668.000 by the end of 2013. The same sub-period the GDP lost almost 20%. On the second half, the cessation of the large decline in GDP caused the increase in the number of small businesses that was placed on almost 755.000 in average the second period, 2014-2017.

b/ How the number of people employed in small enterprises was changing?

Despite the decrease in the number of employees in Polish small companies (about 4,5 million of employees) during the global economic crisis, the following years brought stable growth. As a result, there were about 4,8 million people at the end of the period under review. In the Greek case the number of employees has been influenced by the austerity programs and further from decisions on economic and credit policy; the consequences were much more serious compared to the other two parameters, especially on 2011 the year after the begin of the austerity program and 2015, the year of capital controls; the loss of more than one hundred thousand and two hundred thousand jobs were recorded respectively these two years, even if it is a consequence, to some extent, of unregistered work

c/ How the contribution of small enterprises to GDP was changing?

The contribution of small companies in GDP reached the maximum point in Poland in 2013, almost 40%. Since then, this share has changed only a little (38,5%-39,0%). However, taking into account economic growth at that time, its value continued to increase. Small enterprises loose a part on the GDP in the Greek case in favor of bigger companies especially on the second half of the examined period. Their part to GDP passed from 14,5%, in average, the first half of the examined period, 2010-2013 to 10,25% the second half. This evolution is the consequence of the economic environment but also because of difficulties of financing since these enterprises had more difficulties in accessing baking credit than big companies.

The paper contributes to the market failure theory in the area of macroeconomic business cycles. As the downswings because of crises influence on activity of enterprises, there is a need of appropriate government intervention. The analyzed examples suggest that higher level of monetary and credit policy in Poland seems to have a positive impact on the development of small enterprises in the analyzed space time. On the contrary, the austerity program in Greece that belongs to the Eurozone might negatively affect the small companies.

It should be noted that the presented results are based on quantitative methods, while the economic development also covers qualitative issues. Nevertheless, the analysis of data suggests the existence of a relationship between the adopted measures of small enterprises development and the value of GDP. Therefore, it indicates the need for further research, using more advanced methods of analysis. It is also worth expanding the research using qualitative methods.

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Exploring the Family Effect on Innovative Capacity and Earnings Management

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ABSTRACT

Purpose:
This study examines whether family businesses (FBs) differ from non-FBs with regard to innovative strategies, and whether their innovation is a reflection of earnings management behavior.

Design/methodology/approach:
This study extended research into the issue of FBs by investigating innovation capacity and earnings management. We adopted the electronics industry in Taiwan (between 2010 and 2015) as a research sample to determine (1) whether family effects influence innovation performance at the firm level; (2) whether the innovation performance of FBs is an indication of earnings management behavior; and (3) the effects of family involvement and CEO-duality in FBs.

Finding:
Our results show that FBs are less likely than non-FBs to devote resources to increasing innovation. However, managerial participation of family members and a uniform CEO-duality leadership was shown to strengthen efficiency and flexibility in decision-making, thereby enhancing innovation capacity. We also found that FBs with higher innovation capacity are less likely to window-dress earnings. This association is more pronounced in cases of CEO-duality leadership, which implies that FBs' innovative ambitions and duality leadership had greatly advanced in operating performance and corporate governance, and thus restrain managerial self-interested behavior.

Research limitations/implications:
This study had a number of limitations. First is the measure of innovative capacity. There are a number of ways of measuring innovation, and we posit that patents are superior to R&D investment when investigating innovation capacity. Second, our results may have been affected by other determinants of innovation capacity, despite the fact that we adopted several control variables, such as financial characteristics, which may be correlated with innovation outcomes. Third, we used discretionary accruals as a proxy for earnings management; however, this does not necessarily reflect actual practices of earnings management. Although such proxies have been consistently used in previous research, may provide rich insights into earnings management behavior. Despite the noted limitations, our evidence clearly suggests the following: (1) FBs with strong family involvement in management and CEO-duality leadership tend to have higher innovation capacity; and (2) FBs with quality innovation capacity are less likely to engage in earnings management.

Originality/value:
This study fills a gap in the research on FBs by providing evidence concerning the effects of family on innovation and earnings management. Our findings have important implications for future research as well as the establishment of regulations and standards. Our findings provide evidence of a positive association between family effects and innovation capacity, which depends on the degree of family involvement in management and leadership structure. We found that family governance has a significantly positive impact on the competitive advantage of FBs. We also found that the innovation capacity of FBs is negatively associated with earnings management behavior. This study also re-examines the apparent contradictions in previous findings related to earnings management among FBs, while contributing to the literature linking family effects and governance mechanisms to earnings management behavior.

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1. Introduction

FBs play a critical role in the economies of East Asia.[1] The special ownership structure and features of FBs has been attracting considerable attention in the light of recent economic and financial crises.[2] FBs represent an organizational structure that are particularly resilient to disruptive economic shocks (Chrisman, Chua, & Steier, 2011; Sraer & Thesmar, 2007; Villalonga & Amit, 2010). As a result, FBs tend to financially outperform non-FBs during financial crises (Kachaner, Stalk, & Bloch, 2012; Liu, Yang, & Zhang, 2012; Mazzi, 2011; van Essen, Strike, Carney, & Sapp, 2015b). FBs tend to focus on resilience and long-term objectives in order to safeguard their survivability (Gentry, Dibrell, & Kim, 2016; Lumpkin & Dess, 2013; Wilson, Wright, & Scholes, 2013), and forgo excess returns during good economic times in order to increase their odds of survival during slumps. In other words, FBs commonly have slightly lower profits during good economic times, but they outperform their peers during slumps (Kachaner et al., 2012). These imply that the inherent toughness of FB structure seems to have highly stress resistant. Unfortunately, the debate on family governance and the effects of this structure have revealed a number of glaring empirical inconsistencies in recent research[3] (Carney, van Essen, Gedajlovic, & Heugens, 2015; van Essen, Carney, Gedajlovic, & Heugens, 2015a; van Essen et al., 2015b). Up to now, these inconsistencies in previous studies ever increase mystique of family-controlled structure. This study seeks to examine whether FBs' performance are influenced by how business strategies are managed in a FB structure. We hopefully help to fill the gap in the corporate governance debate on FBs and will examine the economic consequences of family governance. This study is not merely academically interesting but can also inspire the practical design of family governance for the efficiency and flexibility of managerial strategies.

FBs often give the public the impression of paternalism, risk aversion, and isolation from real-world trends (De Massis, Di Minin, & Frattini, 2015). Increasingly competitive markets are driving the need for innovation, as the only strategy capable of achieving sustainable competitive advantage (Porter, 1990). Previous studies have reported that FBs are less innovative than conventional firms (e.g., De Massis et al., 2015; Matzler, Veider, Hautz, & Stadler, 2015); however, other studies have found that FBs can be leaders in innovation (e.g., Bennedsen, 2015; Duran, Kammerlander, van Essen, & Zellweger, 2016; Santos, 2015). This raises the question of whether and how the capacity for innovation is influenced by the form of governance found in FBs. Innovation requires financial support, such that the quality of financial reporting becomes an important role, which helps raise external funding for innovative activities. The quality of financial reporting is of a major concern to investors and creditors, such that earnings management may take place for firms with greater need for funds to perform innovative decisions (Igartua, Garrigós, & Hervas-Oliver, 2010; Kouaib & Jarboui, 2016; Markarian, Pozza, & Prencipe, 2008; Raman & Shahrur, 2008). Additionally, innovative strategies will alter along with leadership styles in FBs, then affecting the demand for funds and the possible strategic devices for window-dressing. Further, this study sought to determine whether any link exists between earnings management behavior and the innovation capacity[4] of FBs.

This study collected 3,641 firm-years observations from the Taiwan Stock Exchange (*TES*) for the period from 2010 to 2015. Our results indicate that family effects are significantly negatively associated with innovation capacity, which suggests that the structure of FBs greatly hampers innovative decision-making. However, CEO-duality leadership was shown to strengthen efficiency and flexibility in decision-making, thereby enhancing innovation capacity. We also found that the innovation capacity of FBs is significantly negatively associated with earnings management, which suggests that FBs with higher innovation capacity are less likely to window-dress earnings. This association is more pronounced in cases of CEO-duality leadership, which implies that FBs' innovative ambitions and duality leadership have greatly advanced in operating performance and corporate governance, and thus restrain managerial self-interested behavior. We conclude that family effects are more likely to enhance innovation capacity and restrain earnings management behavior when family members are directly involved in management and particularly in cases on CEO-duality leadership.

This study fills a gap in the research on FBs by providing evidence concerning the effects of family on innovation and earnings management. Our findings have important implications for future research as well as the establishment of regulations and standards. Our findings provide evidence of a positive association between family effects and innovation capacity, which depends on the degree of family involvement in management and leadership structure (e.g., Lam & Lee, 2012; Miralles-Marcelo, Miralles-Quirós, & Lisboa, 2014; Prencipe & Bar-Yosef, 2011; San Martin-Reyna & Duran-Encalada, 2015). We found that family governance has a significantly positive impact on the competitive advantage of FBs. We also found that the innovation capacity of FBs is negatively associated with earnings

[1] Several of FBs are outstandingly in East Asia; for instance Samsung (Korea), Toyota (Japan), Formosa Plastic (Taiwan), and Hong Leong (Singapore). These FBs usually are leading firms and contribute to a large proportion of their countries' GDP.

[2] Please refer to Singh (2013) for a discussion of causes and consequences of global economic and financial crises.

[3] These empirical inconsistencies stem from competing views about the efficacy of managerial ownership: agency vs. stewardship; and alignment vs. entrenchment. Please refer to Section 2 for a discussion of empirical inconsistencies in FB research.

[4] Innovative capacity means different types of patent outputs: invention, utility model and design. In this study, we are interested in different types of patent outputs, we don't focus on numbers of patent outputs. Under Taiwan's Patent Act, in terms of features the patents can classify into three types: invention, utility model and design. Invention patent is granted for technological innovations, that invents over the prior art and possesses practical applicability. Utility model patent is granted for new technical solutions relating to the form, construction or installation of an object. Design patent is granted for original designs relating to the shape, pattern, color or a combination of an object through eye appeal. Additionally, there are differences in terms of its ways of examination and patent terms for invention, utility model and design. An invention patent requires to conduct substantive examination and has a patent term of 20 years. Whereas a utility model patent only require formality examination and has a patent term of 10 years. A design patent also requires substantive examination but it merely covers those innovations made in respect of the shape, pattern, color or a combination of an object and has a patent term of 12 years. In general, invention patents are deemed as having higher innovative quality than utility model and design patents.

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management behavior. This study also re-examines the apparent contradictions in previous findings related to earnings management among FBs (e.g., Ali, Chen, & Radhakrishnan, 2007; Bekiris, 2013; Cziraki, Renneboog, & Szilagyi, 2010; Firth, Fung, & Rui, 2007), while contributing to the literature linking family effects and governance mechanisms to earnings management behavior.

The study is organized as follows: Section 2 reviews the previous literature regarding our research questions. Section 3 describes the sample and the research method used for examining research questions previously discussed. Section 4 presents our empirical results. Section 5 draws conclusions and discusses the limitations of the analysis.

2. Literature Review and Research Questions

FBs play an important role in Asian economies. Their concentrated ownership (La Porta, Lopez-de-Silanes, & Shleifer, 1999; Villalonga & Amit, 2009), family culture (Duh, Belak, & Milfelner, 2010; Eddleston, Kellermanns, & Sarathy, 2008), conservative strategies (Miller, Le Breton-Miller, & Lester, 2011; Pindado, Requejo, & de la Torre, 2011; Zellweger, Nason, & Nordqvist, 2012), financial constraints (Andres, 2011), and lower agency costs (Blanco-Mazagatos, de Quevedo-Puente, & Castrillo, 2007; Chrisman, Chua, Kellermanns, & Chang, 2007) have attracted the interest of scholars since the 1980s. Mainstream research on FBs has focused on their special governance (Chrisman, Chua, Pearson, & Barnett, 2012; Miller, Minichilli, Corbetta, 2013; Miller, Le Breton-Miller, Minichilli, Corbetta, & Pittino, 2014; Simsek, 2015) and links to performance (Cascino, Pugliese, Mussolino, & Sansone, 2010; Patel & Chrisman, 2014; Prencipe, Bar-Yosef, Mazzola, & Pozza, 2011; van Essen et al., 2015b). This study extends this work in two ways: (1) From the perspective of inputs, we analyze whether family effects (including family involvement and CEO-duality leadership) affect decisions pertaining to innovation, and whether this affects innovation performance. (2) From the perspective of outputs, we examine whether the innovation outputs of FBs are an indication of earnings management behavior.

2.1 Family Businesses and Innovation Capacity

Innovation is a powerful strategic tool capable of ensuring a sustainable competitive advantage (Porter, 1990); however, it imposes inherent risks, unpredictable outcomes, and significant investments of time and money. Innovation in FBs relies on family resources, which can atrophy and stifle innovation, rather than stimulating it. FBs are commonly regarded as conservative and risk-averse, when compared to their non-FB counterparts (De Massis et al., 2015; Matzler et al., 2015). This is because FBs usually invest large parts of their private wealth in the firm, and thereby concern with the firm's survivability and increase the aversion to risks. However, in the long-term innovative strategies, the role of risk-taking may well be not only a prerequisite for the creation and securing of family wealth (Rogoff & Heck, 2003) but also for the competitive advantage maintained (Porter, 1990). Therefore, FBs may have risk-taking incentives to encourage innovation. When FBs engage in innovative activities, they tend to have greater discretion with regard to the pushing of risky ideas and combining resources to promote innovation (Arregle, Naldi, Nordqvist, & Hitt, 2012; Barnett, Long, & Marler, 2012). In recent years, scholars have paid increasing attention to innovation management in FBs because of innovation importance and FB ubiquity, but their findings are inconsistent. Some previous studies have provided empirical evidence of a negative association between family effects and innovation (Block, 2012; Chrisman & Patel, 2012; De Massis et al., 2015; Matzler et al., 2015; Munari, Oriani, & Sobrero, 2010; Sirmon, Hitt, Ireland, & Gilbert, 2011), others have reported a positive association (Arregle et al., 2012; Barnett et al., 2012; Duran et al., 2016; Kammerlander, Dessì, Bird, Floris, & Murru, 2015; Llach & Nordqvist, 2010; Patel & Chrisman, 2014; Spriggs, Yu, Deeds, & Sorenson, 2013), and still others have observed both (Kraiczy, 2013; Kellermanns, Eddleston, Sarathy, & Murphy, 2012; Shi, Shepherd, & Schmidts, 2015). One possible explanation for mixed results may be due to the fact that prior studies use various measures for innovative performance.[5] Additionally, we argue that prior research ignores the fact that FBs have different characteristics and may make various impacts on innovative decisions. This fact gives us the opportunity to understand the innovation in FBs because prior studies mentioned above have reported inconclusive findings thus far. Thus, our first research question is as follows:

RQ1: Whether and how FBs undertake innovations differently from non-FBs.

We conjecture that there is a positive (negative) relationship between innovations and FBs, emphasizing the role of FBs in encouraging (discouraging) innovative activities. Noteworthily, encouraging or discouraging different types of innovative activities may imply that FBs attempt to manage their innovative portfolio in maintaining innovative quality at a specific level. This study then includes different types of innovative outputs (invention, utility model and design patents) to proxy for different levels of innovative quality.

Family Involvement

Previous research on FBs has indicated that family involvement plays a critical role in the decision-making process (Shi, 2014); however, there are two opposing perspectives related to family involvement in management (Wang, 2006). From the alignment perspective, family involvement is seen to positively influence performance by mitigating agency problems (Anderson & Reeb, 2003; Arregle, Hitt, Sirmon, & Very, 2007; Minichilli, Corbetta, & MacMillan, 2010; San Martin-Reyna & Duran-Encalada, 2015; Villalonga & Amit, 2006). For instance, some studies indicate that family involvement in management may encourage innovative behavior and eventually lead to higher firm

[5] In the above-mentioned literature on measures of innovative aspects, some studies focus on patent citations (Matzler et al., 2015; Duran et al., 2016) or creative processes (Spriggs et al., 2013; Kellermanns et al., 2012; Shi et al., 2015) while others focus on R&D intensity.

performance (Craig & Moores, 2006; Gudmundson, Tower, & Hartman, 2003; Hsu & Chang, 2011; Wu, 2008; Zahra, 2005). From the entrenchment perspective, family involvement is seen to negatively affect performance due to the entrenchment of resources for the personal benefit of family members (Chirico, Sirmon, Sciascia, & Mazzola, 2011; Cucculellia & Micucci, 2008; Kowalewski, Talavera, & Stetsyuk, 2010; Miralles-Marcelo et al., 2014; Schulze, Lubatkin, & Dino, 2003; Sciascia & Mazzola, 2008). For instance, some studies indicate that family involvement discourages innovative investments and affects firm performance (Block, 2012; Chen & Hsu, 2009; Duran et al., 2016). So far research on FB remains inconclusive on the role of family involvement. Given such contradictory findings in the extant literature, we clearly need to deep into these inconsistencies in order to understand what conditions/effects cause these inconsistencies. In response to the above-mentioned inconsistencies between family involvement and innovation, we argue that (1) previous studies ignore the influence of differences between Eastern and Western culture,[6] (2) most such research has been adopted using a survey questionnaire to gather information about family involvement and innovation, and such information from questionnaire responses is more likely to lack objectivity and effectiveness, and (3) family involvement usually accompanies other features of FBs (e.g., CEO duality, insider ratio, board monotony), but these features of FBs are ignored. This gives this study a chance to reexamine whether and how different levels of family involvement in management exert on innovative outcomes of FBs.

CEO-duality Effects

CEO-duality[7] leadership is more common in FBs than in non-FB firms (Masulis, Pham, & Zein, 2011). Despite intensive research for more than 20 years (Krause, Semadeni, & Cannella, 2014), the effects of this leadership structure on FBs remains an issue of contention, based on the tenets of stewardship theory as opposed to agency theory (Krause et al., 2014). Stewardship theory posits that CEO-duality provides a unified and strong leadership based on family. Agency theory posits that CEO-duality increases the risk of CEO entrenchment. Some studies have reported that CEO-duality encourages innovation (García-Ramos & García-Olalla, 2011; Lam & Lee, 2012; Yasser, Entebang, & Mansor, 2011), other studies have reported that CEO-duality discourages innovation (Lam & Lee, 2008; Prencipe & Bar-Yosef, 2011), and still other studies observed no link between the two (Adnan, Htay, Rashid, & Meera, 2011; Cooper, 2009; Valenti, Luce, & Mayfield, 2011). For instance, Kor (2006) and van Essen, Heugens, Otten, & van Oosterhout (2012) find that CEO-duality leadership creates a clear sense of innovation strategic decision and encourages innovative activities of FBs. In contrast, Chen & Hsu (2009) and Zona (2014) find that FBs invest less in innovation than other firms when CEO-duality leadership is present. We argue that CEO-duality leadership is a necessary complement to family involvement, and they should not discussed separately. In FBs, family involvement play a crucial role when examining the relationship between CEO-duality leadership and decision making because of the fact that CEO-duality leadership is more common in FBs than in non-FB firms (Masulis, Pham, & Zein, 2011) and such leadership structure is close related to the level of family involvement. If prior studies could consider FBs' features in examining CEO-duality effects, a better understanding about how CEO-duality leadership affects firm decisions could be obtained. This study thus makes an attempt to explore and reexamine CEO-duality effects on innovative decisions of FBs.

2.2 The Innovative Capacity of Family Business and Earnings Management

Although innovations are costly and risky, they are one of the major sources for enhancing firm's competitive advantage. Innovative firms need to spend substantial resources to perform innovative decisions, such that external funds play an important role in supporting innovations. Firms with quality financial reporting are more likely to obtain external funding, such that innovative firms may window-dress earnings to portray a more favorable earnings picture. Previous researchers (Kouaib & Jarboui, 2016; Markarian, Pozza, & Prencipe, 2008; Raman & Shahrur, 2008) have reported that investment in innovation is positively associated with earnings management. Innovative firms tend to have the motivation and capacity to indulge in earnings management. In the context of FBs, there are two competing theories to explain the effects of family on earnings management behavior: entrenchment effects and alignment effects (Ali et al., 2007; Bona-Sanchez, Pérez-Alemán, & Santana-Martín, 2011; Wang, 2006; Yeo, Tan, Ho, & Chen, 2002). From the perspective of entrenchment, FBs are more likely to through managerial entrenchment to manage earnings for their private benefits (Ali et al., 2007; Firth et al., 2007; Wang, 2006). From the perspective of alignment, FBs are less likely to engage in opportunistic behavior because the agency problem is less severe (Ali et al., 2007; Bekiris, 2013; Cascino et al., 2010; Chen, Chen, & Cheng, 2008; Cziraki et al., 2010; Wang, 2006). Unlike previous studies that discussed the relationship between innovation and earnings management,[8] we sought insight into whether innovation in FBs plays a role in motivating earnings management behavior. We conjecture that FBs with innovative capacity are less likely to indulge in earnings management because innovative outcomes enhance the profitability of firms and thereby promote earnings quality. Contrarily, FBs with innovative capacity are more likely to indulge in earnings management because innovative activities increase external funding needs and thereby promote window-dressing of financial statements. Based on the above discussion, our second research question is as follows:

[6] In the family-controlled structure, Eastern culture emphasizes the concept of "family" while Western culture emphasizes the concept of "business". Cultural differences between Eastern and Western are likely to result in inconsistent results of FB studies. In the above-mentioned literature, some studies focus on Eastern FBs (Hsu & Chang, 2011; Wu, 2008; Chen & Hsu, 2009) while others focus on Western FBs. Additionally, studies of Western FBs are usually adopting questionnaires to gather information about family involvement and innovation.

[7] CEO-duality means the situation when the CEO is simultaneously the chairman of the board.

[8] Prior studies mainly focus on examining the association between R&D investments and earnings management and demonstrate that R&D activities provide an opportunity for earnings to be managed (Bartov, 1993; Bens, Nagar, & Wong, 2002; Bens, Nagar, Skinner, & Wong, 2003; Bushee, 1998; Burgstahler & Dichev, 1997; Cohen, Dey, & Lys, 2008; Dechow & Sloan, 1991; Roychowdhury, 2006).

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RQ2: Whether and how innovative outcomes of FBs reflect earnings management behavior differently from non-FBs.

