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# contents

## Articles

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To provide members with the opportunity exchange information, opinions etc. by publishing a relevant scientific journal or by cooperation in elaborating scientific studies in relation to the future development of higher education and research as well as to improve their quality in the field of economic studies and business administration.

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# INSTITUTIONAL CHANGES IN THE EURO-ZONE AND THE GREEK DEBT CRISIS

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**Abstract**
This study attempts to quantify the effects of the implicit restrictive monetary policy, exercised by the European Central Bank (ECB) in Greece, during the world financial crisis. An autoregressive distributed lags (ARDL) testing approach is used to verify the existence of a long-run relationship between GDP, total money supply and government expenditure in the Greek economy from 2002 to 2013. The main findings suggest that the institutional settings of the ECB should allow the use of monetary policy during periods of monetary crisis. Money supply in the Greek economy is in a positive relationship to the GDP. If the institutional settings of the ECB were different, allowing money supply to remain stable during the crises, a significant portion of the GDP decline would have been averted.

**JEL Classification:** E520, E580
**Key words:** Monetary policy, Euro-zone, External Debt, Greece

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## 1. Introduction: The Deep Economic Crisis and the problem of Public Debt

The Greek economy is in the midst of a deep crisis, as a result of a large fiscal deficit, huge debt and a continued erosion of its competitive position. The global crisis amplified the cumulated negative effects of these chronic weaknesses and accelerated the downturn of the economy.

The crisis that the Greek economy is facing today is all-encompassing and multi-faceted. Therefore, it calls for a bold response of the same kind: sustainable, on-going and convincing fiscal consolidation, especially on the expenditure side, coupled with ground breaking *structural reforms* aimed at improving the operation of markets and enhancing competitiveness.

Most importantly, Greece must break the behavioral pattern, attitudes and policies that have brought the country to its present situation. Politicians also must change attitudes by trying to implement the structural reforms needed, without considering the short-term political cost and their survival on the political scene. A lot has been done, most of which should have been done decades ago e.g. the opening of the so called 'closed' professions, deregulation of shopping times, the licensing system for taxis and lorries, the reform and increase in the efficiency of the public health system, the reform of the supplementary pension system etc. However, some reforms failed to be completed owing to the attitudes of politicians, who continue taking into account pressures applied from special interest groups and/or considering short-term political cost.[1] Therefore, the debt crisis has caused serious problems to Greek society. These problems have to be resolved soon.

The purpose of this paper is not to argue that Greece is without blame for the crisis and its results. It goes without saying that the structural reforms for increasing market efficiency have to be completed and they should have been completed at the same time that were implemented in the rest of the E.U. states during the 60's and the 70's. It is argued however, that the severe effects of the financial/debt crisis on

1. An example of ill-implemented structural reforms is the system of licensing taxis, where in principle the issuance of new taxi licenses is allowed by the reformed intuitional framework but in practice no new taxi license can be issued because strict population criteria are set which do not permit new licenses. Another ill-implemented measure is the so called 'Athena' project for the reform of the higher education sector. The minister, instead of using criteria that are internationally accepted in academia for restructuring higher education establishments, in order to minimise the political cost, chose to debate the project with local politicians. The project resulted in many non-rational choices: departments with one, two or no members of staff at all, departments in the engineering faculty which accept students with a background in literature (!) and Institutions with two identical departments e.g. two Departments of Business Administration in the same Faculty.

the welfare of the Greek people could have been alleviated, if the Eurozone had had a different approach (different institutional settings) in dealing with the 2008 world financial crisis.

The paper proceeds as follows: section 2 reviews the literature on the Greek crisis, section 3 attempts a historical overview of the crisis, with proposals as to what could have been done differently on the part of the Greek government, section 4 provides evidence, using an econometric model, of the effects of the decrease in the money supply (money stock) due to the EU policies on the GDP and section 5 presents the conclusions.

## 2. Literature review of the Greek crisis

In the literature analyzing the causes of the crisis and the possible remedies, there are papers that point the finger at the Greek governments, indicating as a solution to the crisis a possible exit from the Eurozone. Additionally, there are papers that try to analyze the institutional framework of the Eurozone and the attitude of Europe (i.e. mainly Germany) towards the Greek crisis. This strand of papers indicate that the solution to the crises does not rest with Greece alone but with the institutional changes that have to be made in the Eurozone.

De Grauwe (2010) argues that the crisis was allowed to unfold because of hesitation and ambiguities by both the Eurozone governments and the ECB. The Eurozone governments failed to give a clear signal about their readiness to support Greece. The failure to do so mainly resulted from disagreements, among member state governments, concerning the appropriate response to the Greek crisis. The ECB, in turn, created ambiguities about the eligibility of the Greek government debt as collateral in liquidity provision (*ibid*, p. 2).

The same author (De Grauwe: 2011) further argues that there is a need for a fundamental restructuring of the Eurozone's institutions. In that restructure it is essential that the ECB take on the full responsibility as lender of last resort in the government bond markets of the Eurozone. Without this guarantee, the government bond markets in the Eurozone cannot be stabilized and crises will remain endemic. Moreover, he argues that further steps towards political unification must be taken, without which effective control of national government deficits and debts cannot be implemented. Liquidity provision should be performed by a central bank and the governance of moral hazard by another institution which will act as the supervisor to the system.

Kouretas and Vlamis (2010) argue that the Eurozone governments failed to give a clear signal, indicating their readiness to support Greece, while the Greek fiscal crisis was escalating. Additionally, the institutional setting of the EU resulted in a lack of solidarity funds at supranational level. Since the Eurozone is a monetary union and not an economic one there is no federal budget. Therefore, monetary policy is set at a supranational level by the ECB, but fiscal policy is still in the hands of national policy makers. Whenever a crisis occurs at the EU periphery, there is no adjustment mechanism to deal with such a crisis at a supranational level. Katsimi and Moutos (2010) conclude that fiscal discipline, within the Eurozone, should be the top and only priority of policymaking. Current account imbalances within the Eurozone, should also feature in any reform of the structure of economic governance.

Featherstone (2011) argues that when the market crisis erupted, the European Union's Council of Ministers and the ECB failed to provide a timely and effective response. The implications are threefold: the constraints on domestic reform proved immutable to EU stimuli; the 'euro' is more vulnerable to crisis than previously acknowledged; and the early discussion on 'euro' governance reform suggests that its underlying philosophy has not shifted significantly towards more effective 'economic governance'. Within Greece, the unprecedented external monitoring and policing of its economy –though matched by some initial successes– raises in the longer term sensitive issues of legitimacy and governability, with uncertain prospects for avoiding further crises.

Arghyrou and Tsoukalas (2011) on the other hand, argue that either Greece will introduce the reforms necessary to address the initial source of the crisis, *i.e.* deteriorating fundamentals, allowing the country to stay in the European Monetary Union (EMU), or Greece will not promote any reforms, in which case the only option will be to leave the euro. EMU periphery economies have diverged so much from those of core EMU countries that either they cannot sustain, or markets consider that they are not able to sustain, the cost of reforms necessary to stay in the Eurozone. They propose a temporary split of the euro into two currencies, both run by the ECB. The hard euro will be maintained by the core EMU members, whereas the periphery EMU countries will adopt the weak euro for a suitable period of time. The plan involves a one-off devaluation of the weak euro versus the strong one simultaneously with the introduction of far-reaching reforms and rapid fiscal consolidation in the periphery EMU countries.

Sklias and Maris (2013) focus on the poor political and institutional performance over the last three decades in Greece. They argue that the Greek crisis has important political elements, owing to which the crisis will persist; the economic factors have contributed to the crisis but they are not the root causes, which can be found only within the political and institutional model of development and the mode of Greek governance.

To conclude, most of the authors recognize that the institutional framework of the Eurozone and the attitude of Europe towards the Greek crisis has affected the development and evolution of the crisis. It is pointed out that the solution does not rest with Greece alone but with the institutional changes that have to be made in the Eurozone.