As discussed previously, the fact that CEO-duality represents unambiguous leadership in FBs leads to effective decision-making, superior performance (Chiang & Lin, 2007; Guillet, Seo, Kucukusta, & Lee, 2013; Krause & Semadeni, 2013), and a reduced likelihood of earnings management. In contrast, CEO-duality practices in FBs would result in a higher likelihood of self-interested behavior of earnings management activities (Chi, Hung, Cheng, & Lieu, 2015; Stockmans, Lybaert, & Voordeckers, 2013). We conjecture that CEO-duality remains in its unambiguous leadership as a monitoring role of strengthening decision-making efficiency and supervising performance, thereby reducing the possibility of earnings management. Contrarily, CEO-duality remains in its predominant leadership as an entrenchment role of selecting self-interested plans and portraying favorable performance, thereby increasing the possibility of earnings management. We further consider CEO-duality effects to examine the association between innovative capacity of FB and earnings management behavior.

3. Research Method

3.1 Sample Description

We began our sample selection process by identifying electronics firms listed on the *TSE* for the period from 2010 to 2015. We focused on the electronic industry in order to keep the sample size manageable. Furthermore, electronics firms survive on patents, which makes innovation a necessity. Thus, we also manually collected patent-related data from the Taiwan Patent Search System (*TPSS*), which resulted in 4,994 preliminary firm-year observations during our sample period. We began by eliminating 410 observations that lacked patent-related information. Our empirical analysis dealt with the effects of family ownership on innovation capacity and earnings management; therefore, we required information pertaining to the ownership structure of every electronics firm included in the study. Thus, we eliminated 762 observations that lacked information of ownership structure. We also eliminated 181 observations due to a lack of requisite financial data in the Taiwan Economic Journal (*TEJ*) database.[9] Finally, the final sample comprised 3,641 firm-year observations (See Panel A of Table 1).

Panel B shows that approximately 56.17% of the final sample obtained new patents. Panel C illustrates the distribution of ownership structure and patent information among firm-year observations, showing that approximately 53.04% of the final sample (in which approximately 52.46% of FBs obtained new patents) were FBs.[10] This indicates that more than 50% of the family-controlled electronics firms are willing to accept the risks involved in promoting innovation. This appears to be consistent with recent reports by Kammerlander and van Essen (2017) and PwC (2016), indicating that family-owned businesses are among the most innovative in their industries.

Table 1 Sample Distribution

Panel A : Sample selection criteria

Firm-year observations of electronics industry from 2010-2015	4,994
Less: observations for which patent data were not available in TPSS	(410)
Less: observations for which ownership structure were not available in TEJ	(762)
Less: observations for which financial data were not available in TEJ	(181)
Final firm-year observations	3,641

Panel B : Distribution of patent information by year

Year / Patent[a]	2010	2011	2012	2013	2014	2015	Total
Patent	324	317	345	359	347	353	2,045(56.17%)
No Patent	275	284	262	248	264	263	1,596(43.83%)
Total	599(16.45%)	601(16.51%)	607(16.67%)	607(16.67%)	611(16.78%)	616(16.92%)	3,641

Panel C : Distribution of ownership structure and patent information

Patent / Ownership[b]	Patent	No Patent	Total
Family	1,013(27.82%)	918(25.21%)	1,931(53.03%)
Non-Family	1,032(28.35%)	678(18.62%)	1,710(46.97%)
Total	2,045(56.17%)	1,596(43.83%)	3,641(100.00%)

[a] Patent denotes companies obtained new patents, but not vice-verse.

[b] Family denotes companies belong to family businesses, but not versa. The information of family businesses is as defined in *TEJ*.

[9] The *TEJ* database in Taiwan closely resembles *CRSP* and *COMPUSTAT* databases in the United States of America.

[10] In 2015, 62.77% of listed firms in Taiwan are FBs, and the percentage of FBs in the Taiwan electronic industry is 53.03%.

3.2 Research Design

In this section, we first describe the empirical models used to address research issues, followed by a discussion of the variables. We estimate Equations (1) and (2) using a pooled probit model to examine the association between family business and innovative capacity. The pooled OLS model of Equation (3) is used to examine the association between innovative capacity of family business and earnings management. We also include year fixed effects in all research models and adopt clustering by firms plus White's heteroskedasticity-adjusted standard errors (Boone et al. 2013; Gow et al. 2010; Petersen 2009).

3.2.1 Family Business and Innovation Capacity

To test whether FBs affect patent-related innovation, we first estimate Equation (1). We further estimate Equation (2) to determine whether innovation capacity is affected by the degree of family involvement in management.

$$INNOVATION = \gamma_0 + \gamma_1 FAMILY + \gamma_2 LOSS + \gamma_3 LEV + \gamma_4 GROWTH + \gamma_5 ROA + \gamma_6 FCF + \gamma_7 SIZE + \varphi\, YEAR + \varepsilon \quad (1)$$

$$INNOVATION = \gamma_0 + \gamma_1 FAMILY + \gamma_2 LEVEL + \gamma_3 FAMILY \times LEVEL + \gamma_4 LOSS + \gamma_5 LEV + \gamma_6 GROWTH + \gamma_7 ROA + \gamma_8 FCF + \gamma_9 SIZE + \varphi\, YEAR + \varepsilon \quad (2)$$

Where *INNOVATION* is the innovative capacity, we following prior studies (Cornaggia, Mao, Tian, & Wolfe, 2015; Fang, Tian, & Tices, 2014; He & Tian, 2013; Hirshleifer, Low, & Teoh, 2012; Tian & Wang, 2014) use four measures of patent-related innovation as proxies for it: *INN*, *ININV*, *INNUM*, and *INNDES*.[11] *INN* equals 1 if the firm obtained new patents, else 0;[12] *ININV* equals 1 if the firm obtained new invention patents, else 0; *INNUM* equals 1 if the firm obtained new utility model patents, else 0; *INNDES* equals 1 if the firm obtained new design patents, else 0; *FAMILY* equals 1 if the firm belongs to FBs, else 0;[13] *LEVEL*, the level of management involvement, equals the number of managers of internal parts (including the internalization of the board, general manager, treasurer of internalization) divided by the number of directors concurrently act as managers; *FAMILY* × *LEVEL*, the level of family involvement in management, equals an interaction between *FAMILY* and *LEVEL*; *LOSS* equals 1 if operating income is less than zero, else 0; *LEV* equals long-term debt divided by total assets; *GROWTH* equals percentage growth in sales; *ROA* equals net income divided by total assets; *FCF* equals cash flow from operations minus cash dividends divided by total assets; *SIZE* equals the natural log of total assets; and *YEAR* equals dummy variables controlling for years.

In Equation (1), we use four dependent variables as proxies for innovative capacity: *INN*, *ININV*, *INNUM*, and *INNDES*. *FAMILY* is test variable as proxy for family effects. If family effects contribute to patent-related innovation, then γ_1 should be positive, but not vice-verse. We further include *LEVEL* and its interaction with *FAMILY* into Equation (2). By examining the significance of the coefficient of *FAMILY* × *LEVEL*, we can shed light on the association between levels of family involvement in management and innovative capacity. Our control variables include factors considered major determinants affecting firms' innovative capacity. For example, firm's financial condition plays an important role in affecting innovative decisions and following innovative capacity. According to previous studies (Cornaggia et al., 2015; Fang et al., 2014; He & Tian, 2013; Hirshleifer et al., 2012; Jouber, 2013; Merkley, 2014; Tian & Wang, 2014), we consider five proxies for a firm's financial condition: performance (*ROA* and *LOSS*), sales growth (*GROWTH*), cash flow (*FCF*), and leverage (*LEV*). We predict that the coefficients of *ROA* and *GROWTH* (or *LOSS*) to be positive (or negative) because profitable (or unprofitable) firms are more (or less) likely to be financially-profited and more (or less) likely to make investments in innovation. Similarly, we expect the coefficient of *FCF* (or *LEV*) to be positive (or negative) because firms with (without) financial flexibility appear less (or more) financially-constrained and more (or less) likely to deploy financial resources for innovative projects. As in previous studies (Eberhart, Maxwell, & Siddique 2008; Pandit, Wasley, & Zach, 2011), we controlled for R&D activities (*RD*) because may has a positive effect on innovative capacity. We included firm size (*SIZE*) as a control variable to control for the firms' size effect (Ettredge, Johnstone, Stone, & Wang, 2011; Bens et al. 2011), because the firm size could be used to capture firm-specific risk on innovative investments. We also included *YEAR* as dummy variables in Equations to mitigate the problem of omitted variables in model estimation (Bentley, Omer, & Sharp, 2013; Chandra, 2011). In sum, we expect firms perform better (*ROA*), less loss (*LOSS*), have higher cash flows (*FCF*) and sales growth (*GROWTH*), have less debt (*LEV*), have higher R&D spending (*RD*), and have larger size (*SIZE*) are associated with higher innovative capacity.

3.2.2 Innovation Capacity of Family Business and Earnings Management

To determine whether the innovation capacity of FBs is associated with earnings management, we implemented the following regression model:

[11] We use patents as measures of firm's innovative capacity because patents can reflect innovative outputs and future perspectives directly.

[12] In terms of features the patents can classify into three types: invention, utility model and design. The innovative quality of invention patents is higher than utility model and design patents.

[13] *FAMILY* follows the definition of the *TEJ* database: (1) both the board chair and the CEO are members of same family group; or (2) family members occupy over 50% of the board seats while affiliated firms and outside directors occupy less than 33% of the board seats; or (3) family members occupy over 33% of the board seats and at least three family members are board directors, supervisors, and managers; or (4) the family holds control rights exceeding critical control rights.

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$$DA = \gamma_0 + \gamma_1 FAMILY + \gamma_2 INNOVATION + \gamma_3 FAMILY \times INNOVATION + \gamma_4 LOSS + \gamma_5 LEV + \gamma_6 GROWTH + \gamma_7 ROA + \gamma_8 SIZE + \gamma_9 QUICK + \gamma_{10} OCF + \varphi YEAR + \varepsilon \quad (3)$$

Where *DA* equals discretionary accruals from the cross-sectional Modified Jones Model[14] (Dechow, Sloan, & Sweeney, 1995); *QUICK* equals current assets (less inventories) divided by current liabilities; and *OCF* equals cash flow from operations divided by total assets. Other control variables are the same as previously mentioned in Equation (1).

Earnings management occurs when managers make permitted discretionary judgments in measuring and recognizing specific accruals in financial reporting to reach the desired objectives. Thus, discretionary accruals play an important role in detecting earning management and affecting earnings quality. Using accrual models can help us to distinguish discretionary and non-discretionary accruals in determining the degree of earnings management because the distinction between discretionary and non-discretionary accruals is difficult to distinguish. Therefore, we follow prior studies (Brousseau & Gu, 2013; Dechow et al., 1995; Dechow, Ge, & Schrand, 2010; Ogneva, 2012; Perotti & Wagenhofer, 2014) to employ discretionary accruals to proxy for earnings management behavior (*DA*). We include family effects (*FAMILY*) and its interaction with innovative outputs (*INNOVATION*) into Equation (3). By examining the significance of the coefficient of *FAMILY* ×*INNOVATION*, we can shed light on whether and how innovative effects of FBs affect earnings quality. If innovative outputs of FBs contribute to high-quality earnings, then γ_3 should be negative, but not vice-verse. Following prior research (Chen, Cheng, & Wang, 2015; Chi, Lisic, & Pevzner, 2011; Choi, Kim, & Lee, 2011; Dee, Lulseged, & Zhang, 2015; Gerakos, 2012; Othman & Zeghal, 2006; Gaio, 2010; Barton & Simko, 2002), our control variables include major determinants affecting firms' earnings management behavior. To control for the influences of firm performance, we consider three proxies for a firm's profitability: performance (*ROA* and *LOSS*), and sales growth (*GROWTH*). We predict that the coefficients of *ROA* and *GROWTH* (or *LOSS*) to be positive (or negative) because profitable (or unprofitable) firms have more (or less) capacity to use accruals in managing. Contrarily, we predict that the coefficients of *ROA* and *GROWTH* (or *LOSS*) to be negative (or positive) because profitable (or unprofitable) firms are more (or less) likely to be financially-profited and less (or more) likely to exercise discretion over certain accounting decisions. Firm's capital structure is associated with earnings management behavior, we thus include four proxies for a firm's financial status: leverage (*LEV*), cash flow (*OCF*), quick ratio (*QUICK*), and firm size (*SIZE*). We predict that the coefficients of *OCF* and *QUICK* to be negative because firms with financial flexibility appear less financially-constrained and less likely to engage in earnings management. On the contrary, firms with financial flexibility have more capacity to manipulate earnings. Similarly, we expect the coefficient of *LEV* to be positive because high leverage firms are more likely to avoid debt covenant violations by engaging in earnings manipulation. Conversely, we expect the coefficient of *LEV* to be negative because high leverage firms are more likely to face financial difficulties and they have less capacity to exercise discretion in reporting earnings. We expect the coefficient of *SIZE* to be negative because the hefty reputational costs likely to be incurred if larger firms engage in earnings management. Conversely, we expect the coefficient of *SIZE* to be positive because larger firms face greater pressure to meet or beat expectations by market participants. As mention before, we also included *YEAR* as dummy variables in Equation (3).

4. Empirical Results

4.1 Descriptive Statistics and Univariate Tests

Table 2 presents descriptive statistics[15] for our sample of non-FBs (n = 1,710), as compared to FBs (n = 1,931). Means and medians of innovative capacity (*INN*, *ININV*, and *INNUM*) are statistically smaller for FBs, except for *INNDES*. This preliminary result suggests that FBs seem to play a constricting role in firms' innovative decisions. Means and medians of management involvement (*LEVEL*) are statistically larger for FBs, suggesting that members of FBs have significantly higher percentage of management involvement. FBs have significantly higher leverage ratios (*LEV*) and lower quick ratio (*QUICK*) than non-FBs and are more likely to report current year losses (*LOSS*). Additionally, FBs have smaller size than non-FBs.

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[14] Most the models for the detection of earnings management have been developed and applied. The most commonly used model is the Modified Jones Model, because it provides the most powerful test of earnings management (Brousseau & Gu, 2013; Dechow et al., 1995; Dechow, Ge, & Schrand, 2010; Ogneva, 2012; Perotti & Wagenhofer, 2014). Therefore, we use the Modified Jones Model to estimate discretionary accruals, this model is described in the following description:

First, the Modified Jones Model discretionary accrual is estimated cross-sectionally each year using all firm-year observations in the same two-digit SIC code.

$$TA_{it} = \beta_1(1/ASSETS_{it-1}) + \beta_2(\Delta REV_{it} - \Delta REC_{it}) + \beta_3 PPE_{it} + \varepsilon_{it}$$

where TA_{it}, total accruals at year *t* for company *i*, is the change in non-cash current assets minus the change in current liabilities excluding the current portion of long-term debt, minus depreciation and amortization, scaled by lagged total assets. ΔREV_{it} is change in revenues scaled by lagged total assets, $ASSETS_{it-1}$, ΔREC_{it} is change in receivables scaled by $ASSETS_{it-1}$, and PPE_{it} is net property, plant and equipment scaled by $ASSETS_{it-1}$. Second, using coefficients b_1 to b_3 estimated from the OLS regression by industry and year, we estimate discretionary accruals (*DA*) for each sample firm as:

$$DA_{it} = TA_{it} - \{b_1(1/ASSETS_{it-1}) + b_2(\Delta REV_{it} - \Delta REC_{it}) + b_3 PPE_{it}\}$$

[15] To control for outliers, we winsorized all continuous variables at the 1st and 99th percentiles.

Table 2 Descriptive Statistics

	Non-Family[b] (n = 1,710)			Family (n = 1,931)			Test of Differences[c]	
Variables[a]	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	*t*-test	Wilcoxon
INN	0.6035	1	0.4893	0.5246	1	0.4995	4.80***	4.79***
ININV	0.4468	0	0.4973	0.3485	0	0.4766	6.08***	6.05***
INNUM	0.4064	0	0.4913	0.3573	0	0.4973	3.05***	3.05***
INNDES	0.1012	0	0.3016	0.1113	0	0.3146	-0.99	-0.99
LEVEL	0.4177	0.25	0.4986	0.5122	0.5	0.5330	-5.51***	-5.69***
DA	0.0031	0.0085	0.1107	0.0069	0.0069	0.1007	-1.09	0.23
LOSS	0.2281	0	0.4197	0.2574	0	0.4373	-2.06**	-2.06**
LEV	0.0485	0.0067	0.0732	0.0601	0.0164	0.0845	-4.38***	-2.96***
GROWTH	0.0579	0.0170	0.2833	0.0489	0.0129	0.2956	0.94	1.66*
ROA	0.0360	0.0463	0.0869	0.0343	0.0388	0.0846	0.60	1.94*
FCF	0.0308	0.0356	0.0884	0.0322	0.0367	0.0846	-0.49	-0.48
SIZE	15.2513	15.0320	1.4231	15.1547	14.9731	1.4121	2.05**	2.12**
QUICK	2.3377	1.5979	2.1560	2.0940	1.4909	1.8169	3.70***	4.21***
OCF	0.0681	0.0673	0.1088	0.0667	0.0675	0.1049	0.41	0.90

[a] The definition of the variables reported in this table are: *INN* = 1 if the firm obtained new patents, else 0; *ININV* = 1 if the firm obtained new invention patents, else 0; *INNUM* = 1 if the firm obtained new utility patents, else 0; *INNDES* = 1 if the firm obtained new design patents, else 0; *LEVEL* = the number of managers of internal parts (including the internalization of the board, general manager, treasurer of internalization) divided by the number of directors concurrently act as managers; *DA* = discretionary accruals from the cross-sectional Modified Jones Model (1995); *LOSS* = 1 if operating income is less than zero, else 0; *LEV* = long-term debt divided by total assets; *GROWTH* = percentage growth in sales; *ROA* = equals net income divided by total assets; *FCF* = cash flow from operations minus cash dividends divided by total assets; *SIZE* = equals the natural log of total assets; *QUICK* = current assets (less inventories) divided by current liabilities; *OCF* = cash flow from operations divided by total assets. All continues variables are winsorized at the first and 99th percentiles.

[b] Family denotes companies belong to family businesses, but not versa. The information of family businesses is as defined in *TEJ*.

[c] Asterisks*, **, ***indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

Panel A of Table 3 presents the Pearson correlation matrix for all variables included in Equations (1) and (2). Panel A indicates that the degree of correlation between innovative capacity (*INN*, *ININV*, *INNUM*) and family effects (*FAMILY*) is significantly negative (between -0.0505 and -0.1003). We note that the correlation between the control variables are mostly not very high, except for those between *ROA* and *LOSS*. Panel B of Table 3 presents the Pearson correlations among the variables included in Equation (3). Panel B shows that the correlation between earnings management (*DA*) and innovative capacity (*INN*) is significantly positive, indicating that firms with stronger innovative capacity seem more likely to manage their earnings. Control variables of Panel B are highly correlated with our earnings management measures, and the correlations between our control variables are mostly not very high, except for those between *ROA* and *OCF*. We also estimate variance inflation factors (VIF) for all models and find that the average VIF is less than 1.9 and none of the VIFs exceeded 10, suggesting that multicollinearity is unlikely to be a serious problem (Kennedy, 1998).

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Table 3 Pearson Correlation Matrix

Panel A : Family Business and Innovative Capacity

Variables[a]	*INN*	*ININV*	*INNUM*	*INNDES*	*FAMILY*	*FAMILYIN*	*LOSS*	*LEV*	*GROWTH*	*ROA*	*FCF*
ININV	**0.7133**										
INNUM	**0.6922**	**0.2794**									
INNDES	**0.3051**	**0.2820**	**0.3014**								
FAMILY	**-0.0794**	**-0.1003**	**-0.0505**	0.0165							
LEVEL	0.0278	-0.0240	**0.0456**	0.0117	**0.0909**						
LOSS	**-0.0802**	**-0.0629**	**-0.0743**	**-0.0405**	**0.0341**	0.0209					
LEV	**0.0336**	**0.0609**	0.0256	**0.0537**	**0.0724**	-0.0158	**0.1141**				
GROWTH	0.0198	0.0089	**0.0344**	-0.0005	-0.0156	-0.0023	**-0.2793**	0.0047			
ROA	**0.0760**	**0.0603**	**0.0555**	0.0041	-0.0100	0.0169	**-0.7388**	**-0.1427**	**0.3814**		
FCF	**0.1188**	**0.1130**	**0.0751**	0.0182	0.0081	-0.0185	**-0.2450**	**0.0749**	**0.0424**	0.3428	
SIZE	**0.3207**	**0.4021**	**0.1930**	**0.2896**	**-0.0340**	**-0.0999**	**-0.2246**	**0.2562**	**0.0843**	0.2103	**0.2474**

Panel B : The Innovative Capacity of Family Business and Earnings Management

Variables[a]	*DA*	*FAMILY*	*INN*	*ININV*	*INNUM*	*INNDES*	*LOSS*	*LEV*	*GROWTH*	*ROA*	*SIZE*	*QUICK*
FAMILY	0.0180											
INN	**0.0448**	**-0.0794**										
ININV	0.0247	**-0.1003**	**0.7133**									
INNUM	0.0277	**-0.0505**	**0.6922**	**0.2794**								
INNDES	-0.0292	0.0165	**0.3051**	**0.2820**	**0.3014**							
LOSS	**-0.3629**	**0.0341**	**-0.0802**	**-0.0629**	**-0.0743**	**-0.0405**						
LEV	**-0.1631**	**0.0724**	**0.0336**	**0.0609**	0.0256	**0.0537**	**0.1141**					
GROWTH	**-0.1061**	-0.0156	0.0198	0.0089	**0.0344**	-0.0005	**-0.2793**	0.0047				
ROA	**0.4875**	-0.0100	**0.0760**	**0.0603**	**0.0555**	0.0041	**-0.7388**	**-0.1427**	**0.3814**			
SIZE	-0.0082	**-0.0340**	**0.3207**	**0.4021**	**0.1930**	**0.2896**	**-0.2246**	**0.2562**	**0.0843**	**0.2103**		
QUICK	**0.1132**	**-0.0612**	**-0.0712**	-0.0292	**-0.1385**	**-0.0971**	**-0.0542**	**-0.2382**	**-0.1121**	**0.1152**	**-0.2669**	
OCF	**0.1350**	-0.0068	**0.1349**	**0.1248**	**0.0678**	0.0058	**-0.3829**	-0.0129	**0.1619**	**0.5804**	**0.2330**	**0.0772**

[a] The definition of the variables reported in this table are: *INN* = 1 if the firm obtained new patents, else 0; *ININV* = 1 if the firm obtained new invention patents, else 0; *INNUM* = 1 if the firm obtained new utility patents, else 0; *INNDES* = 1 if the firm obtained new design patents, else 0; *DA* = discretionary accruals from the cross-sectional Modified Jones Model (1995); *FAMILY* = 1 if the firm belongs to family businesses, else 0; *LEVEL* = the number of managers of internal parts (including the internalization of the board, general manager, treasurer of internalization) divided by the number of directors concurrently act as managers; *LOSS* = 1 if operating income is less than zero, else 0; *LEV* = long-term debt divided by total assets; *GROWTH* = percentage growth in sales; *ROA* = equals net income divided by total assets; *FCF* = cash flow from operations minus cash dividends divided by total assets; *SIZE* = equals the natural log of total assets; *QUICK* = current assets (less inventories) divided by current liabilities; *OCF* = cash flow from operations divided by total assets. All continues variables are winsorized at the first and 99th percentiles.