## 3. An historical overview of the crisis

### *3.1 Some facts about the Greek debt crisis*

The Greek debt crisis began when Greece was borrowing heavily to cover its increasing budget deficits and financial markets realized that, at that pace, the debt would not be manageable. Table 1 presents the increase in the budget deficits produced by the Greek government from 2003 to 2010. It can be seen that the deficit rocketed in 2009. This was, mainly, due to the adjustment in the measurement methodology made by the newly elected Greek government[2]. The spread of Greek government bonds against the interest rates of German government bonds was rapidly increasing. When it reached 7% the government decided that borrowing from the financial markets was not an option, because the debt would not be sustainable.

2. The deficit of the state-owned enterprises was included in the public deficit.

**Table 1:** GDP, Public revenues, expenses and debt (in mil. Euros, current prices

| Year | GDP | Revenues | Expenses | Deficit | Public Debt | % GDP |
|---|---|---|---|---|---|---|
| 2003 | 153,045 | 37,500 | 40,735 | -3,235 | 179,008 | 117.00% |
| 2004 | 164,421 | 40,700 | 45,414 | -4,714 | 198,832 | 120.90% |
| 2005 | 196,609 | 42,206 | 48,685 | -6,479 | 209,723 | 118.90% |
| 2006 | 213,085 | 46,293 | 50,116 | -3,823 | 224,162 | 105.10% |
| 2007 | 228,180 | 49,153 | 55,733 | -6,580 | 237,742 | 104.20% |
| 2008 | 239,141 | 51,680 | 61,642 | -9,962 | 260,439 | 108.90% |
| **2009** | **237,494** | **48,491** | **71,810** | **-30,866** | **298,524** | **125.68%** |
| 2010 | 231,000 | 52,700 | 66,188 | -19,473 | 340,680 | 147.48% |

*Source:* Greek Ministry of Finance

As a result, the Greek government signed a 'memorandum' with the E.U. and the International Monetary Fund (IMF) for borrowing 110 billion euros, in order to cover the immediate operational needs of the Greek state. At the same time, the Greek government agreed to take immediate action for the rapid reduction of the budget deficit and to make the necessary structural changes in the economy, in order to increase its competitiveness.

There are some points that have to be made, regarding this first agreement between the Greek government and the international lenders:

- The huge increase in the budget deficit in 2009 (it more than tripled in one period) was mainly the result of the change in the accounting methodology, used by the Greek government. The world financial markets were in turmoil due to the unprecedented financial crisis that started in the US in 2008. Obviously, it was a very bad time to make the change in the accounting methodology that resulted in an increase of the public deficit by 7% of the GDP[3].
- The Greek government did not bargain at all with the international lenders over the terms of the loan. It has to be pointed out that at that time it was in the interest of all the core EU countries to find a solution regarding the Greek debt, without proceeding to a haircut or leaving Greece to become bankrupt, since their banking sector, as can be seen from Table 2, was exposed to

3. The deficit before the adjustment was about 9% and after the adjustment it rocketed to 16% of GDP.

Greek government bonds. The largest amount was held by the banking sector of France, followed by Switzerland and Germany.

**Table 2:** Distribution of Greek public bonds in 2007

| **Country** | **Public bonds, in million euros** |
|---|---|
| France | 58,040 |
| Switzerland | 49,205 |
| Germany | 33,258 |
| USA | 12,624 |
| United Kingdom | 9,494 |
| Holland | 9,115 |
| Portugal | 7,936 |
| Ireland | 6,543 |
| Japan | 6,498 |
| Italy | 6,447 |
| Other countries | 33,610 |
| **Total** | **232,770** |

*Source:* World Bank

This is a conclusion reached by other researchers as well (e.g. Gocaj *et.al.*, 2013) and the references therein): a possible Greek default in 2008 threatened the entire euro area, due to the integrated nature of European banking. Germany and France held almost half of all European exposures to those countries and a Greek default would spread panic to German and French banks and the world financial system.