4.2 Multivariate Analysis

4.2.1 Family Business and Innovation Capacity

Table 4 lists the estimated results from the probit regression in Equation (1). Our first question focuses on whether the coefficient of *FAMILY* captures the effects of family ownership on innovation capacity. In column (1), the reported coefficient of *FAMILY* is negative and statistically significant (t = -4.27 at the 1% level of significance), which suggests that FBs are less likely to devote resources to increase innovation than are non-FBs. Our results imply that the conservative behavior of FBs tends to hamper innovation. Various measures of patent output were used as dependent variables in examining the first research question. We found that the coefficient of *FAMILY* in columns (2)

and (3) is significantly negative, whereas in column (4), it is positive but does not reach the level of significance. These results strongly suggest that FBs play a significant role in constraining invention and utility patents; however, they appear to encourage innovation in design patents. This may be due to the fact that the uncertainty in obtaining invention and utility patents is likely to increase the perceived risk. Our results imply that FBs are conservative and stable, which means that they are less likely to make risky decisions. Our overall empirical results suggest that family effects reduce innovation capacity. For control variables, the coefficient related to a firm's leverage *(LEV)* was significantly negative, whereas the coefficients of cash flow (*FCF*) and firm size (*SIZE*) were significantly positive.

Table 4 Family Effect and Innovative Capacity

		(1) Dep. Var. = *INN*		(2) Dep. Var. = *INNINV*		(3) Dep. Var. = *INNUM*		(4) Dep. Var. = *INNDES*	
Variables[a]	**Pred. Sign**	**Coef.**	***z*-value**[b]	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**
CONSTANT		-4.8535	-16.58***	-6.5691	-21.72***	-2.8977	-11.09***	-6.5289	-18.65***
FAMILY	?	-0.1869	-4.27***	-0.2612	-5.78***	-0.1072	-2.49**	0.1361	2.25**
LOSS	-	0.0065	0.09	0.0962	1.22	-0.1367	-1.82**	-0.1706	-1.60*
LEV	-	-0.9451	-3.18***	-0.8918	-2.91***	-0.3975	-1.37*	-0.6367	-1.62*
GROWTH	+	-0.0225	-0.26	-0.0079	-0.09	0.0607	0.70	-0.0736	-0.57
ROA	+	-0.2824	-0.69	-0.3165	-0.73	-0.5551	-1.35*	-1.5150	-2.50***
FCF	+	0.7400	2.69***	0.4763	1.62*	0.5528	1.98**	-0.8195	-1.99**
SIZE	+	0.3406	17.79***	0.4318	21.91***	0.1721	10.29***	0.3411	15.73***
YEAR		Included		Included		Included		Included	
Pseudo R^2		9.12%		14.50%		3.26%		11.89%	
N		3,641		3,641		3,641		3,641	

[a] The definition of the variables reported in this table are: *FAMILY* = 1 if the firm belongs to family businesses, else 0; *LOSS* = 1 if operating income is less than zero, else 0; *LEV* = long-term debt divided by total assets; *GROWTH* = percentage growth in sales; *ROA* = equals net income divided by total assets; *FCF* = cash flow from operations minus cash dividends divided by total assets; *SIZE* = equals the natural log of total assets; *YEAR* = dummy variables controlling for years. All continues variables are winsorized at the first and 99th percentiles.

[b] Asterisks*, **, ***indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. One-tailed for directional expectations, and two-tailed for others.

Family Involvement

Family involvement may play a critical decision-making role in innovation, and this may be determined by the degree of family involvement in management. In the following, we seek to determine whether family involvement plays a critical role in promoting the innovation capacity of FBs. Table 5 lists the estimation results obtained using Equation (2). In columns (1), (3), (5), and (7), the results of coefficient on *FAMILY* is similar to those documented in Table 4, showing that FBs have lower innovative capacity; moreover, the coefficient of *LEVEL* is significantly positive (at least at the 5% significance level), except for the results in column (3), implying that firms with higher management involvement are more likely to encourage innovative behavior. In columns (2), (4), (6), and (8), we include the interaction term between *FAMILY* and *LEVEL*. The coefficient of *FAMILY*×*LEVEL* is insignificant and positive ($z = 1.25$) in columns (2), indicating that there is essentially no relationship between performance in innovation and family involvement. Considering various types of patent-related innovations, we found that the coefficient of *FAMILY*×*LEVEL* is only significant and positive ($z = 1.97$ and significant at the 5% level) in column (4), whereas it is insignificant and negative in columns (6) and (8). These results suggest that FBs with greater involvement in management are more likely to invest in the development of new patents, which implies that these firms are ambitious and willing to accept the implied challenges. Our results indicate that, on the positive side, FBs encourage participation in developing long-term goals and strategies (Carnes & Ireland, 2013; Upton, Teal, & Felan, 2001), and strong family involvement in management appears to benefit innovation by helping firms to identify and understand the challenges and opportunities they face (Chrisman, Chua, & Steier, 2002; Craig & Dibrell, 2006; Mitra, 2013; Zahra, 2005).

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Table 5 Family Involvement and Innovative Capacity

		(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
		Dep. Var. = *INN*		Dep. Var. = *INN*		Dep. Var. = *ININV*		Dep. Var. = *ININV*		Dep. Var. = *INNUM*		Dep. Var. = *INNUM*		Dep. Var. = *INNDES*		Dep. Var. = *INNDES*	
Variables[a]	Pred. Sign	Coef.	*z*-value[b]	Coef.	*z*-value	Coef.	*z*-value	Coef.	*z*-value	Coef.	*z*-value	Coef.	*z*-value	Coef.	*z*-value	Coef.	*z*-value
CONSTANT		-5.0174	-16.96***	-4.9873	-16.81***	-6.6400	-21.72***	-6.5959	-21.52***	-3.0926	-11.65***	-3.0990	-11.62***	-6.8314	-18.79***	-6.8350	-18.70***
FAMILY	?	-0.2021	-4.60***	-0.2512	-4.26***	-0.2679	-5.90***	-0.3480	-5.70***	-0.1241	-2.86***	-0.1136	-1.95*	0.1187	1.95*	0.1241	1.50
LEVEL	?	0.1702	4.05***	0.1096	1.71*	0.0703	1.63	-0.0248	-0.38	0.1831	4.41***	0.1956	3.14***	0.2076	3.62***	0.2140	2.43**
FAMILY×LEVEL	?			0.1058	1.25			0.1708	1.97**			-0.0223	-0.27			-0.0109	-0.10
LOSS	-	-0.0001	-0.01	-0.0050	-0.07	0.0930	1.18	0.0863	1.09	-0.1483	-1.96**	-0.1474	-1.95**	-0.1901	-1.78**	-0.1897	-1.77**
LEV	-	-0.9714	-3.27***	-0.9692	-3.26***	-0.9018	-2.94***	-0.8972	-2.93***	-0.4156	-1.43*	-0.4163	-1.43*	-0.6486	-1.65**	-0.6488	-1.65**
GROWTH	+	-0.0214	-0.25	-0.0176	-0.20	-0.0075	-0.08	-0.0018	-0.02	0.0616	0.71	0.0609	0.70	-0.0819	-0.63	-0.0823	-0.63
ROA	+	-0.3549	-0.86	-0.3631	-0.88	-0.3473	-0.80	-0.3623	-0.83	-0.6540	-1.58*	-0.6527	-1.57*	-1.6822	-2.75***	-1.6822	-2.75***
FCF	+	0.7645	2.77***	0.7656	2.77***	0.4821	1.64*	0.4819	1.64*	0.5785	2.06**	0.5786	2.06**	-0.7782	-1.87**	-0.7783	-1.87**
SIZE	+	0.3470	18.06***	0.3467	18.04***	0.4347	21.96***	0.4345	21.94***	0.1802	10.69***	0.1802	10.69***	0.3550	15.99***	0.3551	15.99***
YEAR		Included		Included		Included		Included		Included		Included		Included		Included	
Pseudo R^2		9.44%		9.48%		14.55%		14.63%		3.66%		3.66%		12.41%		12.41%	
N		3,641		3,641		3,641		3,641		3,641		3,641		3,641		3,641	

[a] The definition of the variables reported in this table are: *FAMILY* = 1 if the firm belongs to family businesses, else 0; *LEVEL* = the number of managers of internal parts (including the internalization of the board, general manager, treasurer of internalization) divided by the number of directors concurrently act as managers; *LOSS* = 1 if operating income is less than zero, else 0; *LEV* = long-term debt divided by total assets; *GROWTH* = percentage growth in sales; *ROA* = equals net income divided by total assets; *FCF* = cash flow from operations minus cash dividends divided by total assets; *SIZE* = equals the natural log of total assets; *YEAR* = dummy variables controlling for years. All continues variables are winsorized at the first and 99th percentiles.

[b] Asterisks*, **, ***indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. One-tailed for directional expectations, and two-tailed for others.

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CEO-duality Effects

We also took CEO-duality effects into account in exploring the relationship between family involvement in management and innovation capacity. The results are presented in Table 6. In columns (1), (3), (5), and (7) of Panel A, the coefficient of *FAMILY* is insignificant and negative, except for the results in column (7); moreover, the coefficient of *LEVEL* is significant and positive, except for the results in columns (3) and (5). In columns (1), (3), (5), and (7) of Panel B, the result of coefficients on *FAMILY* and *LEVEL* is similar to those reported in Table 5. These results seem to imply that CEO's duality brings positive effects in mitigating the negative effects of family business on innovative capacity. After including the interaction term between *FAMILY* and *LEVEL*, most of the coefficients on the interaction terms and the *LEVEL* variables in each panel have opposite signs. We further found that the coefficients of *FAMILY*×*LEVEL* in Panel A are significant and positive (at least at the 5% significance level), whereas most of coefficients of *FAMILY* × *LEVEL* in Panel B are significant and negative. It was noted that most of the coefficients on the interaction terms and the *LEVEL* variables in each panel have opposite signs. These results indicate that only CEO-duality firms with family involvement in management are likely to excel in innovation. This result appears consistent with stewardship theory, which states that CEO-duality enhances the uniformity of leadership and enables prompt decision-making (Bennington, 2010; Boyd, Haynes, & Zona, 2011; Daily & Dalton, 1993; Krause et al., 2014; Ramdani & Van Witteloostuijn, 2010).

Overall, our results suggest that FBs are more likely to hamper the development of patent-related innovations than are non-FBs. However, performance in patent-related innovation is enhanced when the family is more involved in management and when the firm has a CEO-duality structure. Our results imply that managerial efforts of family members and uniform CEO-duality leadership strengthen decision-making efficiency and flexibility of innovative decisions and thus enhance their innovative capacity.

4.2.2 Innovation Capacity of Family Business and Earnings Management

As previously noted, our results show that family involvement and leadership play important roles in the formation of strategies related to innovation, which ultimately affects patent-related outcomes. Our second question focuses on the coefficient of *FAMILY* × *INNOVATION*, and whether the innovation strategies of FBs contribute to earnings management. Table 7 presents the estimation results. In columns (1), (3), (5), and (7), the coefficient of *FAMILY* is insignificant and positive; moreover, the coefficients of *INNOVATION* (*INN*, *ININV*, and *INNUM*) are significant and positive, except for the coefficient of *INNDES*. These results imply that FBs' earnings quality is slightly lower, and firms with patent-related innovation seems to be more likely to manage earnings through innovative activities. After including the interaction term between *FAMILY* and *INN* in column (2), the coefficients of *FAMILY* and *INN* are both significantly positive, indicating that FBs engage in more opportunistic reporting behaviour (Cascino et al., 2010; Chi et al., 2015; Ding, Qu, & Zhuang, 2011; Gopalan & Jayaraman, 2012) or that firms focusing on innovation are more likely to engage in earnings management (Mizik, 2010; Osma & Young, 2009; Pandit, Wasley, & Zach, 2011; Shust, 2015). Notably, the coefficient of *FAMILY* × *INN* is significantly negative, suggesting that FBs with higher innovation capacity are less likely to window-dress earnings. Our results imply that FBs with higher innovation capacity are less likely to indulge in earnings management. We also classified patent-related innovation into three categories and included the interaction term between *FAMILY* and *INNOVATION* (*ININV*, *INNUM*, and *INNDES*) in columns (4), (6), and (8). We found that the coefficient of *FAMILY* ×*ININV* in column (4) is significant and negative (t = -2.74 at significance level of 1%) whereas coefficients of *FAMILY* ×*INNNUM* and *FAMILY* ×*INNDES* in columns (6) and (8) are insignificant. These results suggest that only FBs with highly innovative "invention patents" exhibit a greater tendency to reduce levels of earnings management, implying that combined effects of FBs and quality innovation enhance competitiveness and performance of such types of FBs and are therefore less likely to engage in earnings management. For control variables, the coefficients related to a firm's leverage (*LEV*), sales growth (*GROWTH*), size (*SIZE*), quick ratio (*QUICK*), and cash flow (*OCF*) were significantly negative, whereas the coefficient of financial performance (*ROA*) was significantly positive.

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Table 6 Family Involvement and Innovative Capacity: Considering the CEO-duality Effect

Panel A : Observations with CEO duality (n=1,594)

		(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
		Dep. Var. = *INN*		Dep. Var. = *INN*		Dep. Var. = *ININV*		Dep. Var. = *ININV*		Dep. Var. = *INNUM*		Dep. Var. = *INNUM*		Dep. Var. = *INNDES*		Dep. Var. = *INNDES*	
Variables[a]	**Pred. Sign**	**Coef.**	***z*-value**[b]	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**
CONSTANT		-5.1894	-10.74***	-5.0184	-10.30***	-7.1122	-14.02***	-6.9810	-13.65***	-3.7939	-8.39***	-3.6881	-8.04***	-6.6470	-10.86***	-6.4112	-10.36***
FAMILY	?	-0.0246	-0.37	-0.2449	-2.38**	-0.1043	-1.52	-0.2601	-2.40**	-0.0215	-0.32	-0.1844	-1.78*	0.2115	2.23**	-0.1504	-0.98
LEVEL	?	0.1876	2.76***	-0.0244	-0.24	0.1230	1.74	-0.0246	-0.23	0.1109	1.63	-0.0455	-0.44	0.3047	3.17***	-0.0624	-0.39
FAMILY×LEVEL	?			0.3824	2.79***			0.2669	1.86*			0.2808	2.04**			0.6012	2.99***
LOSS	-	0.1626	1.46*	0.1446	1.29*	0.1985	1.71**	0.1840	1.58*	0.0436	0.39	0.0296	0.26	-0.2101	-1.32*	-0.2474	-1.54*
LEV	-	-1.3714	-3.22***	-1.4280	-3.34***	-1.0363	-2.33***	-1.0797	-2.41***	-0.6526	-1.52*	-0.7043	-1.63*	-0.6014	-1.02	-0.7743	-1.28*
GROWTH	+	0.0807	0.65	0.0924	0.74	-0.0234	-0.18	-0.0175	-0.13	0.1120	0.88	0.1197	0.94	0.2968	1.68**	0.3239	1.84**
ROA	+	-0.3217	-0.52	-0.3292	-0.53	-0.3732	-0.57	-0.3729	-0.57	-0.1733	-0.27	-0.1750	-0.28	-2.8527	-3.00***	-2.9177	-3.06***
FCF	+	1.3549	3.27***	1.3582	3.28***	0.5001	1.13	0.4891	1.11	1.3276	3.09***	1.3171	3.08***	0.4322	0.68	0.4038	0.64
SIZE	+	0.3469	10.99***	0.3437	10.88***	0.4542	13.76***	0.4511	13.65***	0.2173	7.46***	0.2149	7.37***	0.3364	8.78***	0.3352	8.68***
YEAR		Included		Included		Included		Included		Included		Included		Included		Included	
Pseudo R^2		7.87%		8.23%		12.32%		12.48%		4.15%		4.35%		10.43%		11.34%	
N		1,594		1,594		1,594		1,594		1,594		1,594		1,594		1,594	

Panel B : Observations without CEO duality (n=2,047)

		(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
		Dep. Var. = *INN*		Dep. Var. = *INN*		Dep. Var. = *ININV*		Dep. Var. = *ININV*		Dep. Var. = *INNUM*		Dep. Var. = *INNUM*		Dep. Var. = *INNDES*		Dep. Var. = *INNDES*	
Variables[a]	**Pred. Sign**	**Coef.**	***z*-value**[b]	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**
CONSTANT		-4.8489	-12.67***	-4.8901	-12.74***	-6.3682	-16.28***	-6.3657	-16.26***	-2.6430	-7.89***	-2.6986	-8.03***	-6.9556	-15.01	-7.0898	-15.13***
FAMILY	?	-0.3591	-6.00***	-0.2870	-3.94***	-0.3993	-6.53***	-0.4057	-5.42***	-0.2066	-3.57***	-0.0977	-1.37	0.0429	0.53	0.2249	2.24**
LEVEL	?	0.1832	3.28***	0.3028	3.38***	0.0422	0.74	0.0327	0.38	0.2385	4.41***	0.4018	4.87***	0.1458	1.93*	0.3897	3.60***
FAMILY×LEVEL	?			-0.1985	-1.73*			0.0168	0.15			-0.2880	-2.63***			-0.4572	-3.03***

LOSS	-	-0.1727	-1.66**	-0.1689	-1.62*	-0.0302	-0.28	-0.0304	-0.28	-0.3085	-2.98***	-0.3045	-2.94***	-0.2125	-1.44*	-0.2150	-1.45*
LEV	-	-0.5433	-1.29*	-0.5692	-1.35*	-0.7407	-1.75**	-0.7380	-1.74**	-0.1373	-0.34	-0.1879	-0.47	-0.5736	-1.08	-0.6888	-1.29*
GROWTH	+	-0.1375	-1.12	-0.1479	-1.21	-0.0027	-0.02	-0.0019	-0.02	0.0014	0.01	-0.0123	-0.10	-0.4615	-2.41**	-0.4849	-2.52***
ROA	+	-0.4517	-0.82	-0.4349	-0.79	-0.4291	-0.73	-0.4310	-0.74	-0.9773	-1.77**	-0.9632	-1.75**	-0.7155	-0.88	-0.7564	-0.93
FCF	+	0.2434	0.65	0.2375	0.64	0.4344	1.10	0.4350	1.10	-0.0387	-0.10	-0.0439	-0.12	-1.7098	-3.07***	-1.7382	-3.10***
SIZE	+	0.3461	13.94***	0.3465	13.95***	0.4259	16.85***	0.4260	16.85***	0.1597	7.57***	0.1601	7.59***	0.3660	13.14***	0.3697	13.18***
YEAR		Included		Included		Included		Included		Included		Included		Included		Included	
Pseudo R^2		11.36%		11.47%		16.62%		16.62%		4.08%		4.33%		15.01%		15.64%	
N		2,047		2,047		2,047		2,047		2,047		2,047		2,047		2,047	

[a] The definition of the variables reported in this table are: *FAMILY* = 1 if the firm belongs to family businesses, else 0; *LEVEL* = the number of managers of internal parts (including the internalization of the board, general manager, treasurer of internalization) divided by the number of directors concurrently act as managers; *LOSS* = 1 if operating income is less than zero, else 0; *LEV* = long-term debt divided by total assets; *GROWTH* = percentage growth in sales; *ROA* = equals net income divided by total assets; *FCF* = cash flow from operations minus cash dividends divided by total assets; *SIZE* = equals the natural log of total assets; *YEAR* = dummy variables controlling for years. All continues variables are winsorized at the first and 99th percentiles.

[b] Asterisks*, **, ***indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. One-tailed for directional expectations, and two-tailed for others.

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Table 7 The Innovative Capacity of Family Business and Earnings Management

		(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
Variables[a]	**Pred. Sign**	**Coef.**	***z*-value**[b]	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**
CONSTANT		0.1059	5.98***	0.1022	5.75***	0.1149	6.27***	0.1118	6.09***	0.0945	5.40***	0.0937	5.35***	0.0895	4.97***	0.0895	4.97***
FAMILY	?	0.0043	1.56	0.0131	3.13***	0.0045	1.62	0.0106	2.98***	0.0038	1.37	0.0068	1.93*	0.0035	1.28	0.0035	1.20
INN	+	0.0126	4.31***	0.0211	5.00***												
FAMILY×INN	?			-0.0154	-2.79***												
ININV	+					0.0126	4.05***	0.0204	4.84***								
FAMILY×ININV	?							-0.0154	-2.74***								
INNUM	+									0.0063	2.17**	0.0104	2.50***				
FAMILY×INNUM	?											-0.0078	-1.38				
INNDES	+													-0.0029	-0.61	-0.0031	-0.45
FAMILY×INNDES	?															0.0004	0.05
LOSS	-	0.0027	0.56	0.0025	0.52	0.0022	0.47	0.0023	0.48	0.0028	0.59	0.0028	0.58	0.0025	0.51	0.0025	0.51
LEV	-	-0.0499	-2.70***	-0.0501	-2.71***	-0.0512	-2.77***	-0.0505	-2.73***	-0.0524	-2.83***	-0.0521	-2.81***	-0.0542	-2.92***	-0.0542	-2.92***
GROWTH	-	-0.1307	-23.62***	-0.1302	-23.53***	-0.1310	-23.67***	-0.1304	-23.56***	-0.1306	-23.56***	-0.1304	-23.50***	-0.1308	-23.57***	-0.1308	-23.57***
ROA	+	0.9712	34.04***	0.9708	34.06***	0.9721	34.05***	0.9720	34.07***	0.9680	33.88***	0.9681	33.89***	0.9666	33.79***	0.9666	33.78***
SIZE	-	-0.0076	-6.66***	-0.0077	-6.75***	-0.0080	-6.79***	-0.0080	-6.82***	-0.0065	-5.90***	-0.0066	-5.96***	-0.0060	-5.25***	-0.0060	-5.23***
QUICK	-	-0.0016	-2.08**	-0.0015	-2.05**	-0.0018	-2.41***	-0.0018	-2.43***	-0.0014	-1.86**	-0.0013	-1.79**	-0.0016	-2.10**	-0.0016	-2.10**
OCF	-	-0.2393	-14.85***	-0.2395	-14.88***	-0.2378	-14.77***	-0.2369	-14.73***	-0.2352	-14.60***	-0.2357	-14.63***	-0.2345	-14.55***	-0.2345	-14.54***
YEAR		Included		Included		Included		Included		Included		Included		Included		Included	
Adj R^2		39.08%		39.19%		39.05%		39.15%		38.85%		38.86%		38.78%		38.76%	
N		3,641		3,641		3,641		3,641		3,641		3,641		3,641		3,641	

[a] The definition of the variables reported in this table are: *FAMILY* = 1 if the firm belongs to family businesses, else 0; *INN* = 1 if the firm obtained new patents, else 0; *ININV* = 1 if the firm obtained new invention patents, else 0; *INNUM* = 1 if the firm obtained new utility patents, else 0; *INNDES* = 1 if the firm obtained new design patents, else 0; *LOSS* = 1 if operating income is less than zero, else 0; *LEV* = long-term debt divided by total assets; *GROWTH* = percentage growth in sales; *ROA* = equals net income divided by total assets; *SIZE* = equals the natural log of total assets; *QUICK* = current assets (less inventories) divided by current liabilities; *OCF* = cash flow from operations divided by total assets; *YEAR* = dummy variables controlling for years. All continues variables are winsorized at the first and 99th percentiles.

[b] Asterisks*, **, ***indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. One-tailed for directional expectations, and two-tailed for others.

CEO-duality Effects

As discussed above, FBs are more likely to determine a higher presence of CEO-duality (Corbetta & Salvato, 2004), and CEO-duality role is in spirit similar to strong family leadership power. CEO-duality may remain in its unambiguous leadership as a monitoring role of strengthening decision-making efficiency and supervising performance, thereby reducing the possibility of earnings management. Contrarily, CEO-duality may remain in its predominant leadership as an entrenchment role of selecting self-interested plans and portraying favorable performance, thereby increasing the possibility of earnings management. Thus, CEO-duality leadership seems to play a necessary complement to family involvement, and they should not discussed separately. Next, we took CEO-duality leadership into account to determine whether the innovation outcomes of FBs reflect their earnings management behavior. The results of this investigation are presented in Table 8. In columns (1), (3), (5), and (7) of Panel A and Panel B, the result of coefficients on *FAMILY* and *LEVEL* is similar to those reported in Table 7. We further included the interaction term between *FAMILY* and *INNOVATION* (*INN*, *ININV*, *INNUM*, and *INNDES*) in columns (2), (4), (6), and (8) and found that the coefficients of *FAMILY* × *INN* and *FAMILY* ×*ININV* in Panel A are significantly negative (both at the 1% significance level), whereas all of the coefficients of *FAMILY* ×*INNOVATION* in Panel B are insignificant. We also noted that results in Panel A in Table 8 are similar to those reported in Table 7. These results suggest that CEO-duality is an indication of unambiguous leadership in FBs with good performance in developing invention patents, which promotes effective decision-making, better performance, and reduces the likelihood of engaging in earnings management. Our findings also imply that CEO-duality practices have a positive effect on FBs with valuable innovations and tend to limit earnings management.

Overall, our results suggest that the combined effects of a FB structure and quality innovation helps to mediate opportunistic reporting behavior. Earnings management is also much less frequent among companies with CEO-duality leadership, which implies that FBs' innovative ambitions and duality leadership had greatly advanced in operating performance and corporate governance, and thus restrain managerial self-interested behavior.

4.2.3 Sensitivity Analysis (not tabulated)

We performed four sets of sensitivity analysis to determine the sensitivity of our findings. We first re-ran our analysis using R&D spending as a substitution for *INNOVATION*. Our results indicate that FBs actually invest less in R&D activities (Block, 2012; Gomez-Mejia, Campbell, Martin, & Hoskisson, 2014), and no relation exists among R&D spending, levels of family involvement, and CEO-duality. We also determined that growing FBs with greater involvement in management were more likely to invest in R&D activities, whereas mature FBs were less likely to invest in R&D activities. We also observed that our results were affected by alternative measures of innovation capacity, R&D spending, because R&D investment is highly uncertain and is an innovative input. We used performance-adjusted discretionary accruals as an alternative measure of earnings management by including current ROA in the modified Jones model (Kothari, Leone, & Wasley, 2005; Krishnan, Su, & Zhang, 2011; Trombetta & Imperatore, 2014). We obtained similar results in terms of polarity and significance when we used the alternative measures of earnings management. Changes in the chairman and CEO roles were shown to affect CEO-duality effects and bias empirical findings; therefore, we excluded observations related to changes of chairman and CEO. After re-running the models, our results proved highly robust as long as we excluded firms that changed their chairman or CEO. We excluded observations related to restatements and auditor changes because they were shown to affect measures of earnings management (DeFond & Subramanyam, 1998; Kedia, Koh, & Rajgopal, 2015). Excluding observations with restatements or auditor changes to re-run our analyses, we obtained substantially similar results. Overall, the inference of our results did not change.

Table 8 The Innovative Capacity of Family Business and Earnings Management: Considering the CEO-duality Effect

Panel A : Observations with CEO duality (n=1,594)

		(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
		Dep. Var. = *INN*		Dep. Var. = *INN*		Dep. Var. = *ININV*		Dep. Var. = *ININV*		Dep. Var. = *INNUM*		Dep. Var. = *INNUM*		Dep. Var. = *INNDES*		Dep. Var. = *INNDES*	
Variables[a]	**Pred. Sign**	**Coef.**	***z*-value**[b]	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**	**Coef.**	***z*-value**
CONSTANT		0.1708	6.04***	0.1645	5.81***	0.1823	6.25***	0.1760	6.03***	0.1596	5.68***	0.1588	5.65***	0.1526	5.35***	0.1528	5.35***
FAMILY	?	0.0044	1.11	0.0174	3.01***	0.0047	1.19	0.0134	2.69***	0.0044	1.10	0.0082	1.65*	0.0045	1.13	0.0047	1.13
INN	+	0.0126	3.02***	0.0257	4.32***												
FAMILY×INN	?			-0.0244	-3.08***												
ININV	+					0.0136	3.04***	0.0259	4.20***								
FAMILY×ININV	?							-0.0238	-2.89***								
INNUM	+									0.0051	1.20	0.0108	1.76*				
FAMILY×INNUM	?											-0.0107	-1.29				
INNDES	+													-0.0049	-0.71	-0.0035	-0.32
FAMILY×INNDES	?															-0.0023	-0.17
LOSS	-	-0.0101	-1.50*	-0.0103	-1.54*	-0.0103	-1.54*	-0.0100	-1.49*	-0.0096	-1.42*	-0.0097	-1.44*	-0.0096	-1.42*	-0.0096	-1.42*
LEV	-	-0.0381	-1.47*	-0.0432	-1.67**	-0.0411	-1.59*	-0.0435	-1.68**	-0.0430	-1.66**	-0.0439	-1.69**	-0.0452	-1.74**	-0.0452	-1.74**
GROWTH	-	-0.1170	-15.50***	-0.1164	-15.46***	-0.1169	-15.48***	-0.1166	-15.48***	-0.1168	-15.44***	-0.1163	-15.36***	-0.1166	-15.40***	-0.1166	-15.39***
ROA	+	0.8616	21.27***	0.8596	21.28***	0.8626	21.29***	0.8634	21.36***	0.8581	21.14***	0.8564	21.09***	0.8560	21.04***	0.8561	21.03***
SIZE	-	-0.0116	-6.30***	-0.0116	-6.33***	-0.0122	-6.42***	-0.0121	-6.37***	-0.0105	-5.82***	-0.0106	-5.87***	-0.0099	-5.39***	-0.0099	-5.39***
QUICK	-	-0.0011	-1.12	-0.0011	-1.14	-0.0014	-1.42*	-0.0015	-1.46*	-0.0012	-1.15	-0.0011	-1.11	-0.0013	-1.32*	-0.0013	-1.32*
OCF	-	-0.2038	-8.88***	-0.2046	-8.93***	-0.2003	-8.77***	-0.2012	-8.82***	-0.1977	-8.63***	-0.1981	-8.65***	-0.1956	-8.55***	-0.1956	-8.55***
YEAR		Included		Included		Included		Included		Included		Included		Included		Included	
Adj R^2		39.40%		39.72%		39.40%		39.68%		39.10%		39.13%		39.07%		39.03%	
N		1,594		1,594		1,594		1,594		1,594		1,594		1,594		1,594	

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Panel B : Observations without CEO duality (n=2,047)

		(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
		Dep. Var. = *INN*		Dep. Var. = *INN*		Dep. Var. = *ININV*		Dep. Var. = *ININV*		Dep. Var. = *INNUM*		Dep. Var. = *INNUM*		Dep. Var. = *INNDES*		Dep. Var. = *INNDES*	
Variables[a]	Pred. Sign	Coef.	*z*-value[b]	Coef.	*z*-value	Coef.	*z*-value	Coef.	*z*-value	Coef.	*z*-value	Coef.	*z*-value	Coef.	*z*-value	Coef.	*z*-value
CONSTANT		0.0750	3.19***	0.0730	3.09***	0.0831	3.42***	0.0816	3.35***	0.0630	2.72***	0.0622	2.69***	0.0578	2.41**	0.0575	2.40**
FAMILY	?	0.0042	1.08	0.0087	1.45	0.0042	1.08	0.0073	1.45	0.0033	0.87	0.0058	1.18	0.0028	0.73	0.0024	0.60
INN	+	0.0127	3.11***	0.0170	2.85***												
FAMILY×INN	?			-0.0076	-0.98												
ININV	+					0.0122	2.84***	0.0159	2.75***								
FAMILY×ININV	?							-0.0074	-0.96								
INNUM	+									0.0074	1.87**	0.0106	1.88**				
FAMILY×INNUM	?											-0.0062	-0.79				
INNDES	+													-0.0035	-0.56	-0.0052	-0.58
FAMILY×INNDES	?															0.0032	0.27
LOSS	-	0.0125	1.86**	0.0124	1.84**	0.0119	1.77**	0.0119	1.76**	0.0124	1.83**	0.0123	1.82**	0.0115	1.70**	0.0115	1.70**
LEV	-	-0.0595	-2.27**	-0.0584	-2.22**	-0.0591	-2.25**	-0.0579	-2.20**	-0.0560	-2.28**	-0.0592	-2.25**	-0.0615	-2.34***	-0.0617	-2.34***
GROWTH	-	-0.1433	-17.87***	-0.1429	-17.81***	-0.1440	-17.95***	-0.1435	-17.85***	-0.1433	-17.85***	-0.1431	-17.82***	-0.1437	-17.87***	-0.1437	-17.86***
ROA	+	1.0646	26.71***	1.0648	26.71***	1.0659	26.71***	1.0656	26.70***	1.0617	26.61***	1.0627	26.62***	1.0602	26.55***	1.0601	26.54***
SIZE	-	-0.0057	-3.87***	-0.0058	-3.91***	-0.0061	-3.95***	-0.0062	-3.97***	-0.0047	-3.28***	-0.0047	-3.31***	-0.0041	-2.73***	-0.0040	-2.70***
QUICK	-	-0.0022	-1.97**	-0.0022	-1.94*	-0.0024	-2.14**	-0.0024	-2.14**	-0.0018	-1.65**	-0.0018	-1.60*	-0.0020	-1.81**	-0.0020	-1.82**
OCF	-	-0.2718	-12.04***	-0.2718	-12.04***	-0.2721	-12.04***	-0.2711	-11.99***	-0.2691	-11.91***	-0.2697	-11.93***	-0.2702	-11.92***	-0.2703	-11.92***
YEAR		Included		Included		Included		Included		Included		Included		Included		Included	
Adj R^2		39.14%		39.14%		39.09%		39.09%		38.96%		38.95%		38.86%		38.83%	
N		2,047		2,047		2,047		2,047		2,047		2,047		2,047		2,047	

[a] The definition of the variables reported in this table are: *FAMILY* = 1 if the firm belongs to family businesses, else 0; *INN* = 1 if the firm obtained new patents, else 0; *ININV* = 1 if the firm obtained new invention patents, else 0; *INNUM* = 1 if the firm obtained new utility patents, else 0; *INNDES* = 1 if the firm obtained new design patents, else 0; *LOSS* = 1 if operating income is less than zero, else 0; *LEV* = long-term debt divided by total assets; *GROWTH* = percentage growth in sales; *ROA* = equals net income divided by total assets; *SIZE* = equals the natural log of total assets; *QUICK* = current assets (less inventories) divided by current liabilities; *OCF* = cash flow from operations divided by total assets; *YEAR* = dummy variables controlling for years. All continues variables are winsorized at the first and 99th percentiles.

[b] Asterisks*, **, ***indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. One-tailed for directional expectations, and two-tailed for others.

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5. Conclusions

This study extended research into the issue of FBs by investigating innovation capacity and earnings management. We adopted the electronics industry in Taiwan (between 2010 and 2015) as a research sample to determine (1) whether family effects influence innovation performance at the firm level; (2) whether the innovation performance of FBs is an indication of earnings management behavior; and (3) the effects of family involvement and CEO-duality in FBs.

We found that FBs play a significant role in encouraging innovation-related decisions; however, this is the case only when family assumes a greater role in management. We determined that in cases of CEO-duality status, firms are more likely to invest in innovation-related activities. We also found that FBs with quality innovative patents and CEO-duality leadership are less likely to be involved in earnings management. We determined that growing FBs with strong family involvement in management are more likely to invest in valuable innovations. Mature and declining FBs with quality innovations proved less likely to engage in earnings management. This series of sensitivity analyses proved the robustness of our results.

This study had a number of limitations. First is the measure of innovative capacity. There are a number of ways of measuring innovation (Cooper, Knott, & Yang, 2015), and we posit that patents are superior to R&D investment when investigating innovation capacity. Second, our results may have been affected by other determinants of innovation capacity, despite the fact that we adopted several control variables, such as financial characteristics (Cornaggia et al., 2015; Fang et al., 2014; He & Tian, 2013; Hirshleifer et al., 2012; Jouber, 2013; Merkley, 2014; Tian & Wang, 2014), which may be correlated with innovation outcomes. Third, we used discretionary accruals as a proxy for earnings management; however, this does not necessarily reflect actual practices of earnings management. Although such proxies have been consistently used in previous research (Brousseau & Gu, 2013; Dechow et al., 1995; Dechow et al., 2010; Ogneva, 2012; Perotti & Wagenhofer, 2014), may provide rich insights into earnings management behavior. Despite the noted limitations, our evidence clearly suggests the following: (1) FBs with strong family involvement in management and CEO-duality leadership tend to have higher innovation capacity; and (2) FBs with quality innovation capacity are less likely to engage in earnings management.

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Sustainability of Current Account Deficit in Turkey

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ABSTRACT

Purpose:
This study aims to examine the sustainability of the current account deficit in Turkey for the quarterly data between 2003 and 2018. Besides, some policy implications are made to ensure the sustainability of the current account deficit in Turkey's economy.

Design/methodology/approach:
The dynamics related to the sustainability of the current account deficit is analysed within the framework of the "intertemporal budget constraint approach" developed by Husted (1992). The long-term dynamics are empirically investigated using the Johansen cointegration test. Econometric analysis is also expanded within the framework of the Vector Error Model to reveal the short-term dynamics.

Findings:
The results of Johansen cointegration analysis suggest that current account income and expenses are integrated with the cointegrating coefficient less than 1, implying that Turkey has a weak form of current account deficit sustainability. Findings of the Vector Error Correction model confirm the results of long-run analysis and indicates that the deviations from the long-term equilibrium are corrected at a rate of 78% every quarter term.

Research limitations/implications:
The "intertemporal budget constraint approach" developed by Husted (1992) focuses on the equilibrium between current account income and expenses to analyse the sustainability of the foreign balance. However, the sustainability of the foreign deficit is also closely related to what kind of capital inflows is used to finance the foreign deficit. Therefore, the implications made regarding the sustainability of the current account deficit in Turkey based on the Husted model should be accepted with some reservations.

Originality/value:
Since external imbalances are a key challenge for most of the developing countries to provide full integration into the world economy, many empirical studies are examining the current account sustainability. The majority of these studies focus on the long-run dynamics of the current account imbalances. Unlike most of the previous studies, this paper also focuses on the short-run dynamics of the current account balance. Thus, the difference of this study from other studies stems from the examination of the dynamics of current account sustainability not only in the long term but also in the short term.

1. Introduction

Developing countries cannot sustain a satisfactory growth rate for a long time as they experience important problems in their economic structures that negatively affect their production processes. Thus, it is observed that the growth processes in developing countries are interrupted from time to time by crises. One of the most important problems preventing the achievement of sustainable growth rates arises from the imbalances in the current account. Accordingly, the risks resulting from the growth of current account deficits cause economic development processes to be cut by the crises. Thus, deficits in the current account prevent developing countries from achieving sustainable growth rates. Therefore, it is vital for policymakers in developing countries to observe and effectively analyse the dynamics that guide the current account (Senadza and Aloryito, 2016; 55-56).

Being open to international trade allows a country's total consumption to be higher than its production. Of course, if the country does not have sufficient production capacity, the number of goods and services available cannot meet the total consumption. However, some part of the goods and services needed can be provided by importing them from

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abroad. In this case, because of the increasing import demand of the country, trade deficits occur in the current account balance. At this point, foreign funds should be withdrawn from abroad to finance the current account deficit. In other words, deficits caused by the increase in imports in the current account can be financed by capital inflows in the financing account, that is, foreign borrowing. That means the current account deficit leads to significant increases in the country's external debt burden. Therefore, the increase in the current account deficit causes various risks to emerging due to the increase in the external debt burden. So much so that these risks can reach a level that will cause foreign capital inflows to stop and exit after a while. From this point on, the developing country cannot finance its current account deficit and faces an economic crisis.

As can be understood from the explanations above, having a sustainable current account deficit for the developing countries is one of the basic conditions for ensuring macroeconomic stability. Hence, this study aims to analyse the sustainability of the current account deficit in Turkey for the period between 2003 and 2018. The dynamics related to the sustainability of the current account deficit is analysed within the framework of the "intertemporal budget constraint approach" developed by Husted (1992). Johansen cointegration test and Error Correction Model as the econometric methods are used. In the first part of the study, the theoretical framework of the research has been determined. In the second part, empirical studies conducted on the subject in the literature are reviewed. In the third section, information about the data set, method, and econometric results are given. In the last part, some policy implications are made to ensure the sustainability of the current account deficit in Turkey's economy.

2. Theoretical Framework

The current account deficit mainly stems from the fact that more imports are made in foreign trade than exports. The reason for such a deficit is the deficiencies in the production capacity due to structural problems in the economy. In this way, countries that have various structural problems in the production process may consume more than they produce by giving a current deficit. Since the current account deficits are generally financed by debt-generating capital movements, the foreign debt stock also increases during the current account deficit in these countries. For this reason, in the long run, it is not possible to consume more than it produces. Thus, developing countries must eliminate the deficiencies in production capacity by solving their structural problems in the long term, even if they have current account deficits in the short term. That means the sustainability of deficits in the current account depends on resolving structural problems in production capacity. Foreign funds used to finance current deficits can be paid back if only these funds are used to increase the country's production capacity and foreign exchange revenues. Therefore, there is a significant relationship between the sustainability of the current account deficit and the development of production capacity in the export sector in the long-run. In other words, the sustainability of the current account deficit is possible if foreign debt can be paid back by gaining export revenues (Milesi-Ferretti and Razin, 1996: 2).

Developing countries do not have financial funds enough to finance their investments due to insufficient capital accumulation for historical reasons. Besides, developing countries do not have the technological infrastructure to produce intermediate and capital goods used in the production process (Yalçınkaya & Temelli, 2014: 205, Insel & Kayıkçı, 2012: 46). Thus, the production structures of developing countries are insufficient. For this reason, they can solve the difficulties in the production process only by importing intermediate and capital goods from abroad. In this case, even if they give a current account deficit in the short term, they have the chance to improve the country's production structure and increase their export capacity by gaining international competitive advantage. For this, the current account deficit must be given by importing capital and intermediate goods, which enables the country to increase its export-based production capacity in the long term. In this context, the main criterion regarding the sustainability of the current account deficit depends on the condition that foreign resources obtained from abroad used in export-based production and hence paid back through export income.

In parallel with the above-mentioned views, Husted (1992) developed the "intertemporal budget constraint approach" and thus modeled the sustainability condition of the current account deficit in the context of developments in the country's ability to pay the debt over time. Thus, the sustainability of the current account deficit is determined depending on the capacity of the economy fulfilling its external financial liabilities. Accordingly, the main criterion regarding the sustainability of the current account deficit has been handled within the framework of the long-term relationship between import expenditures and export revenues. In this way, it is checked whether there is long-term equality between the foreign exchange expenses of the country and foreign exchange revenues. It is concluded that the current account deficit cannot be sustained if foreign exchange revenues through export cannot meet a significant portion of the foreign exchange expenditures incurred by import.

The criterion proposed by Husted (1992) regarding the sustainability of the current account deficit can be determined by testing the cointegrated relationship between imports and exports as an econometric method. Here, the relationship between export revenues and import expenses is analysed using various cointegration tests. When there is a cointegrated relationship between the two variables, it can be determined that the intertemporal budget constraint is met, thus the current account deficit is sustainable (Wu et al. 2001: 220-222). However, if there is no co-integrated relationship between export revenues and import expenditures, it is concluded that the current account deficit is unsustainable since the intertemporal budget constraint cannot be met and this country will not repay its debt. In short, this model shows that the sustainability of the current account deficit for a long time depends on increasing foreign currency revenues.