- In 2009, the Greek government did not attempt to proceed to an auction of new bonds due to the high spreads prevailing in the world financial markets. It preferred to sign an agreement (memorandum) with the EU and the IMF for the borrowing of 110 billion euros. This was a political decision. There was not an unsuccessful auction of Greek government bonds in the financial markets, but it was a political decision of the government that led to the signing of the memorandum. Further, the effects of the terms of this first memorandum on the Greek economy (and more importantly on Greek society) were not calculated correctly; the effects of the austerity policy measures on the GDP were greatly underestimated, as the IMF recently has admitted. Moreover, the roadmap set by the IMF was completely unrealistic: the im-

plementation of the austerity measures would have allowed Greece to re-enter the financial markets in 2014.

- Tables 3 and 4 show the uses of this first loan of 110 billion Euros. It is observed that (a) in 2011, the total interest is almost equal to the public deficits. (b) EU-IMF loans were not for paying public sector deficits but for the rescue of the European banks holding Greek bonds. Since, the total amount of the EU-IMF loans was approximately 1/3 of the total Greek public debt it was obvious that this deal was not made to help towards a solution to the Greek debt problem.

**Table 3:** GDP, Deficit and Interests

| | GDP Million Euros | Interests Million Euros | Interests/ GDP | Deficit Million Euros | Interests/ Deficit |
|---|---|---|---|---|---|
| 2009 | 237,494 | 12,325 | 5,19% | 32.299 | 38,15% |
| 2010 | 227,994 | 13,209 | 5,79% | 18.467 | 71,53% |
| 2011 | 222,066 | 15,800 | 7,12% | 16.877 | 93,62% |

*Source:* Budget for 2011, Ministry of Finance

**Table 4:** Maturing of Public bonds and EU-IMF loans

| Year | Debt in public bonds maturing (In bil. Euros) | EU-IMF loans (In bil. Euros) |
|---|---|---|
| 2010 | 15,80 | 38,00 |
| 2011 | 31,30 | 40,00 |
| 2012 | 31,70 | 24,00 |
| 2013 | 24,90 | 8,00 |
| **Total** | **103,70** | **110,00** |

*Source:* Bloomberg– Greek Ministry of Finance

According to the Treaty on the European Union (the Maastricht Treaty convergence criteria for the creation of the Euro-zone) inflation rates in the member states should be no more than 1.5 percentage points higher than the average of the three best performing (lowest inflation) member states of the EU. Additionally, the ratio of the annual government deficit to GDP must not exceed 3%. Further, the ratio of gross government debt to GDP must not exceed 60% at the end of the preceding fiscal year. The purpose of setting these criteria was to maintain price stability

within the Eurozone. However, the Eurozone is a non-optimal monetary union; the 'golden rule' of monetary unions is that the exchange rates and interest rates should be closer to the needs of the weakest economies and not to those of the strongest. In Greece, for almost a decade after the creation of the Eurozone, government deficit and public debt criteria were not met and no effective measures were enforced by the EU to make Greek governments converge to the target values.

- It is the opinion of many researchers who have analyzed the causes of the Greek crisis (see section 2 above), that the institutional setting of the Eurozone and the non-intervention of the ECB have a considerable responsibility for the severity of the effects of the crisis - even the outbreak of the crisis itself. The ECB institutionally is not allowed to function as a 'Central' Bank, thus the financing of the debts of the member-states is subject to the evaluation rating of the financial markets. Although, Eurozone countries have transferred (abolished) monetary policy to the ECB, fiscal policy is not co-ordinated among the member states. Therefore, Greece: (a) does not have the ability to devalue its currency to compensate for lost competitiveness. The adjustment should be made by the labour market, (b) cannot exercise monetary policy because all Eurozone countries have transferred it to the ECB, (c) has a 'friendly' to crises GDP structure because the services sector, where productivity increases are difficult, accounts for most of GDP, (d) even if there is a surplus in the budget, it will not be possible to repay the huge external debt, approximately 160% of GDP.