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The model developed by Husted (1992) can be explained with the help of Equality-1 shown below. Here, C_O represents current consumption, Y_O production, B_O external borrowing, I_O investment, r_O world interest rate, $(1 + r_O)$ B-1 represents the debt burden of the previous period.

$$C_O = Y_O + B_O - I_O - (1 + r_O)\, B\text{-}1 \quad (1)$$

After some assumptions, the above budget constraint equality is turned into a model that allows analysing the sustainability constraint of the current account, shown in Equation 2 below. Here, the revenues of exports of goods and services obtained in a certain period with EX are shown. The IM symbolizes the sum of import expenditures and net interest and transfer expenses.

$$EX = \alpha + \beta\, IM + \varepsilon \quad (2)$$

Within the framework of the equation stated above, the sustainability of the current account deficit is analysed within the framework of the condition that the co-integration relationship exists between the EX and IM series and that the co-integration coefficient is equal to one. Accordingly, firstly, the existence of the co-integration relationship between EX and IM series should be tested. Then, the sustainability of the current account deficit may be interpreted in terms of the value of cointegration coefficient. Sustainability of current account deficit is evaluated in the strong form when the co-integration coefficient is equal to one and in the weak form when it is between zero and one (Husted, 1992: 161; Quintos, 1995: 409-411, Baharumshah et al. 2003: 473).

3. Review of Literature

It is seen that many different methods are used in studies on the sustainability of the current account deficit in the literature. However, we can group the methods used in these studies under two groups. Accordingly, a group of economists go beyond the items in the current account and examine the sustainability conditions of the deficits from the different aspects. In this context, indicators such as economic growth rate, investment saving rate, the ratio of external debts to national income, and the ratio of reserves to debt stock are included in the analysis. Besides, some structural features that determine the import dependency of exports in the production process are used in the sustainability analysis of the current account deficit. On the other hand, the economists in the second group investigate the sustainability of current deficits directly based on the items in the current account (Duman, 2018: 127: Ayla and Küçükkale, 2018: 56). Within the framework of the "intertemporal budget constraint approach", sustainability is examined focusing on the existence of a long-term relationship between export revenues and import expenses In our study, this approach developed by Husted (1992) regarding the sustainability of the current account deficit was used. Therefore, studies analysing the existence of the co-integration relationship between export and import variables will be reviewed in the literature section.

Regarding studies analysing individual country experiences, Heidari et al (2012) analyzed the sustainability of the current account in the Iranian economy in the framework of the long-run relationship between exports and imports. By employing the bounds testing approach to data over the sample period 1960–2007, the study reveals that there is a long-run equilibrium relationship between imports and exports over the sample period. This finding suggests that current account deficits in Iran are sustainable. Destaings et al. (2013) examined the sustainability of the current account deficits in Kenya employing the Johansen cointegration test for the data between 1970 and 2012. Empirical findings assert that exports and imports are cointegrated. However, since the cointegration coefficient is not equal to one, the paper concludes that the current account deficit of Kenya is not sustainable in the long-run. Therefore, policy measures to correct unsustainable external imbalances are urgently needed. Asmarani (2015) tests whether the current account deficit is persistent and sustainable in Indonesia using the Autoregressive Distributed Lag (ARDL) approach for the period of 2011-2014. Empirical results show that Indonesia has an unsustainable condition in the current account deficit. Thus, findings call the government to optimize the policy on supporting the export performance. Shuaibu and Oyinlola (2017) examined the sustainability of the current account in Nigeria using time-series analysis including the causality tests of the Toda-Yamamoto modified Wald, Engle-Granger, and Gregory Hansen. Findings suggest that there is current account sustainability in Nigeria, which means that exports could finance imports.

In the literature, some studies have examined the sustainability of the current account deficit based on multi-country experiences. For example, Holmes (2006) used the intertemporal budget constraint model for the sustainability of the current account deficit in Latin American countries. Using the annual data between 1979 and 2001, panel unit root and co-integration techniques are used in the study. According to the findings, the current account deficits of 14 countries, except Brazil and Colombia, from 16 Latin American countries were sustainable. Konya (2009) conducted a study on the sustainability of the current account in three Central European countries, the Czech Republic, Hungary, and Slovenia, during the 1990-2005 timeframe. Cointegration tests showed that the Czech Republic and Slovenia are not in violation of their intertemporal budget constraint and their trade imbalances are sustainable. However, the cointegration relationship between exports and imports is not so strong in Hungary. Sissoko and Jozefowicz (2016) examined the current account sustainability of five countries in Southeast Asian country including Indonesia, Malaysia, The Philippines, Singapore, and Thailand. The paper uses cointegration econometric methodology to test for a relation between exports and imports of the current account based on the data between 1960 and 2014. Empirical results show that Malaysia and Thailand have sustainable current account balances while the current account positions for Singapore, Indonesia, and the Philippines are problematic. Thus, exchange rate adjustments and macroeconomic policy reforms may be necessary to reduce vulnerabilities in external positions for these countries. Finally, Öztürk ve Çoltu (2018) examined the sustainability of the current deficit in fifteen selected OECD countries between 1995 and 2015 by Pesaran CADF unit root and Westerlund ve Edgerton panel cointegration analysis. Empirical findings revealed that the ratio of countries' exports to imports in the long term is

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sustainable in the long term for the 15 countries examined. Considering the short-term parameters, it is concluded that the import coverage ratio for all countries is sustainable in a weak form.

Regarding work done on the sustainability of the current account deficit in Turkey, it is generally determined that a wide variety of cointegration tests is used. In this way, the majority of studies into different periods have demonstrated that the sustainability of the current account deficit is a weak form in Turkey. For example, Yanar and Yücel (2005), has examined the sustainability of Turkey's current account deficit using the intertemporal budget constraint point of view. The study analysed the relationship between annual export income and import expenses for the period 1964-2003 employing the Engle-Granger two-stage cointegration test. According to empirical findings, there is no long-term relationship between imports and export in the period studied. Kalyoncu (2005) examined the sustainability of Turkey's current account deficit, using the approach intertemporal budget constraint for the period between 1987 and 2002. In this framework, long-term interaction between exports and imports, net transfer payments, and net interest payments have been estimated by the Johansen cointegration test. Findings revealed the existence of a long-term balance between the current account income and expenses series. Besides, the cointegration coefficient value was found to be very close to, which indicates that the current account deficits are sustainable in the long term. In another study, Korkmaz (2007) carried out examining the sustainability of Turkey's current account deficit. In this study, the sustainability of the current account deficit was analysed for the period 2001-2005 based on the inter-period budget constraint principle. The findings show that the current account deficit in Turkey's economy is sustainable in a weak form. This result means that the export revenues covered only a certain part of the import expenses in the period examined. Berke (2009) analysed whether the current account deficit is sustainable for Turkey between 1989 and 2006. The results of the classical Engle-Granger cointegration test showed that the current deficits are unsustainable. On the other hand, the findings obtained from the piecewise cointegration method determined that the export and import series returned to their averages in the long run. Peker (2009) analysed the sustainability of the current account deficit using the Johansen cointegration test for monthly data from 1992 to 2007. Although there is a long-term relationship between the export and import series, the co-integration coefficient was calculated as 0.89. Accordingly, it does not meet all of its foreign exchange earnings from foreign exchange expenditures in Turkey. That means the cointegration coefficient value is smaller than 1, which indicates that the current account deficit in Turkey has a weak sustainable form.

As apparent from the studies described above, the sustainability of the current account deficit generally is founded to be at a weak form in Turkey. Similar conclusions are also indicated in researches conducted over the past decade. For example, Ümit (2011) examined the sustainability of the current account deficit using monthly data from 1992 to 2010 and revealed the low level of sustainable current account deficit. However, the import coefficient obtained from the cointegration equation has a value of less than one. In this case, to maintain Turkey's current account deficit a stronger form, priority should be given to policies to increase foreign exchange earnings. Using the inter-period budget constraint model, Ceylan and Çevis (2012) analysed the validity of the current account model before and after 2001, when the inflation-targeting regime was introduced. Accordingly, the relationships between the export revenues and import expenses of the 1987-2001 and 2002-2012 sub-periods were analysed by unit root tests based on the non-linear time series method. Findings obtained in the study determined that cointegration was valid between export revenues and import expenses in the pre-inflation-targeting regime from 1987 to 2000. However, there was no cointegration relationship between current account income and expense in the period of 2002-2012. Thus, the current account deficit in Turkey has proved to have an unsustainable form for the period after the inflation-targeting regime. Altunöz (2014) tested whether the current account deficit was sustainable using the Johansen cointegration test for the period 1994-2013. Findings revealed that there is a long-term relationship between the series. However, the long-term coefficients of the cointegration equation showed that the current account deficit is sustainable in a weak form.

More recently, Koç and Bakırtaş (2016) analysed the sustainability of the current account deficit using the Engle-Granger, Johansen, and ARDL - Boundary Test methods, using quarterly data from 1992 to 2015. Empirical findings have shown that the current account deficit is sustainable in a weak form, although it confirms the cointegration relationship between export revenues and import expenses. Accordingly, it has been emphasized that we should focus on longer-term reformist policies that would transform the economic structure rather than short-term policies. Turan and Barak (2016) investigated whether the current account deficit is sustainable in Turkey between the years 1987-2014. Engle-Granger Cointegration test was used as the econometric method. According to the results obtained, it has been observed that there is a long-term relationship between export and import variables to demonstrate the sustainability of the current account deficit. Besides, in the findings related to the Granger causality test, it was determined that export was the cause of imports. On the other hand, it has been proposed to increase the exchange rate by reducing interest rates. Because the high exchange rate will serve to close the current account deficit by causing the prices of goods in the country to decrease and hence increase export. Finally, Yalçınkaya et al. (2018) level of sustainability of the current account deficit in Turkey's economy, using quarterly data between 1984 and 2017, were analysed. Generalized Method of Moments was applied as an empirical method. The results of the study showed that the current account deficit was strong in the period 1984-2001 and weakly in the periods 1984-2017. It was also pointed out that policy measures to decrease import expenses and increase export revenues should be developed and implemented to increase the sustainability of the current account deficit.

4. Data, Methodology and Empirical Results

In this section, the sustainability of the current account deficit in Turkey will be empirically analysed according to the principles of the intertemporal budget constraint developed by Husted (1992). In this framework, the relationship

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between current account income and expenses will be tested in the short and long run separately. The current account income series (EX) consists of the gains from the exports of goods and services. The current account expense series (IM) consists of goods and services import expenses and net interest and transfer payment expenses. All quarterly data between 2003 and 2018 are obtained from the International Monetary Fund (IMF) data system. Within the framework of econometric analysis, firstly, some unit root tests are applied to time series. Unit root analysis of variables was performed using HEGY (Hylleberg, Engle, Granger and Yoo) and Zivot-Andrews tests developed by Hylleberg et al. (1990) Zivot and Andrews (1992), respectively. Later, long-term relationships between variables were investigated within the framework of the cointegration test developed by Johansen (1991 and 1995). Finally, with the help of the Error Correction Model, the coefficients of short-term relationships are estimated.

4.1 Unit Root Tests

In order to detect the presence of seasonal unit roots on the variables, we conducted the popular approach developed by Hylleberg, Engle, Granger and Yoo (1990) called HEGY unit root testing procedure. Hylleberg et al. (1990) investigate the existence of seasonal and non-seasonal unit roots in a time series using three null hypotheses and alternatives, which are presented below:

$H_0: \pi_1 = 0, H_1: \pi_1 < 0;$ $H_0: \pi_2 = 0, H_1: \pi_2 < 0;$ $H_0: \pi_3 = \pi_4 = 0, H_1: \pi_3 = 0$ and/or $\pi_4 = 0$

Failure to reject the first hypothesis tested with the t-test indicates the presence of a non-seasonal unit root at zero frequency. Failure to reject the second hypothesis, which was also tested with the t-test, indicates the existence of a seasonal unit root at a six-month frequency. Finally, the failure to reject the third hypothesis tested with the help of the F-test also indicates the presence of the seasonal unit root at the annual frequency.

The results of the HEGY unit root test results in Table 1 show that EX and IM series only have a zero-frequency unit root. In other words, export and import series have only non-seasonal unit-roots. Thus, the existence of seasonal unit root was denied for the variables in the model. That means they did not contain seasonal components, which displayed stochastic appearance.

Table 1. Results of the HEGY Unit Root Test

Variable	$t(\pi_1)$	$t(\pi_2)$	$F(\pi_3, \pi_4)$	Decision
EX	-1,23	-4,32*	-4,10**	I (1, 0, 0)
IM	-1,87	-2,13**	-3,85**	I (1, 0, 0)

Note: *, ** indicates the significance level at 1% and 5%, respectively. The critical values for t and F test sourced by Hylleberg et al. (1990).

In time series applications, if a standard unit root test is applied in case of a break in the series used, unreliable test results can be obtained. In order to obtain more realistic results from unit root tests, Zivot and Andrews (1992) developed unit root test that take into account the breaks in the time series. In this study, the unit root test, which takes into account the structural break, is also included in the study. Tablo-2 shows the results of Zivot and Andrews Unit Root Test. As can be seen in Table 2, both EX and IM variables are stationary at the first differences according to the results of unit root tests performed in different structural breaks and quarters. In other words, the results of Zivot-Andrews unit root test, which takes into account the structural breaks, indicate that EX and IM are stationary at I(1). In this way, since the variables are equally stable, it is possible to apply the Johansen Cointegration Test in the analysis of the cointegration relationship between them.

Table 2. Results of Zivot-Andrews Unit Root Test

			Breakpoint	t-statistics	Decision
EX	Level	Intercept	2008 Q3	-2.0762	I(1)
		Intercept+trend	2016 Q1	-3.7281	
	1.differenece	Intercept	2014 Q2	-8.2615*	
		Intercept+trend	2014 Q2	-9.2171*	
IM	Level	Intercept	2008 Q4	-3.7615	I(1)
		Intercept+trend	2012 Q1	-4.9817	
	1.differenece	Intercept	2009 Q1	-10.8271*	
		Intercept+trend	2009 Q1	-10.7615*	

Note: * indicates that the variables are stationary at 1% significance level. Lag lengths of Zivot-Andrews structural break unit root test (max lag = 10) were automatically selected according to the SIC.

4.2 Johansen Cointegration Test

The long-term interaction between current account income (EX) and expenses (IM) is investigated using the Johansen cointegration test and the results are presented in Table-3. Both trace and maximum eigenvalue statistics in the second row of the table were higher than the critical values at a 5% significance level. Thus, the null hypothesis ($\tau = 0$), which claims that there is no cointegration relationship between the series, is rejected and an alternative hypothesis ($\tau = 1$) that assumes that there is a cointegrated relationship is accepted. Accordingly, the income and expense series of the current account are co-integrated. Therefore, our quarterly data from 2003 to 2018 appear to

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support the proposition that in Turkey there exists a stable long-run relationship between export and import plus net transfer payments and net interest payments.

Table 3. Results of Johansen Cointegration Test

Hypothesis	Trace Statistic	Critical Value (% 5)	Maximum Eigenvalue	Critical Value (% 5)
H0: $\tau = 0$, H1: $\tau = 1$	25.3672	20.2618	22.4267	15.8921
H0: $\tau \leq 1$, H1: $\tau = 2$	3.7612	9.1645	3.7612	9.1645

Note: Lag order is determined as 6 using SIC'a (Schwarz Information Criterion).

The results of the cointegration analysis show that the income and expense series of the current account are co-integrated in the long term. Thus, in the relevant period, the current account deficit in Turkey regardless of whether weak or strong can be said to be sustainable. To decide whether sustainability is weak or strong, it is necessary to look at the long-term coefficients of the cointegrating vector. For the current account deficit to be strongly sustainable, the estimated value of the cointegration vector coefficient must be equal to 1. The estimation results of the long-term cointegration equation are presented in Table-4. It is seen that the coefficient value of the current account expense (IM) is positive. However, the fact that the coefficient value (0.74) is less than 1 indicates the sustainability of the current deficit only in weak form. Therefore, empirical evidence reveals that the current account deficit can be sustained in the examined period in Turkey, but weak form.

Table 4. Results of Long Run Estimation

Variable	Coefficient	Probability
C	3.87**	0.0370
IM	0,74*	0.0014

Note. * and ** show the critical values at the significance levels %1 and %5, respectively.

4.3 Estimation of Error Correction Model

After determining the long-term relationship between the current account income and expenses, our analysis has been expanded within the framework of the Error Correction Model to reveal the short-term dynamics of the interactions among the variables. Accordingly, using the Error Correction Model, the deviations of the co-integrated series from the equilibrium relation are determined over time. The equation for the Error Correction Model used is expressed in Equation-3 below.

$$\Delta EX_t = \mu + \sum_{i=1}^{n} \theta_i \, IM_{t-1} + \sum_{i=0}^{n} \alpha_i \Delta EX_{t-1} + \Upsilon \, ECT_{t-1} + \varepsilon_t \quad (3)$$

Here, a coefficient of error correction term (ECT) is expected to be negative and statistically significant. This finding confirms that the variables will move towards the long-term equilibrium value. The magnitude of the ECT coefficient is an indicator of the speed of convergence towards the long-term equilibrium value. In other words, short-term deviations from the equilibrium state return to the long-term equilibrium at the speed determined by the magnitude of the coefficient of the ECT parameter. The estimation results of the Error Correction Model are presented in Table-5. Accordingly, the coefficient of ECT is found to be negative and statistically significant. Thus, it was determined that the EX and IM series converged towards equilibrium in the long term even if they moved away from the balance levels in the short term. The coefficient of ECT showing the convergence rate for each period is 78%. That means 0,78 of the difference between the observed value and equilibrium value in the model disappears every quarter term. In other words, when a deviation occurs in the long-term equilibrium, this deviation is corrected at a rate of 78% every quarter term. On the other hand, as expected, coefficients of the first, second, and third terms lagged variables of current account expense (IM) reveal that they have a positive effect on the current account income (EX). These findings also indicated that the long-run analysis obtained is reliable. Concerning with the diagnostic tests, R^2 value (0.78) determines that the model in Equation-3 is sufficiently large to explain the relationship under consideration. Besides, Breusch-Godfrey LM test results show that there is no autocorrelation in the model and the White test does not have a variance problem.

Table 5. Estimation Results of Error Correction Model

Variable	Coefficient	Probability
C	9.6782	0.0411**
ΔIM t-1	0.68	0.0000 *
ΔIM t-2	0.47	0.0113 **
ΔIM t-3	0.51	0.0217 **
ECT t-1	-0.78	0.0002 *
Adj R2	0.82	

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Breusch-Godfrey LM	2,0812	0,1891
White Test	0.531	0.1427

Note. * and ** show the critical values at the significance levels %1, and %5, respectively.

5. Conclusion

Sustainability of the current account deficit is of great importance in terms of sustaining economic growth for developing countries. In this respect, the sustainability of the current account deficit is considered an important matter that should be managed for policymakers. Accordingly, this study aims to investigate the dynamics of the current account deficit in Turkey by using "the intertemporal budget constraint approach" developed by Husted (1922). For this aim, quarterly data between 2003 and 2018 were empirically examined within the framework of the Johansen cointegration test and Error Correction Model. Empirical findings have revealed that there is a cointegration relationship between current account incomes and expenses. However, since the cointegration coefficient is smaller than 1, the current account deficit is sustainable in a weak form which means that intertemporal budget constraint is partially provided. The result of the Error Correction Model shows that the deviations from the long-term equilibrium are corrected at a rate of 78% every quarter term.

Overall, according to the "intertemporal budget constraint approach" developed by Husted (1992), the current account deficit in Turkey is sustainable in the weak form for the period of 2003-2018. The policy implication of the finding of the violation of the powerful sustainability for current account balance implies that foreign deficit may trigger a financial crisis in the long run. Therefore, the policymakers in Turkey should implement some measures to increase current account income while decreasing expenses. Accordingly, priority is given to policies that reduce import expenses on the one hand and increase export revenues on the other. Production structures in developing countries like Turkey are mostly dependent on imports in the raw materials and intermediate goods, which often cause the current account deficit problem. In this context, the most effective solution is of course to apply some structural reforms that can save domestic production from import dependency. Thus, the import-dependent production structure in Turkey should be a delicate matter to provide the sustainability of the current account balance.

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Regional Economics in Greece: A Spatial Analysis of Business and Population Dynamics

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ABSTRACT

Purpose:
The economic crisis has led to a series of transformations of the economic and population base of the contemporary spatial units. The present study aims to highlight the indirect impact of the economic crisis on the operation and spatial footprint of the business network in a region with a slight decrease in its population dynamics in the decade 2001-2011.

Design/methodology/approach:
The methodological approach focuses (i) on the spatial and intertemporal observation of the change in the spatial footprint of the businesses and population of Greek Regional Units and (ii) in the identification of spatial clusters with similar behavior of business establishments or deletions (hot-cold spots). For the delineation of the profile of the spatial units, business demography indicators were created, while the analysis was based on spatial statistics methods and spatial autocorrelation indicators, such as the Global and local Moran's I. The panel data used for the present study relate to the establishment and deletions of businesses' during the period 2008-2018 as well as the population Censuses 2001-2011.

Findings:
It is evident that the crisis left its footprint in the Greek periphery. Examining the business network of two Greek Regional Units it is shown that during the crisis period a significant part of the businesses opened ceased in the early years after. Moreover, until 2016 there is a negative balance between business births and deaths. Especially Volos and Skiathos, despite that they presented an increase in their population, show higher intensity of businesses' deaths until 2014 than those of the establishments; after 2015 it is observed an inverse trend with positive establishments balance.The most important finding that confirms that space is not neutral is the autocorrelation in death rates in neighboring municipalities with simultaneous population decline.

Research limitations/implications:
The dependence of the external boundaries of a spatial entity on a neighboring one contributes to the possible effect on spatial patterns. In the present study, the spatial autocorrelation of the establishments and deletions of the businesses of Magnesia and the Sporades was examined, however, the influence of the adjacent area (the Regional Units of Larissa and Fthiotida) was not taken into account due to non-availability of the necessary data.

Originality/value:
The present study contributes to theory by highlighting the impact of the economic crisis in the footprint of a regions' business ecosystem. The added value lies in the connection and dependence of regional economies and populations with space. Future research could build on this study by examining business behavior in other spatial units. Furthermore, this study could be additionally used by policymakers to potentiate awareness of the local development, revitalization, and depopulation challenge.