The crisis would have been avoided (not only the Greek crisis but the debt crises of Portugal and Ireland as well) and there would have been no need for these countries to enter the 'Troika' probation if the ECB had acted as a central bank, *i.e.* if it had followed the example of the Federal Reserve Bank of the USA, increasing the money base by 2 to 2.5 trillion euros. If that were the case, government bond spreads (of the PIGS[4]! countries) would not be high and there would be no need for memorandums, haircuts and the huge decrease in standards of living. The argument against this policy comes mainly from Germany (adopted also by other central European countries) and it is summarized by the motto: '*what about inflation?*'. DeGrauwe (2011) has shown that there is a difference between money base and money stock (M3). In the real economy, what matters (the level of prices including)

4. During the period of the crisis Portugal, Italy, Greece and Spain were named PIGS, an acronym formed by their initials.

is the money stock and not the money base. But it is the money base that is affected by the central bank and that is what concerns the financial markets. So, the argument for the inflation increase is not valid. But even if it were, why is 4% inflation considered to be an 'evil' thing if GDP growth is high and unemployment low?

### *3.2 The Roots of the crisis*

The crisis in the Greek economy stems mainly from chronic problems, but also reflects the impact of the global crisis, which has entered a second, difficult phase, despite a recovery in economic activity worldwide. Apart from its other woes, the Greek economy faces an unprecedented confidence and credibility deficit.
Countries like Greece, with twin deficits and debts, face the risk of a much more difficult and slower exit from the crisis and of a protracted period of low growth. The main features of the crisis can be summarized as follows:

First, the accumulated negative repercussions of chronic weaknesses and distortions as well as macro-economic imbalances have now emerged in full force, as the factors that had previously concealed them, *i.e.* factors that fostered strong economic growth over the 1996-2007 period, have now been exhausted. The explosive fiscal imbalances have been compounded by a major credibility problem, which spread from Greek statistics to its economic policy and to its overall reputation.

Second, the effects of the global crisis on Greece's real and financial sectors are manifesting themselves with some lag. Due to the domestic distortions, Greece may not be able to reap the full benefits of the recovery that has begun to gain traction in the rest of the world.

Third, the crisis in the European and the global economy has entered a second phase, characterized by a recovery that is proceeding at a faltering pace and is uneven across countries. In this phase, the dominant question is how to address the surge in fiscal deficits and debts in all the advanced economies, attributable to the fiscal stimulus and credit support packages.

All the above factors have contributed to the confidence and credibility deficit that Greece faces today, the negative assessments of its recent performance and negative forecast of its medium-term prospects, taking into account its chronic structural weaknesses and macroeconomic imbalances.

## 4. A model to examine one facet of the crisis: the reduction in Money Supply (money stock)

In Keynesian type models, the monetary sector of the economy plays an important role in determining the level of income (or GDP) with the well-known interaction of the IS and LM curves. Economic policy can be exercised by using fiscal or monetary tools. Supply and demand for money affect the level of real interest rate which in turn, affects the level of investment and thus the GDP of the economy.

In principle, in the Eurozone, monetary policy is exercised by the European Central Bank (ECB). Nominal base interest rates are controlled by the ECB and therefore, the real base interest rate for each country is that set by the ECB, accounting for inflation. Commercial banks can borrow from the ECB using as collateral government bonds and/or other assets, so the real interest rate that determines investment in a Eurozone economy is that set by the ECB plus the profit margin of the commercial bank accounting for inflation. So, money supply is regulated by the commercial bank sector of the economy. In the Greek economy, before the crisis, the financing of government budget deficit was a significant factor, affecting the economy's money supply because government bonds were bought in the open market by commercial banks and then they were used by them as collateral in order to borrow money from the ECB. The ECB institutionally, does not have the right to intervene in the government bond market nor can it buy government bonds directly from member states.