1. Introduction

The economic crisis of 2008 decisively affected the Greek area, leaving its mark on the economic stability of Greece and subsequently on its demographic processes. At the same time, significant transformations of land use, socio-

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demographic, and socioeconomic composition of the population occurred. In particular, the residential structure and organization of the medium-sized urban centers (Manika, 2018) and the structure of the rural area (Anastasiou & Duquenne, 2017) were redefined, as expected in areas that encounter conditions of economic instability (Silverman, Yin and Patterson, 2013). The way in which the economic crisis is perceived in the urban space is mainly a consequence of both its intensity and the individual characteristics of the spatial units that are called upon to deal with it.

Although most research on the spatial imprint of the crisis focuses on the urban space or at the state level, its analysis at the regional or municipal level can significantly enrich the study of this phenomenon. Moreover, the methodology presented may be a useful tool for policymakers especially promoting the reduction of inner – territorial differences (Gubanova & Voroshilov, 2019). Understanding the situation or factors of the transformation of the economic identity of cities or regions affected by the economic crisis can help governments select the appropriate policies to regenerate and revitalize these areas. These policies may focus among others on economic, social or environmental terms (i.e. green economy investments (Klasinc, 2015)), or a combination thereof.

This paper is structured in four basic sections. The first section deals with the literature review and is the basis of the research questions posed. The second section presents in detail the data used. Along with the data, the methodology that is applied and the way it is adopted in the context of our research are analyzed. The results of the research are presented in the next section, while the paper comes to an end with the analysis of the conclusions and perspectives of the research for its utilization and further development.

2. Review of Literature

The spatial footprint of the economic crisis is first and foremost perceived in the building reserve, whether this reserve is intertwined with housing or commercial use. After all, the economic downturn has led to a reduction in the demand for housing, thereby reducing rents and real estate prices, affecting homeowners and their neighborhoods as a whole. This unobstructed availability of real estate is often associated with the disintegration and decline of a structured web.

Utilizing these "non-productive" spaces (Newman and Kim, 2017) can help improve the surrounding area (Cohen, 2001) and promote its development. Non-productive areas are defined as areas that, despite being the basis of several developmental, cultural, or ecological policies, remain empty or abandoned (Newman and Kim, 2017). Non-productive spaces can be unstructured, green, abandoned industrial facilities, or generally abandoned shells. The total number of these spaces is constantly increasing, culminating in the period following the global economic crisis of 2008 (Mallach, 2012). Although inactive spaces are very often accompanied by a negative label, it is important to mention that depending on their management and potential utilization they can be powerful mechanisms, as shown in Table 1.

Table 1: Potential challenges of inactive urban areas

Potential challenges of inactive urban spaces	Relevant Literature
A powerful mechanism for new uses (especially in the case of green spaces)	(Frazier & Bagchi-Sen, 2015) (Lee et al., 2018) (Newman et al., 2018) (Freestone & Nichols, 2004) (Bowman & Pagano, 2004) (Stanley, 2016)
Improving social cohesion (as for example community gardens or coworking places)	(Capdevila, 2014) (Tranel & Handlin, 2006)
Crime monitoring or declining	(Kondo et al., 2016)

Source: authors' compilation

From the range of non-productive spaces, we have chosen to study the empty stores, in particular the deletions of businesses. It is a fact that trade is one of the dominant sectors of the Greek economy; the stores of wholesale and retail trade, accommodation and catering services and arts, entertainment, and recreation, have a primary role in the economic identity of rural units and contribute significantly to its development, vitality (Mehta, 2007), (Long and Huang, 2017), and economic performance especially when these businesses are small and operate as magnets of urban growth.

Nevertheless, in the effort to quantify the performance of the effects of the economic crisis in the urban space, the timeless study of the location of businesses and its changes or otherwise the demography of businesses is of high importance. Business study or business demography can be a tool for spatial urban analysis, as it can identify the landscape (Brown, 1993) and determine the robustness, or otherwise liveliness, of an area. It is found in the terms business demography, the demography of the firm or firmography and is a new scientific discipline that first appeared

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in the early 20th century (Markowicz, 2014) and examines the structure and composition of all businesses as well as its changes over time (Froment, 2015). It was also used in the Dutch statistical authority, with the term economic geography (Van Wissen, 2002).

Table 2: Meanings and concepts adopted during the spatial study of businesses

Concepts	Relevant Literature
Retail Location Theory	(Brown, 1993)
Business Demography	(Markowicz, 2014)
Demography of the Firms	(Wissen, 2005) (Giannetti & Velucchi, 2006)
Firmography	(Maoh & Kanaroglou, 2013) (Mejia-Dorantes & Martín-Ramos, 2013)
Mobility of firms	(Froment, 2015)

Source: authors' compilation

Eurostat (Eurostat, 2008) and the European Commission (European Commission, 2014) use the term "business demography" to describe the percentages of business establishments, their deletions, the percentage of active businesses, their building facilities and their movements within the city or periphery complex as a whole, an indicator of the dynamics of the businesses for the specific branch of economic activity, the specific spatial unit or the economic status of each country.

The metaphorical use of the term demography for the business study is often used as significant parallels are found in the mechanisms that cause changes in business as a result of beginnings - establishments and deletions - mortality, aging or even internal changes in former monopolies (Van Wissen, 2002). There is also a direct correlation between the way businesses and demographic populations are studied, using in both cases theories from other scientific fields such as economics, sociology, and geography (Van Wissen, 2002). In any case, the parallelism of the correlation of the population of individuals with that of businesses stops at the impossibility of substantial and objective determination of the maximum period during which a company is active in the labor market (Markowicz, 2014).

3. Data and Methodology

3.1 Data

The Regional Units of Magnesia and Sporades were selected to be studied as they represent a wide range of economic activities and demographic characteristics. Indicative of the demographic changes of the specific regional units (Table 3) is population changes based on the last two censuses (2001 and 2011). It is obvious that the medium and small residential areas show greater resilience, durability, and flexibility, in terms of their population changes compared to other settlements, due to their potential nature. This nature is explained by the character and structure of Greek society, for which much of the inhabitants of smaller cities have incomes from many different sources (agricultural activity alongside main employment) or even financial dependence on other members of their family, so it was not as strongly affected by economic instability as the inhabitants of the larger residential areas as it did not have to move in search of work.

Table 3: Population changes in municipal units (2001-2011)

Municipality	Municipal Unit	Population 2001	Population 2011	Change (%)
Volos	Volos	85001	86046	1,2
	Agria	5835	5632	-3,5
	Esonia	3059	3249	6,2
	Artemida	4397	4145	-5,7
	Iolkos	2081	2138	2,7
	Makrinitsa	7538	7513	-0,3
	Nea Ionia	32979	33815	2,5
	Portaria	2033	1911	-6,0
Almyros	Almyros	13198	12678	-3,9
	Anavra	595	584	-1,8
	Pteleos	2648	2485	-6,2

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	Sourpi	3698	2867	-22,5
Zagora-Mouresi	Zagora	3759	3334	-11,3
	Mouresi	2690	2475	-8,0
	Argalasti	1998	1985	-0,7
	Afetes	1754	1746	-0,5
South Pelion	Milies	3100	3085	-0,5
	Sipiada	2180	2047	-6,1
	Trikeri	1713	1353	-21,0
	Feres	6210	5752	-7,4
Riga-Feraios	Karla	5040	4747	-5,8
	Kerarmidi	580	423	-27,1
Skiathos	Skiathos	5788	6088	5,2
Alonnisos	Alonnisos	2425	2750	13,4
Skopelos	Skopelos	4706	4960	5,4
Total: Regional Units of Magnesia and Sporades		**205005**	**203808**	**-0,6**

Source: ELSTAT. 2011, authors' compilation

The panel data used are derived from the Chamber of Commerce of Magnesia and concern the businesses of all sectors of economic activity. The spatial scale of the analysis is the Kallikratis municipalities of the Regional Units of Magnesia and Sporades in the period 2008 – 2018. The year 2008 was used as the starting point for the analysis as the effects of the economic crisis had not yet become evident on the economic basis of most Greek spatial units. Therefore, this year's picture (financially and demographically) can be the basis for timeless monitoring and comparison. The panel data provides information about businesses establishment date, the start address or the current address (if it differs from the establishment address), the economic sector, and the deletion date (if occurred) for each municipality.

3.2 Methodology

The proposed methodological framework is based on two main pillars. The first concerns the capture of the order of magnitude and the changes in the economic base of the study area both over time (2008-2018) and spatially. The second pillar concerns (i) the exploration of spatial relationships and (ii) the identification of spatial clusters, with similar behavior of establishments and write-offs of businesses (hot-cold spots) or spatial outliers.

In order to outline the economic profile both at the level of the Regional Unit and the level of municipalities, the principles of business demography and descriptive statistics are adopted. The analysis includes the creation of a double-entry matrix (11x12) of the establishments and deletions of businesses in the period 2008-2018. This allows the recording of developments in the balance of businesses in the study area during the economic crisis.

3.2.1 Business Demography Indicators

The results produced by the double-entry matrix were the basis for the creation of crude birth rates (CBR) (commencement of commercial activity) and crude death rates (CDR) (deletion of commercial activity). Through crude ratios will be examined the contribution of the municipalities to the overall economic base of a study area and the systematic high quota of registrations or deletions of individual municipalities. Crude rates are derived from the ratio of the number of events in the total population, expressed by the following general relationship:

$$\text{Crude Rates} = \frac{\text{number of events}}{\text{mean total population}} \quad (1)$$

They are used to describe the intensity of establishments or deletions in a set of businesses by expressing the number of establishments or deletions per 100 businesses, giving information about the frequency of establishments or deletions in the total number of businesses.

The last business demography indicator produced for the present study is the balance between births and deaths.

$$\text{Balance} = \frac{\text{Births}}{\text{Deaths}} \quad (2)$$

The balance indicator is used to compare the percentage of new establishments to the deletions over the period 2008-2018.

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3.2.2 Spatial Autocorrelation

The approach of the second issue, the identification of spatial patterns, requires the use of exploratory spatial data analysis (ESDA) methods and in particular spatial autocorrelation analysis. Spatial statistics focus on the nature of spatial data and, based on mathematical and statistical descriptions, drawing conclusions based on an estimate of the distribution of events and spatial statistical measurements (Zhan et al., 2017).

The method of spatial autocorrelation incorporates tests for both the Global and Local statistical index Moran's I. The Global Moran's I index was used to examine the existence of spatial autocorrelation among locations in data with spatial reference. Its mathematical calculation function is based on the Pearson correlation coefficient (Cliff and Ord, 1973) (Moran, 1950):

$$I = \frac{n \sum_i^n \sum_j^n w_{ij} (x_i - \bar{x}) (x_j - \bar{x})}{\left(\sum_i^n \sum_j^n w_{ij}\right) \sum_i^n (x_i - \bar{x})^2} \quad (3)$$

where n is the sum of the spatial units, wij the weights that determine the degree of spatial proximity of the observations and xi the spatial units.

The index ranges from a set of values from -1 to +1. The values approaching -1 indicate the existence of a strong negative spatial autocorrelation and therefore it is possible to highlight spatial patterns in which the neighboring observations of a variable are expected to follow different types of behavior. When values approach +1 they indicate strong positive spatial autocorrelation and spatial patterns are expected in which the neighboring observations of a variable are expected to follow the same behavior. As long as the index tends to 0, it indicates the absence of spatial relation.

Spatial Weights Creation

The determination of weights is an important part of the methodological approach, as they represent the mathematical structure that evaluates the spatial relationship of a phenomenon or a variable. The method of calculating spatial weights suitable for the data depends on a number of individual factors, including the island and discontinuous character of the study area and non-spatial characteristics, such as population, demographic, social, and economic status (Suryowati, Bekti and Faradila, 2018).

In the case of the study area, the island character (Regional Unit of Sporades) creates a discontinuity in the area. It was also observed that during the decade 2001-2011 (census data) the permanent population showed a decrease. At the same time, the number of people who have moved and changed their place of permanent residency is 21,235, of which 7,527 (35.5%) have moved within the specific spatial units. Following the above data, it was considered appropriate to calculate the weights based on the k-nearest neighbors.

There is no ideal way to select the right number of neighbors (Fotheringham, A.S., Brunsdon and Charlton, 2002) and for this reason, repeated tests were performed to examine the sensitivity of the value and the importance of the index, reaching the 4 nearest neighbors.

Local Indicators of Spatial Association (LISA)

A local indicator of spatial association allows assessing location-specific autocorrelation for each location identifying a value's similarity in this location to its neighbors. This allows locating the clusters rather than pertaining to the pattern as a whole and also characterizing the clusters by type of association (Anselin, 1995). The LISA cluster map shows the significant locations classified by the type of association (Table 4).

Table 4: Types of Spatial Autocorrelation

Spatial Clusters	High-High	Positive spatial autocorrelation for high values	The core of the cluster
	Low-Low	Positive spatial autocorrelation for low values	The core of the cluster
Spatial Outliers	High-Low	Negative spatial autocorrelation, high values surrounded by low	Individual locations
	Low-High	Negative spatial autocorrelation, low values surrounded by high	Individual locations

Source: (Anselin, Syabri and Kho, 2006), authors' compilation

There are two types of associations, spatial clusters, and spatial outliers. The cluster comprises more than just a core but it also encompasses its neighbors, which is the location surrounding it. The spatial outliers concern individual locations, as they are location specific and spatially different from their neighbors.

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4. Results

4.1 Statistical analysis of businesses

During the decade 2008-2018, 10,344 businesses were established in Magnesia and Sporades, of which 38% (3944) were deletions. As a result, a very large amount of newly established companies do not become viable and cease to operate within the first decade of their establishment. In fact, if we examine the establishments per year (Table 5), we discover that a significant amount of these is deletions, either in the same year or within the next two years of their establishment. In addition, more than half of the businesses established in 2008 and 2009 at the end of 2018 no longer existed. Respectively, the businesses that were established during the period 2010-2014 show high percentages of deletions in 2018 (45.5%, 46.7%, 39.4%, and 38.1% respectively). In the coming years, high deletion rates are declining significantly.

Table 5: Establishment-Deletion Details of Magnesia and Sporades Businesses, 2008-2018

	Deletions												
Establishments	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Active	Total
2008	57	130	139	91	103	48	47	32	24	15	10	517	1213
2009		51	149	109	98	52	40	42	23	17	8	533	1122
2010			63	123	96	61	54	39	32	20	14	604	1106
2011				83	119	79	97	39	31	23	14	554	1039
2012					71	110	75	53	38	24	17	596	984
2013						65	96	85	75	48	16	600	985
2014							71	134	62	33	33	542	875
2015								81	73	46	27	494	721
2016									76	60	36	545	717
2017										54	59	662	775
2018											53	753	806
Total	57	181	351	406	487	415	480	505	434	341	287	6400	10344

Examining the annual percentage change of the existing businesses (Table 6) it is found that the years during which the economic crisis in Greece presented high levels of financial and political instability are characterized by a simultaneous decline of the business population. Until 2010, the rate of change in existing businesses increased marginally, which confirms the hitherto imperceptible effect of the crisis on the economic fabric. The highest negative changes are located in the years 2010-2011 (-2.5%), 2011-2012 (-2.9%) and 2012-2013 (-2.9%), while the decline in the rate of change lasts up to in 2016 (-1%), lower intensity, however. In the following years, the trend is reversed, culminating in the year 2017-2018, where it shows a significant positive change (1.7%).

Table 6: Annual changes of Existing Businesses, Establishments and Deletions

YEAR	Annual change of existing businesses (%)	Annual change of Establishments (%)	Annual change of Deletions (%)
2008-2009	0,24	-7,5	1,3
2009-2010	0,07	-1,4	33,5
2010-2011	-2,4	-6,1	1,4
2011-2012	-2,9	-5,2	-0,6
2012-2013	-2,9	0,1	-31,9
2013-2014	-0,8	-11,2	0,0

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2014-2015	-1,7	-17,7	-12,4
2015-2016	-1,0	-0,6	-15,1
2016-2017	0,2	8,1	-27,1
2017-2018	1,7	4,1	-23,4

Regarding the changes in the establishment and deletion of businesses (Figure 1), Magnesia and the Sporades follow the economic course of Greece. The annual changes of the establishments until 2012 are at high negative levels, de-escalating in 2013, and in 2014 and 2015 they return, doubling the negative rate of establishments. Respectively, in 2009-2010 the number of businesses that were deleted from the registers of the Chamber of Magnesia increased by 33.5%. This change seems to be eliminated two years later (2012-2013) with a corresponding reduction of the deletion rate by 32%. 2015 is a milestone for businesses, as the annual valuation of new establishments is positive and at the same time significantly reduces the percentage of deletions.

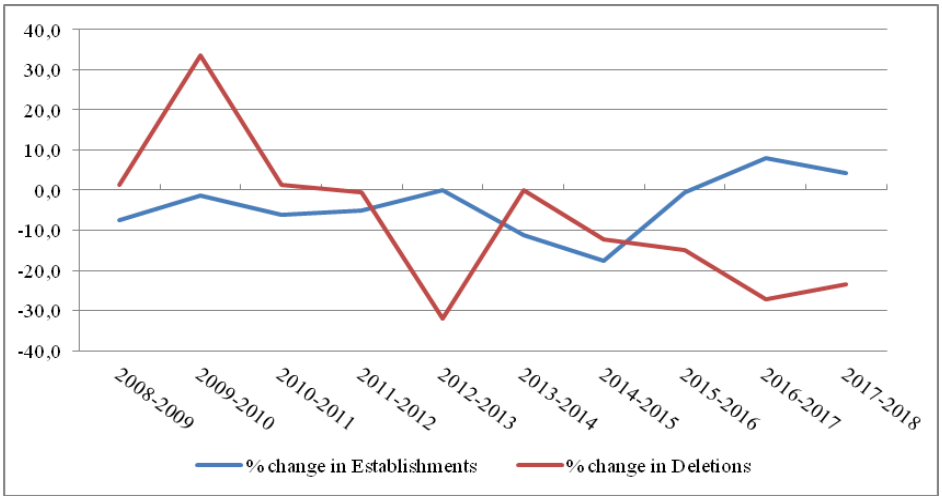

Figure 1: Change of Establishments and Deletions of Businesses, 2008-2018

The business population pyramid (Figure 2) borrows the form and logic of its depiction of the demographics. In the crude birth rate (CBR) the simulated curve follows a slightly declining trend from 2008 to 2012. The significant inflow of new business inflows (> 6%) is a significant increase in the business population holding up the indices. The downward trend is slightly reversed in 2013 and then follows a downward trend until 2018.

The rise in the crude death rate (CDR) until 2012 suggests an increase in business deletions. The crude index is thus shaped by the increase in deletions while reducing the population of existing businesses. Therefore the base of the pyramid (2008, 2009) is wider than the top (2017, 2018), as the number of existing businesses decreases during the study period, due to the simultaneous reduction of establishments and increase of deletions. It is important to note that after 2013 the CDR has been steadily declining.

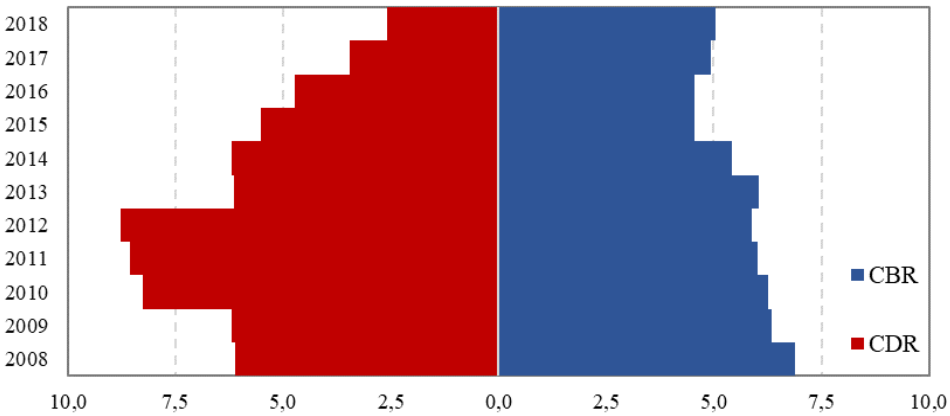

Figure 2: The pyramid of Establishments and Deletions (Crude Rates), 2008-2018

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The balance of establishment-deletions (or births-deaths) from 2008 to 2012 (Table 7) shows a steady decrease, while in 2010 it is the first year that the deletions exceeded the establishments. In 2012 the balance sheet showed the largest imbalance, with 67 businesses being established for every 100 deletions. In 2013 there is a balance, which in the next three years will again receive a negative sign. The situation is changing significantly and the balance captures a very strong and significant change in 2017 (141.6) and 2018 (193.7). Especially in 2018, the percentage of establishing new businesses is twice that of deletions.

Table 7: Demographic indicators of Magnesia and Sporades businesses, 2008-2018

Year	CBR	CDR	Balance
2008	6,9	6,1	112,2
2009	6,4	6,2	102,6
2010	6,3	8,3	75,8
2011	6,0	8,6	70,1
2012	5,9	8,8	66,9
2013	6,1	6,1	98,4
2014	5,4	6,2	87,6
2015	4,5	5,5	81,9
2016	4,6	4,7	95,5
2017	4,9	3,4	141,6
2018	5,0	2,6	193,7

4.2 Spatial Statistical Analysis

In addition to the analysis of the study area as a whole, Crude birth (CBR) and death (CDR) rates, were calculated on the spatial scale of the Kallikratis Municipalities (Table 8) in order to identify differences in the intensity of establishments and deletions in the individual space. The first finding of the analysis at a lower spatial level is the heterogeneity in the contribution of the municipalities to all businesses of the study area. Both the CBR and the CDR during 2008-2013 presented higher tensions than in previous years. The analysis of the cruse rates also shows that in 2018 the phenomenon of business deletions was severely reduced.

There emerged municipalities systematically characterized by high rates of establishments (such as Volos and Skiathos) throughout, and municipalities with high rates of establishments until 2015 and high decline in 2017 and 2018 (Almyros, Alonissos). Finally, municipalities with medium intensity of establishment are identified until 2012, and significant negative changes in the coming years (Zagora-Mouresi, South Pelion, Riga-Feraios). The intensity of the deletions shows different behavior and consequently, the participation of the municipalities in the whole study area is differentiated. Volos and Skiathos (2010-2014) show high death rates of businesses, whose intensities are stronger than those of the establishments. The municipalities of Riga Feraiou and Alonissos have been characterized by small intensities over time and therefore have a smaller contribution to the whole, a fact that in practice proves the limited tendency of companies to deletion in these municipalities. Finally, in the island municipality of Skopelos in the period 2010-2012, particularly large deletions were detected, but after 2015 they doubled.