After the crisis, Greek banks were on the one hand cut-off from the ECB and on the other, owing to the great uncertainty caused by statements and scenarios that Greece would (or could) exit the Eurozone, faced a considerable flow of deposits to financial institutions abroad. As a result, the money sector of the economy experienced a considerable decrease in money supply (see Figure 1). If this had happened to a non-Eurozone economy interest rates would have increased and the central bank would have intervened by increasing money supply. But in a Eurozone country interest rates are regulated by the ECB and the ECB cannot institutionally increase money supply. As a result, a mild increase occurred in commercial banks' interest rates (in all kinds of loans, investment, consumer and mortgages) on **existing** loans. Due to the sharp decrease in the money supply banks simply did not have money for **new** loans. There has been a gap between money supply and demand since, interest rates could not increase rapidly as they were regulated by the ECB and at the set level of interest rate there had been not enough money supply to meet

demand. So, healthy enterprises could not receive short-term loans for working capital, for acquiring material crucial for their production process, consumer loans were completely stopped and no new mortgages were provided for houses.

In order to examine the effect of the change in money supply caused by the Greek debt crisis and the Eurozone institutional settings on the real economy, GDP was taken to be affected by the total money supply of the economy. The other explanatory variable that was put in the model was total government expenditure. Of course, government expenditure (G) is part of the total GDP produced in a country (the other elements being private consumption, investment and the external sector of the economy). It was decided to include it as an explanatory variable because of its multiplying effect on GDP properties. A positive and statistically significant coefficient is expected for this variable. A further reason for using these variables only was that these two variables are the main variables for exercising economic policy (*i.e.* monetary and fiscal). Therefore, the model used is:

$$GDP_t = f(Ms_t, G_t) + e_t;$$

where GDP is gross domestic product, Ms money supply, G total government expenditure, e is the disturbance term which is assumed to be an independent and identically distributed random variable, t indicates time. The estimated final model was in double logarithmic form:

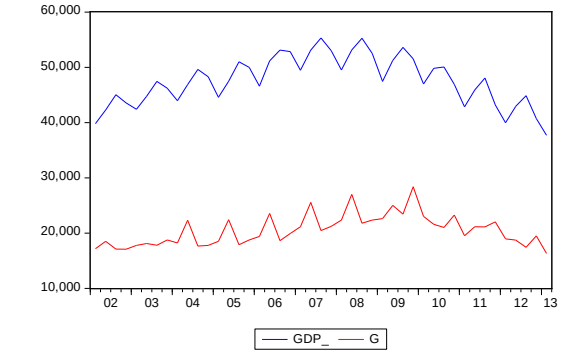
$$lnGDP_t = a_0 + b_1 lnMs_t + b_2 lnG_t + e_t \quad \textbf{(1)}$$

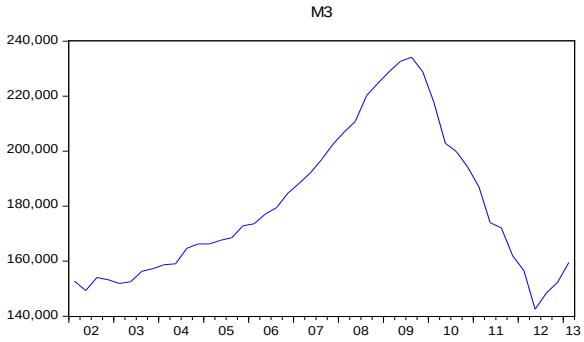
The model was estimated in a double logarithmic form for two reasons: (a) to reduce the variability of the data and (b) to interpret the estimated coefficients of the explanatory variables as elasticities. The sample period was from January 2002 to January 2013, quarterly data were used and the sample size was 45 observations.

*4.1 Data description*

The aim of the authors is to show the effect of the decrease in money supply, due to the Eurozone institutional settings, on GDP. The GDP series, in constant 2005 prices, were extracted from the database of the Hellenic Statistical Authority (ELSTAT) for the period of 2002q1 to 2013q1. Data for total government expenditure were extracted from the same database. As a measure of money supply, the M3 has been used for the Greek economy. Quarterly data for M3 have been extracted from the Bank of Greece database. Real money supply was calculated using the inflation rate reported by Eurostat for the Greek economy.

**Figure 1:** Money Supply, Government Expenditure and GDP in the Greek Economy




*Source:* GDP and government expenditure data was extracted from the Hellenic Statistical Authority (ELSTAT); money supply (m3) data was extracted from the Bank of Greece. Graphs are produced by the authors.