Table 8: Crude Birth Rates and Crude Death Rates at municipality level, 2008-2018

Crude Rate	Municipality	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
CBR	Volos	7,4	6,6	6,1	5,7	6,4	6,5	5,9	4,8	4,6	4,9	5,0
	Almyros	6,4	8,0	7,7	4,5	5,7	7,9	6,3	4,0	3,7	2,6	2,1
	Zagora-Mouresi	6,4	4,9	4,7	3,0	4,5	3,6	4,0	2,9	3,4	4,1	3,9
	South Pelion	5,5	5,1	5,5	4,7	4,7	3,7	2,6	3,1	2,1	3,2	3,3
	Riga-Feraios	5,4	5,4	8,3	7,3	3,5	5,2	3,6	2,9	3,1	4,0	3,5
	Skiathos	6,3	6,4	8,1	7,9	5,3	6,7	5,1	5,9	5,7	7,0	7,6
	Alonissos	6,9	8,0	7,7	4,5	5,7	7,9	6,3	4,0	3,7	2,6	2,1

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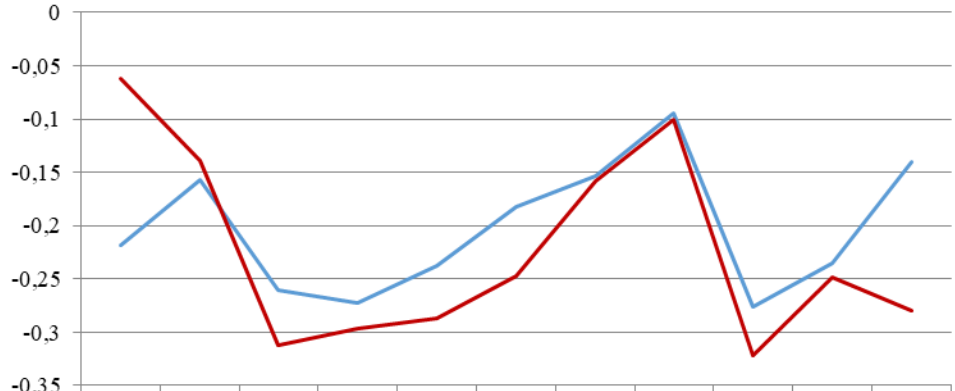
	Skopelos	4,4	5,6	6,9	8,2	3,8	5,2	5,0	5,3	3,8	4,8	6,6
CDR	Volos	6,6	6,8	8,6	9,6	9,7	6,9	6,5	6,4	4,9	3,5	2,7
	Almyros	6,1	3,4	5,4	5,0	4,5	4,8	3,3	3,0	2,8	3,2	1,4
	Zagora-Mouresi	4,8	3,9	5,4	5,7	5,9	5,3	5,9	4,0	2,5	2,7	2,3
	South Pelion	4,6	4,9	7,2	5,8	5,6	3,4	3,9	3,4	4,3	3,4	1,6
	Riga-Feraios	5,2	5,5	8,6	7,0	6,1	4,0	6,0	3,4	4,5	2,5	2,5
	Skiathos	5,3	5,5	7,7	7,0	7,0	4,9	4,8	3,5	5,3	3,4	3,1
	Alonissos	5,3	3,4	5,4	5,0	4,5	4,8	3,3	3,0	2,8	3,2	1,4
	Skopelos	4,8	3,1	9,0	7,5	8,6	4,8	5,0	3,0	3,6	2,8	1,5

Global Moran's I

The economic crisis left its spatial imprint on the municipalities of Magnesia and the Sporades and caused transformations in the economic field. The analysis of spatial autocorrelation and the calculation of local indicators for the decade 2008-2018 showed the trends of establishment and deletions of businesses through a series of spatial patterns.

The Global Moran's I index (Figure 3) highlights a significant negative spatial correlation for both the Crude Indicator of Establishments (CBR) and the Crude Indicator of Deletions (CDR), for most years of the study period ($p < 0.05$). Consequently, the existence of spatial autocorrelation confirms the existence of spatial patterns, as municipalities with similar rates of establishment and deletion tend to be closer to each other. In particular, the differences in the CBR index are particularly small, with the exception of the years 2009, 2014, 2015, and 2018, in which low-intensity spatial autocorrelation is observed. Regarding the CDR, the highest negative autocorrelation was observed in 2010 and 2016, while particularly high intensities occurred during the years 2011, 2012 and 2013, during which the economic crisis in Greece was not completely controlled and the economic environment was highly unstable.

As can be seen from the data, the deletion of businesses shows higher intensities compared to the establishment during the years 2009-2017, however, they follow the same trend. In 2008 the behavior of the indicators is diametrically opposed, with the CBR showing autocorrelation, in contrast to the CDR where its distribution in the space follows a random pattern, confirming that in 2008 crisis was in a fetal stage and did not affect spatial behavior of deletions. The reverse situation is reflected in 2018, where the post-crisis era seems to be spatially affecting the deletion of businesses in relation to the establishment of new businesses, in which it seems to have little influence.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
CBR Moran's I	-0,218	-0,157	-0,261	-0,273	-0,237	-0,182	-0,153	-0,095	-0,276	-0,235	-0,14
CDR Moran's I	-0,062	-0,139	-0,312	-0,297	-0,287	-0,247	-0,158	-0,101	-0,322	-0,249	-0,28

Figure 3: Global Moran's I Index, Regional Units of Magnesia and Sporades, 2008-2028

Local Moran's I

In the case of CBR the results do not identify evidence of clustering but spatial outliers (Figure 4). The study area as confirmed by Local Moran's I does not present significant hot or cold spots for the establishments, only

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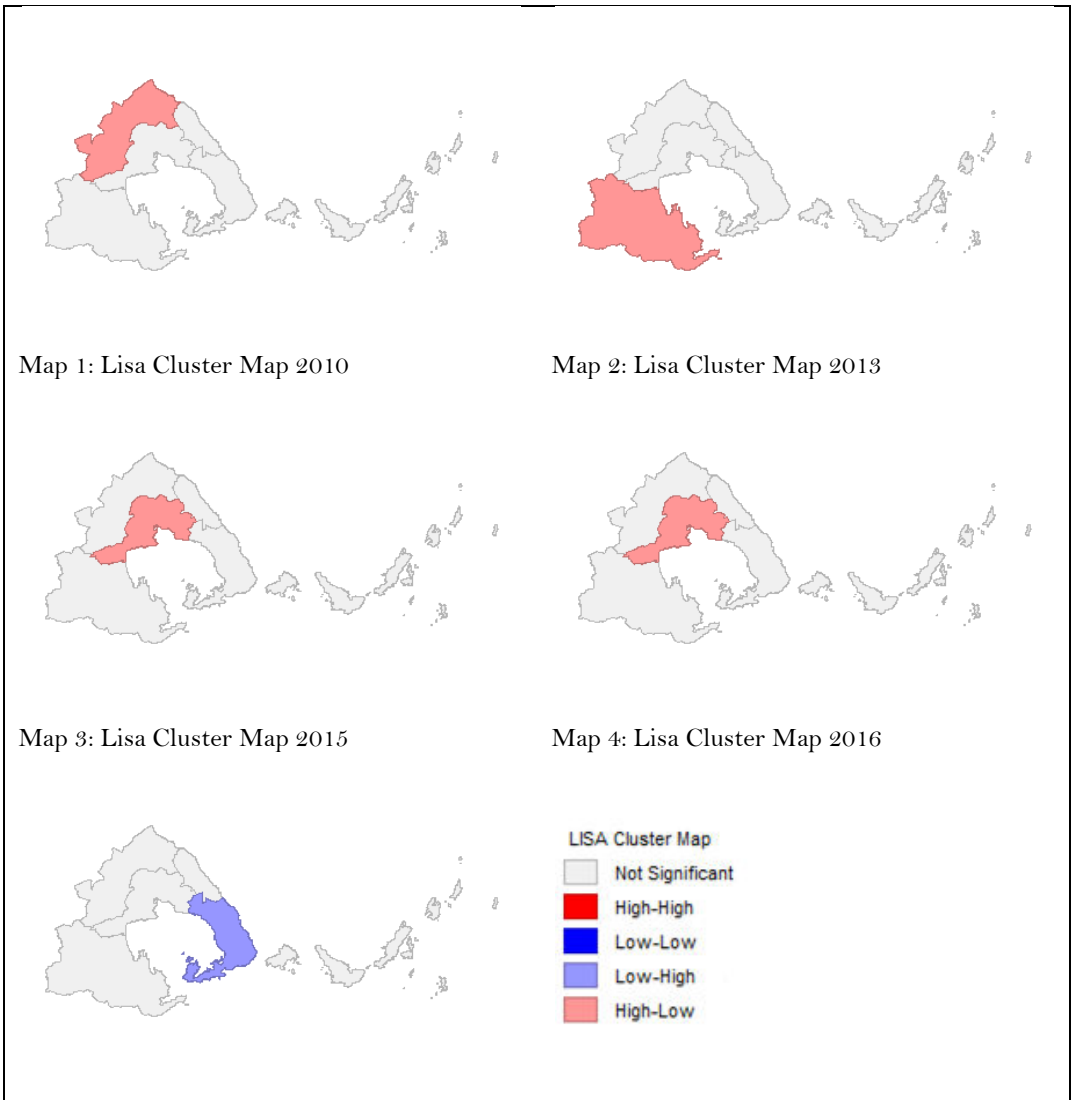
municipalities that are classified as spatial outliers. The specific spatial patterns are distinguished in five years of the period 2008-2018 and the majority of them are defined as "low-high" type. These are the municipalities of Riga-Feraios (2010) ($p < 0.05$), Almyros (2013) ($p < 0.05$), Volos (2015, 2016) ($p < 0.001$), which have low business establishment rates but are adjacent to municipalities with high establishment rates. In 2017, a "high-low" municipality appears in the municipality of South Pelion ($p < 0.05$), with a significant percentage of new businesses, surrounded by cold spots.

Moran's I local indicators for the business death rate (Figure 5) confirm the existence of hot and cold spots across Magnesia and Sporades stores. In 2008, a cold spot was found in Skiathos ($p < 0.05$), which confirms the existence of a spatial cluster in which the neighboring municipalities have an equally high mortality rate in businesses. The previous pattern ceases to exist in 2009 and is being replaced by a high price hub in the municipality of South Pelion ($p < 0.05$), with a simultaneous appearance of a spatial outlier in the municipality of Zagora-Mouresi ($p < 0.05$). In 2011 the same municipalities are transformed into spatial outliers ($p < 0.05$) with low-mortality patterns and spatial proximity to municipalities with high accumulation of deletions. The deletions of businesses in the study area in 2012 and 2013 do not follow any spatial pattern and are obviously distributed randomly, while in 2014 the municipality of South Pelion reappears as a spatial outlier ($p < 0.05$), creating a "low-high" type pattern. This particular pattern is maintained in 2015 ($p < 0.001$), while an additional hot spot is located in the municipality of Zagora-Mouresi ($p < 0.05$) confirming the high deletion of businesses in neighboring municipalities. In 2016, a change took place and Zagora-Mouresi does not represent a hot spot but is a spatial outlier ($p < 0.001$) of the "low-high" type. In 2017, a random distribution is made in the area, however, the overall pattern of 2015 reappears, highlighting a source of a high percentage of business deletions in the municipality of Zagora-Mouresi ($p < 0.05$).



Map 1: Lisa Cluster Map 2010

Map 2: Lisa Cluster Map 2013

Map 3: Lisa Cluster Map 2015

Map 4: Lisa Cluster Map 2016

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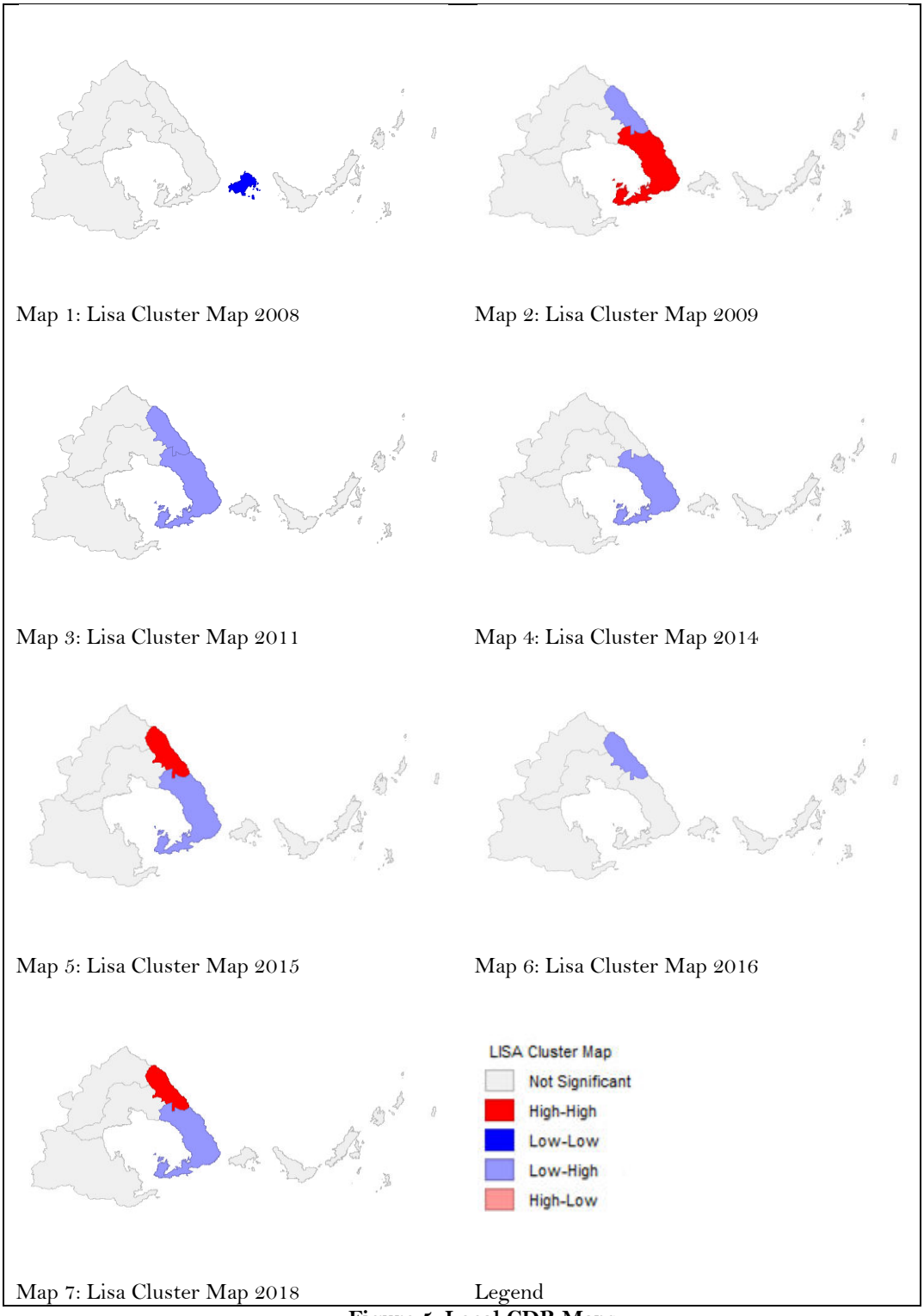
Map 5: Lisa Cluster Map 2017 Legend

Figure 4: Local CBR Maps



Map 1: Lisa Cluster Map 2008 Map 2: Lisa Cluster Map 2009

Map 3: Lisa Cluster Map 2011 Map 4: Lisa Cluster Map 2014

Map 5: Lisa Cluster Map 2015 Map 6: Lisa Cluster Map 2016

Map 7: Lisa Cluster Map 2018 Legend

Figure 5: Local CDR Maps

5. Conclusion and Recommendations

The economic crisis left its spatial footprint on the municipalities of Magnesia and the Sporades and caused transformations in the economic field. Given that 40% of businesses established in these Regional Units in the decade 2008-2018 have not survived, it highlights the need to investigate the spatial behavior of establishments and the deaths of businesses.

Spatial analysis of crude indices identified spatial inhomogeneity, especially in terms of the behavior of establishing new businesses during the decade 2008-2018. On the contrary, the deletion of the businesses seems to

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create spatial clusters in the municipalities with a developed tourist sector. In addition, these municipalities contribute with high intensity to the spatial footprint of the economic profile of the Regional Units. Specifically, cold spots are located in Skiathos in 2008, while emerge noticeable spatial clusters with a high death rate in the municipalities of South Pelion (2009) and Zagora-Mouresi (2015, 2018).

However, it must be born in mind that the dependence of the external boundaries of a spatial entity on a neighboring one contributes to the possible effect on spatial patterns. In the present study, the spatial autocorrelation of the establishments and deletions of the businesses of Magnesia and the Sporades was examined, however, the influence of the adjacent area (the Regional Units of Larissa and Fthiotida) was not taken into account due to non-availability of the necessary data. This constitutes a limitation for the present research, especially knowing that space is not neutral and presents continuity beyond the administrative limits.

The present research sheds the light on the interdependent relationship of space and businesses, as proved by literature review, in practice. The implications of the results may be deployed by local actors to plan strategies for entrepreneurship incentives, revitalization, and attractiveness of a medium-sized regional unit, with both urban and rural populations. Tracing this complex relationship can also help Greek regions become "smarter" and more innovation-oriented (Katimertzopoulos & Vlados, 2019), with limited corruption levels (Botrić et. al., 2015). In view of the findings mentioned, future research regards further the investigation of the driving forces that triggered the transformations in the business sector of Magnesia and Sporades.

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Physicians' Brain Drain: Investigating the Determinants to Emigrate Through Empirical Evidence

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ABSTRACT

Purpose:
The economic crisis in Greece has caused widespread suffering both in society and the economy. Among other things, new forms of geographical mobilities emerged highlighting the country's inability to retain a scientifically skilled workforce. One of the most important scientific branches been hit is the medical one. The purpose of this study is to identify the intention as well as the main factors that push young greek physicians to emigrate.

Design/methodology/approach:
For the present study, a tool for assessing young physicians' perceptions was designed and field research was performed on 239 medical school students and young physicians for up to 39 years. Descriptive and inferential statistical analysis was used to describe the data and generalize the results. Finally, Factor Analysis (Principal Component Analysis) was used to condense the initial variables and capture the determinants in physicians' brain drain.

Findings:
Young physicians show high intention to seek employment abroad. There are differences between men and women regarding their perceptions of the possible causes of emigration. Women consider more than men that unemployment, employment prospects, and opportunities and quality of life to be the most important reasons in the migratory decision. In addition, the young doctors whose family incomes are either very low or quite high are more receptive to looking for work abroad. Finally, the multivariate analysis highlights four main determinants feeding physicians decision-making; homeland's social identity, lack of prospects, unfavorable economic environment, and continuation of studies.

Research limitations/implications:
The period of the field research was conducted from September to November 2018. As a result, there are restrictions on whether participants' responses are affected by the economic crisis or not, as Greece in 2018 began to show macroeconomic stability.

Originality/value:
In the last decade, a large wave of young scientists' emigration has been recorded in Greece. This wave intensified in 2012 and became permanent in the following years, taking on large-scale exodus, with high annual outflows. Brain Drain as an evolving phenomenon has been studied both by the national and international academic community. However, in the case of Greece, the research of perceptions, intentions, and the main reasons for brain drain by medical professionals is limited. The present study seeks to fill the gap found in the literature through field research about the determinants of physicians' brain drain in Greece.

1. Introduction

Greece is a country with a strong migration history in terms of both internal (Anastasiou & Duquenne, 2017) and external migration (Loizou et al., 2014). The two major waves of external migration that took place in the early and mid-20th centuries were mainly involving unskilled workforce. The changing face of immigration, however, continues to fuel Greece's historic tradition, abandoning the country in search of opportunities but also better working and living conditions.

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The Greek economy and society are once again experiencing a modern phase of mass migration in its history. The economic crisis of 2008 in the context of horizontal economic, political and social changes, fed back a new wave of external migration with a direct impact on the highly specialized young workforce (Cavounidis, 2015). Among the affected scientific disciplines is the physician, who suffers significant losses.

The investigation of the intention of the Greek medical personnel to move professionally abroad as well as the factors of its impetus in other countries is very limited and a gap is identified in the field of bibliography. Taking into consideration the extensive nature of the phenomenon, the investigation of both the perceptions and intentions of Greek physicians is a matter of increased interest.

The paper is divided into four sections: In the first section, a short literature review on both brain drain in Greece and physicians' brain drain is taking place as well the driving forces of physicians' brain drain are explored. In the subsequent section (Data and Methodology) information is provided for the field research and the methodological approach is analyzed. Finally, in the Results section, there are presented the main descriptive findings from the analysis conducted and the principal components affecting young physicians emigrating decisions. The Conclusions and Recommendations discuss the results conducted from the quantitative analysis.

2. Review of Literature

2.1 The Greek Brain Drain

In the migratory history of the Greeks, the mass exits came after a recession that widened the country's prosperity gap in comparison with the most developed countries. It is worth mentioning that before the economic crisis the Greeks were among the European people with the greatest stiffness in emigration (Vandenbrande et al., 2006), while just one year before the crisis the percentage of Greeks who would choose to work in another country, in case of unemployment in Greece, was very low compared to the average of the EU (Special Eurobarometer 337, 2010). The change in economic and social conditions in Greece over the last decade has highlighted external migration on the one hand as a survival strategy for some, and on the other hand as an attractive option for developing a career of another part of Greeks (Labrianidis & Pratsinakis, 2016). Nevertheless, an issue emerges on the social integration of the Greek migrants at the new workplace Mitsakis & Mendonca, 2017). Brain drain as a phenomenon triggered by the economic crisis is particularly evident in European Southern countries (especially Italy, Spain, Portugal), as their economies have been hit hard (Christopoulos et al., 2014; Marinakou et al., 2016). The most popular migratory destinations are European countries with an emphasis on Germany and the United Kingdom, followed by the United States and Australia (Christopoulos et al., 2014; Labrianidis & Pratsinakis, 2016), while mobilities were also observed in the large urban areas of Canada, especially after 2012 (Aravossitas & Sugiman, 2019). As regards the last, a big part concerns Greek people with Canadian citizenship (Aravossitas & Sugiman, 2019).

In the era of crisis, the greatest exportable product of Greece is its scientific staff (Marinakou et al., 2016), recording a loss of 12 billion euros per year (Endeavor Greece, 2014). The estimated loss of human capital between 2008 and 2013 ranges from 350000 (Endeavor estimation) to 427000 (Bank of Greece estimation) young scientists. It is worth mentioning that, based on recent research, young people who want to immigrate often have highly structured and comprehensive reasoning about their intentions, in contrast with the reluctant ones who make vague arguments about the reasons that led them to reject it (Theodossiou et al., 2017).

Among the most important reasons for relocation are not only unemployment and the unfavorable economic situation, but also the inability of the state to provide opportunities for excellence and personal development (Bank of Greece, 2016; Duquenne & Metaxas, 2017). "Generation E" (expats) or "generation G" (young, talented and Greek) or "generation We" is the generation of Greek scientists (Bank of Greece, 2016) who, in the last decade, immigrated to developed economies looking for opportunities for social and economic progress (Damanakis, 2014; Endeavor Greece, 2014; ICAP, 2015; Labrianidis & Pratsinakis, 2016; Labrianidis & Vogiatzis, 2013).

The profile of emigrants under this type of mobility involves young Greeks about 30 years old, with high academic education, changing their country of residence for several economic reasons. Of the 190000 Greek graduates living abroad, 140000 left the country after 2010. In particular, 75% are graduates of higher education and one-third of them are either postgraduate students or graduates of medical schools and the Polytechnic (Labrianidis & Pratsinakis, 2016).

The push factors of Greek scientists abroad stem from both a general sense of lack of prospects in their homeland (Labrianidis & Vogiatzis, 2013) and an accumulated frustration for the gloomy socio-economic situation in Greece, accompanied by deep frustration as regards the political status and state institutions (Duquenne & Metaxas, 2017). In addition, corruption, fraud, "partnership", unworthiness, protection, nepotism, and customer bonds (Panagiotakopoulos, 2020; Duquenne & Metaxas, 2017; Anastasiadou, 2016; Giousmpasoglou et al., 2016; ICAP, 2015; Tsekeris et al., 2015) are significant obstacles to the development of the career of the new skilled workforce. Besides, classical reasons for leaving the country remain the low wages and limited career opportunities (Mitsakis & Mendonca, 2017).

Moreover, data on students studying social sciences reveal the deterioration of employment opportunities in Greece (Kalamatianou & Kougioumoutzaki, 2012). Even though lack of work is one of the most important factors leading to emigration decisions, it does not seem to be entirely determinant. Many of the high-skilled immigrants do not mainly leave to search for work due to high unemployment in Greece, but mostly to seek better working conditions, prospects and job stability, benefits that are degraded at the moment in Greece. The majority of migrants in this third mass exodus are very dissatisfied with the employment conditions, career prospects, and the relevance of their job to their educational background. The above concerns of young people with high qualifications, under

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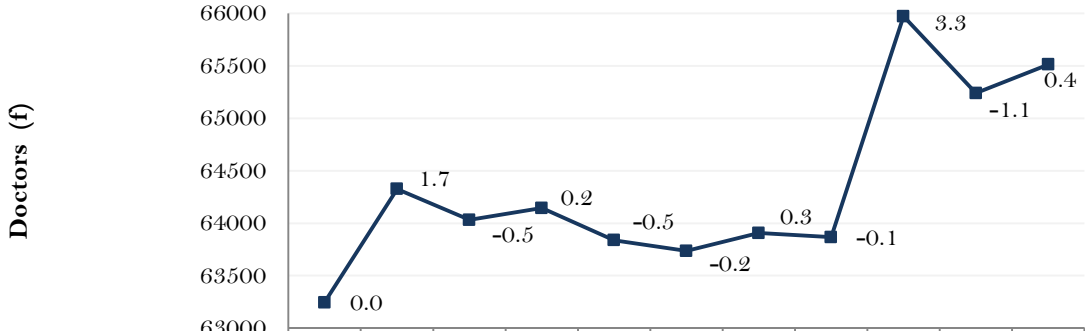
conditions of pressure and strict austerity, can lead to a mass exodus abroad (Theodoropoulos et al., 2014), with Greece incurring particularly negative consequences. Among other negative things, we also observe a reduction in the capacity of the economy, a downgrading of research activities at the domestic level, and a shrinking of the country's human resources.

Repatriation in the near future is neither a plan nor a wish, taking into consideration the existing situation (Labrianidis & Pratsinakis, 2016; Markantonatou, 2013). Till now, the large escape of young scientists abroad is perhaps an exaggerated scenario, as the estimates of the number of young people leaving the country do not seem to compose a mass phenomenon. At this point, it is worth mentioning that in addition to Greek scientists there is a large group of second-generation immigrants in Greece who choose to remain in Greece and aspire to their personal and professional development (Michail & Christou, 2018).

2.2 Greek Physicians' Brain Drain

Greece is one more example of a country that was hit by the financial crisis and has exiled a significant portion of the medical field. The ratio of doctors to the country's population may remain the highest in the EU, specifically 6.6 doctors correspond per 1000 inhabitants, in comparison to 3.6 which is the mean of the European Union (OECD, 2019). However, since 2010 there has been a steady decline in the number of physicians (Figure 1) mainly attributed to the brain drain phenomenon. Since 2015, however, there has been a dramatic increase in the number of doctors in Greece (+ 3.3%), which may hide a possible brain gain, given that the number of students admitted and graduated from medical schools in the country remains in relatively stable levels.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Annual change (%)		1.7	-0.5	0.2	-0.5	-0.2	0.3	-0.1	3.3	-1.1	0.4
Doctors (Total)	63244	64326	64032	64145	63838	63736	63906	63866	65972	65240	65513

Figure 1: Doctors in Greece, 2008-2018

More than 18000 Greek physicians work abroad and many of them have left the country due to the economic crisis (Athens Medical Association, 2019a). In particular, in the last decade, more than 10000 doctors originating from Athens have left the country. At the same time, unemployment or underemployment affects 25% of the members of the Athens Medical Association (AMA) (Athens Medical Association, 2019b), while in 2018 the unemployment of doctors in Greece reached record levels, as 28% (2100 people) of the members of the Medical Association of Athens were unemployed or underemployed. Between 2013 and 2018, 1500 doctors a year applied for certificates in order to move abroad. In 2018, the registered AMA members showed a decrease of 4% compared to 2009 and 1.1% compared to 2017 (Athens Medical Association, 2018).

Young physicians without a medical specialty are on standby situations and show a declining trend throughout the study period (Figure 2), except for 2016 when there was a slight increase. Specialized doctors show slightly lower trends, of lower intensity in comparison with the ones expecting medical specialty. Combining the simultaneous economic crisis and the brain drain of all scientific disciplines in the country, it appears that the decline in the number of doctors who are waiting for a specialty or are being trained may be due to the leak abroad. The percentage of specialized medical personnel leaving abroad has been increased in a fivefold rate during the five years 2007-2012 (Athens Medical Association, 2013). In 2019, AMA issued 1097 certificates to doctors who planned to go abroad, whereas 348 were for doctors without specialization and 749 for specialized (Athens Medical Association, 2019a).

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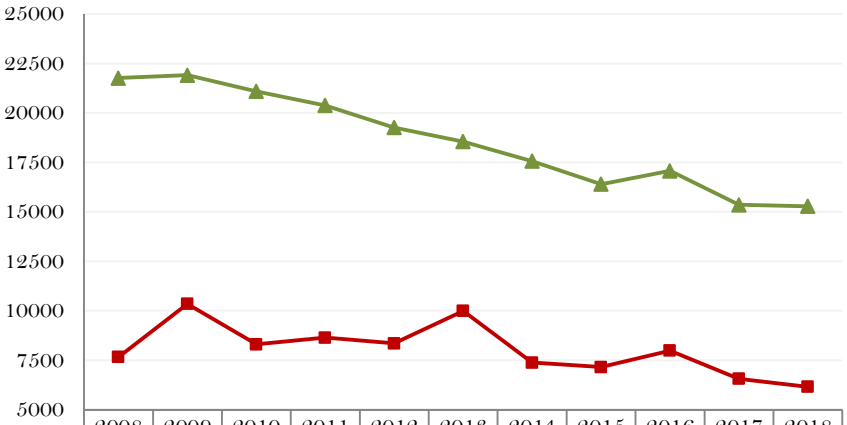

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Without speciality	14093	11550	12787	11737	10913	8556	10181	9246	9077	8784	9122
Interns (Trainees)	7666	10354	8302	8643	8353	9994	7380	7153	7991	6569	6159

Figure 2: Interns and Doctors without a specialty in Greece, 2008-2018

The effort of our society to retain the medical workforce in the country is extremely significant as the total expenditure per capita until the end of studies exceeds the amount of 85000 euros (Athens Medical Association, 2019a). Consequently, the phenomenon of brain drain, in addition to the migratory component, has direct economic implications due to the loss of resources invested in medical training (Sidiropoulos et al., 2017).

Research on the leakage of push factors of Greek physicians is very limited. Among the most important factors are limited opportunities, insecurity, declining income, high taxation, and limited funding for biomedical research (Ifanti et al., 2014). A similar study by medical graduates showed that the vast majority are willing to leave Greece in search of work abroad, with dominant destinations in Germany and the United Kingdom (Labiris et al., 2014). At the same time, it turned out that young doctors are negatively affected by unworthiness in combination with their low absorption by the private and public sectors (Sidiropoulos et al., 2017). An important element is also the choice of the specialty that can financially support the desired lifestyle of future doctors (Labiris et al., 2014).

Greece is currently deprived of a dynamic new generation of doctors who could contribute through their up-to-date knowledge to the rejuvenation of aging health care (Filippidis, 2016). The literature suggests a number of measures to encounter physicians' brain drain. It is recommended that motivational theories (Maslow, Adams, Herzberg, McClelland) could be applied to medical personnel in order to observe human behavior, attitudes, and perceptions (Chatziprodromidou et al., 2018). Interventions should aim to improve working conditions, postgraduate education, biomedical research, and health tourism (Sidiropoulos et al., 2017).

3. Data and Methodology

In order to explore the main factors affecting the intention of greek physicians to emigrate field research was conducted using questionnaires. The study population concerns the medical students of the seven medical schools in Greece so as the young physicians up to the age of 39 years old operating in Greece. The research process lasted from September to November 2018 and the participants were selected through random sampling techniques. The survey was internet-based, so the questionnaires were delivered online through the institutional emails provided by Greek medical schools and medical associations.

The research tool designed for the purpose of the present methodology consists of 21 questions (Table 1) exploring the participants' perceptions of emigrating. The data were measured with 5-point Likert scales in order to provide reliable estimates (Nemoto & Beglar, 2014). Finally, 239 young physicians participated in the research (sample size), while the confidence intervals deal with the sampling.

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Table 1: Factors affecting physicians brain drain

Push Factors	Variables	Relevant Literature
Professional and Economic reasons	Unemployment Lack of employment opportunities Lack of perspectives Career promotion Low wages High taxation High living costs Low specialization	(Gouda et al., 2015; Hagander et al., 2013; Ifanti et al., 2014; Klein et al., 2009; Marchal & Kegels, 2003; Ricketts, 2010; Sidiropoulos et al., 2017; Syed et al., 2007)
Personal reasons	Poor quality of life Experiences Unfavorable conditions to establish a family General disappointment Seek better luck	(Akl et al., 2007; Arah et al., 2008; Benamer et al., 2009; Gouda et al., 2015; Klein et al., 2009; Labiris et al., 2014; Sheikh et al., 2012)
Social reasons	Social exclusion Marginalization Racism Criminality	(Akl et al., 2007; Arah et al., 2008; Sheikh et al., 2012)
Educational reasons	Master studies Ph.D. studies Erasmus studies 2nd degree studies	(Akl et al., 2007; Benamer et al., 2009; Hagander et al., 2013; Ifanti et al., 2014; Sidiropoulos et al., 2017; Syed et al., 2007)

Source: Authors' compilation

As concerns the data analysis methods, descriptive statistical analysis was performed to describe the sample profile, while statistical hypothesis testing examined the influence of gender and income on brain drain push factors. A subsequent multivariate analysis was undertaken. Initially, exploratory factor analysis was used to identify and validate the structure of the questions and reduce their count. To ensure the satisfactory endogenous correlations, the Kaiser-Mayer-Olkin (KMO) statistical test and the Bartlett Sphericity Test (B.S.) were used. Factor extraction was done by Principal Components Analysis and the axes of the factors were rotated by Varimax rotation. The total sampling rate (KMO) is 0.822, so it is considered appropriate to use the factor analysis tool as the data show remarkable homogeneity. The Principal Component Analysis presents four Principal Components, that reduce significantly the dimensions of the medical brain drain in Greece (81% of dimension reduction), and in parallel interpret 70% of the total variance.

4. Results

The sample consists of 239 participants (Table 2). The majority of them are women (56.8%). The largest percentage concerns students before obtaining their basic degree (45.9%), following from doctors in a medical specialty (29%). Annual household income is more evenly distributed among sample participants. It is observed an association between gender and age ($p < .05$) and gender and annual household income ($p<0.05$), whereas Academic/professional status, is completely independent of gender ($p > .05$).

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Table 2: Profile of the sample

Sample	Men	%	Women	%	Total	%	p-value Chi-square
	112	43.2	147	56.8	259	100	
Age							
18-24	54	48.2	94	63.9	148	57.1	.011
25-39	58	51.8	53	36.1	111	42.9	
Academic/professional status							
BSc student	45	40.2	74	50.3	119	45.9	.369
MSc/PhD student	19	17.0	17	11.6	36	13.9	
in Medical speciality	35	31.3	40	27.2	75	29.0	
Rural service doctor	13	11.6	16	10.9	29	11.2	
Annual household income							
< 10000 €	20	17.9	40	27.2	60	23.2	.036
10000 – 15000 €	19	17	35	23.8	54	20.8	
10000 – 25000 €	31	27.7	37	25.2	68	26.3	
> 25000 €	42	37.5	35	23.8	77	29.7	

As seen in Table 3, job search intention abroad is high ($p<.05$). Among the strongest reasons that contribute to the decision of young doctors for future migration ($p<.05$) are the lack of prospects, career advancement, low wages, gaining experience, general frustration, and searching for better luck. In contrast, participants are less likely to immigrate due to the conditions of social exclusion, high marginalization, criminality or to obtain a second degree ($p <.05$). The high cost of living is equally a low-intensity factor.

Table 3: Descriptive statistics of push factors

Push Factors	Mean	Sig. (2-tailed)
Job search intention abroad	5.21 (1.8)	.000
Unemployment	4.76 (2.1)	.000
Lack of perspectives	5.54 (1.6)	.000
Career promotion	5.16 (1.7)	.000
Low wages	5.25 (1.7)	.000
High taxation	4.35 (1.8)	.003
High living costs	3.46 (1.7)	.000
Lack of employment opportunities	4.76 (1.8)	.000
Low specialization	4.87 (1.8)	.000
Poor quality of life	4.24 (2.0)	.067
Experiences	5.36 (1.7)	.000
Unfavorable conditions to establish a family	3.98 (1.9)	.852
General disappointment	5.30 (1.8)	.000
Seek better luck	5.22 (1.8)	.000
Master studies	3.90 (2.2)	.456
PhD studies	4.33 (2.1)	.015
Erasmus studies	3.27 (2.3)	.000
2nd degree studies	2.39 (1.8)	.000
Social exclusion	2.64 (1.8)	.000
Marginalization	2.62 (1.8)	.000
Racism	2.75 (1.9)	.000
Criminality	2.95 (2.0)	.000

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There is a difference in means between men and women ($p<.05$) as concerns their perceptions about unemployment (men: M= 4.17, SD=2.2; women: M= 5.20, SD= 1.9), lack of perspectives (men: M= 5.22, SD=1.8; women: M= 5.78, SD= 1.5), living costs (men: M= 3.13, SD=1.6; women: 3.71, SD= 1.8), employment opportunities (men: M= 4.29, SD=2.0; women: 5.12, SD= 1.7), quality of life (men: M= 3.93, SD=2,1; women: 4.47, SD= 1.9), and further studies (men: M= 3.50 SD=2.2; women: 4.20, SD= 2.1) as motives for leaving the country.

In addition, there is a statistically significant difference for doctors whose income ranges between 10000-25000 (M= 4.73, SD=2.1;) and those with less than 10000 (M= 5.68, SD=1.5) or greater than 25000 (M= 5.58, SD=1.5;) in their intention to look for work abroad, with the second to have much stronger intention ($p<.05$). The lack of prospects is an incentive for doctors of all incomes to abandon Greece but it seems to have greater intensity in low incomes ($p<.05$). The same perception is found in the unemployment factor where participants with an income of more than 10000 are slightly positively willing to leave their country as a result of unemployment. In contrast, young scientists with incomes below 10000 have a strong intention to move abroad because of this ($p<.05$). Among the positive factors that repel the country's medical personnel is the promotion of their career and it significantly influences all incomes. Particularly significant is the finding that respondents with positive intention for job search abroad (81%) could return to Greece if conditions got better.

4.1 Factors affecting physicians' job search intention abroad

The four main components that have been detected (Table 4), reveal that the push factors for Greek physicians' brain drain arise from a general feeling of the lack of prospects in their homeland, an accumulated disappointment about the socio-economic situation in Greece, accompanied by the deep disappointment by homeland's social identity. In addition, stagnant conditions are major impediments to the career development of Greek medical care personnel. And finally, the continuation of studies remains a classical reason for leaving the country.

Table 4: Component Matrix

		Principal Components			
Items	H^2	Homeland's social identity	Lack of prospects	Unfavorable economic environment	Continuation of Studies
Marginalization	.733	.913			
Social Exclusion	.484	.898			
Racism	.691	.879			
Criminality	.759	.801			
Poor quality of life	.751	.518			
Seek better luck	.763		.848		
General disappointment	.766		.840		
Experiences	.867		.719		
Unemployment	.795			.804	
Lack of employment opportunities	.665			.795	
Low wages	.768			.575	
High taxation	.589			.538	
Postgraduate Studies	.545				.846
Doctorate	.563				.831
Obtain 2nd degree	.509				.590
% of Total Variance		35.4%	15.9%	10.5%	7.4%

1st component: Homeland's social identity (35.4% of total variance).

The first complex component, which contributes to the highest percentage in the interpretation of physicians' brain drain intention, highlights the social aspect of the phenomenon. It is composed of five individual variables with very high factor loadings and at the same time, they are positively correlated. The combination of the initial variables reflects the climate that results from marginalization, social exclusion, racism, crime, and low living standards. The above compose an abnormal social environment with conditions incompatible with the lower acceptable threshold of quality of life of young doctors.

2nd component: Lack of prospects (15.9%).

The second principal component participates with a particularly significant percentage in the interpretation of the under study phenomenon and reflects the lack of development and career prospects in the country. It consists of three initial variables, two of which have very high factor loadings, which are positively correlated with each other. The logic of

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interpretation is based on the general frustration of young scientists. It springs from the unattractive inner environment where it functions as a pole of repulsion for young scientists to seek new nodes of fortune and experiences.

3rd component: Unfavorable economic environment (10.5%).

The third principal component is both economic and social and defines the economically stationary conditions of Greece. It consists of four initial variables that are positively correlated. The hyper-variable is formed by unemployment, which may indirectly reflect the changing conditions in the medical industry, lack of professional opportunities, low wages, and high taxation. Therefore, the unfavorable economic environment feeds the outflow of new doctors abroad.

4th component: Continuation of Studies (7.4%).

The latter component has the least weight in the interpretation of physicians' brain drain; however, it is a classic reason why young scientists are leaving the country. Continuing studies, whether it is a doctoral degree or a master's degree or even obtaining a second degree, is a timeless factor in interpreting the phenomenon. This component also reflects the need and the willingness for young physicians to engage in research that is often limited and underpaid in Greece. It consists of three initial variables with positive correlations and high factor loadings in the first two.

The analysis conducted on 239 young physicians highlights high intentions to seek employment abroad. There are statistically significant differences between men and women regarding their perceptions of the possible causes of emigration. Women consider more than men that unemployment, employment prospects, and opportunities and quality of life to be the most important reasons in the migratory decision. An important aspect of migratory decision making plays also the family income. The young doctors whose family income is either very low or quite high are more receptive to looking for work abroad. Finally, the multivariate analysis highlights four main determinants feeding physicians decision-making; homeland's social identity, lack of prospects, unfavorable economic environment, and continuation of studies.

5. Conclusion and Recommendations

In Greece, in recent years, there has been a shrinking trajectory of the medical workforce, as the brain drain has penetrated this scientific field as well. Since 2010, there has been a steady decline in the number of physicians, which is largely attributed to brain drain. The domestic health system and the chronic pathogens it faces do not have a lot of leeway for the suspension/limitation of the phenomenon, as for the time being the incentives for them to return to the country are not attractive, confirming that the Greek State had not developed a risk culture (Eleftheriadis & Vyttas, 2016).

The emigration of highly qualified scientific personnel has multiple effects on Greek society. Firstly, it weakens the country scientifically. As a result, there is a threatening shortage of doctors, leading to a major undermining of the quality of health services and making it difficult to develop medical innovation in Greece. Physicians' brain drain has parallel unfavorable economic implications as Greece does not avail of the scientists though funded them for their studies.

A barometer in the decision for young physicians to emigrate is the social identity of Greece, characterized by racism, social exclusion, criminality, and marginalization, which is inconsistent with the ideal level of the desired quality of life of doctors. The lack of development prospects is also an important impulse in the emigration decision. Finally, the factors that strengthen their intention to look for work abroad are the domestic unfavorable economic environment as well as the possibilities for conducting research and postgraduate specialization that exist abroad. The results of the analysis confirm previous research on Greek students as regards the social injustice and non-confidence to the politicians and their intention to restrain the economic situation in the country, mainly due to nepotism and corruption (Panagiotakopoulos, 2020; Anastasiadou, 2016; Giousmpasoglou et al., 2016).

In a country like Greece, where the geographical distribution of doctors has inequalities, it is imperative for the State to intercept this phenomenon. An optimistic compensatory factor in the intention of emigration of young doctors abroad is their intention to repatriate in case of improvement of the socio-economic conditions. This finding suggests the need to create a health map, record needs, and link the entrants of medical schools with these needs, taking into account the geographical peculiarities of the country. Furthermore, this has to be brought to the attention of the Greek policy makers and political actors to create bridges that will provide opportunities in the medical staff so that it remains in the country.

The present research could be further developed by focusing on the actions needed to intercept physicians' emigration. This direction would possibly benefit the functioning of the health system, and reverse the brain drain into brain gain.

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