The above figure shows the raw data used. Quarterly GDP and government expenditure was not seasonally adjusted. For this reason, the D1, D3 and D4 dummies were included. It is seen that from 2009 to 2012, *i.e.* in just two years, real money supply for the Greek economy has been reduced by 39.15% (peak at 2009q3, min at 2012q2).

### *4.2 Estimating methodology*

In order to examine the long-run relationship (co-integration) between the GDP and the explanatory variables of total money supply (M3) and government expenditure (G) a cointegration analysis has been used. Before examining the existence of co-

integration between the variables we must analyze first, the order of integration of the variables considered. This analysis is usually done using the ADF (Dickey, Fuller, 1981) or the P-P (Phillips, Perron, 1988) unit root test. The P-P unit root test was used to test the series for stationarity.

**Table 5:** Phillips-Peron unit root test results

| | Level | First Difference |
|---|---|---|
| GDP | -1.59 | -11.86* |
| Total Money Supply (M3) | -1.01 | -3.92* |
| Government Expenditure (G) | -3.74* | -17.98* |

Notes: The values refer to Phillips-Perron adj. t-test statistic. The asterisk indicates statistical significance of at least 5% level.

*Source:* Authors' estimations

The values of the P-P test are presented in Table 5. The null hypothesis ($H_0$) of a unit root (non-stationarity) is tested against the alternative. $H_0$ was rejected at 5% level of statistical significance for G and therefore, it is concluded that it is I(0). The GDP and M3 variables were found to be I(1); the null hypothesis was rejected at 5% level at the first difference.

When there are only I(1) variables, the maximum likelihood approach of Johansen and Juselius (1990) can be used. In our case the system contains I(0) and I(1) variables and therefore, the Autoregressive Distributed Lag modeling (ARDL) suggested by Pesaran *et al.* (1999, 2001) will be used. The ARDL method can be applied on a time series data irrespective of whether the variables are I(0) or I(1) (Pesaran and Pesaran, 1997), it generally provides unbiased estimates of the long-run model and validates the t-statistics even when some of the regressors are endogenous (Laurenceson and Chai, 2003). However, it is necessary to check that the variables are not I(2) because, in this case, ARDL would produce spurious results (Oteng-Abayie *et.al.*, 2006). As can be seen from the above Table, the variables are either stationary on their level or at their first difference.

Following Pesaran *et.al.* (1999, 2001) the ARDL representation of equation (1) is:

$$\Delta lnGDP_t = a_0 + \vartheta lnGDP_{t-1} + \sum_{i=1}^{\mu} \theta_i DL_{i,t-1} + \sum_{j=1}^{p} a_j \Delta lnGDP_{t-j} + \sum_{i=1}^{\mu} \sum_{j=0}^{p} \beta_{ij} \Delta DL_{i,t-j} + \tau T + \delta_1 D1 + \delta_3 D3 + \delta_4 D4 + \omega_t \quad \mathbf{(2)}$$

where $\Delta$ is the first-difference operator, *GDP* is Gross Domestic Product in constant prices, *DL*=(*ln* M3, *ln* G) is the vector with the explanatory variables; M3 is total money supply in real terms and G represents total government expenditure, in constant prices, *D1*, *D3*, *D4* are seasonal dummies, *T* time trend, $\omega$ is a white noise error term, $\mu$=2 is the number of explanatory variable, $\vartheta, \theta_i$ are the coefficients that represent the long-run relationship, $a_j$, $\beta_{ij}$ are the coefficients that represent the short-run dynamics of the model and p is the number of lag length.

The ARDL method to co-integration requires[5]: First, equation (2) is estimated and the lag order of the ARDL is determined using the appropriate lag selection criterion. To find the order of the ARDL model $8^{\mu}$ 7=448 regressions were estimated. Second, a test was conducted that the errors in equation (2) are serially independent. The Lagrange Multiplier (LM) test was used to test the null hypothesis that the errors in equation (2) are serially independent against the alternative that there are autoregressive or moving average relationships in the errors. Then, the model is tested for stationarity (*i.e.* dynamic stability). The requirement is that the inverse roots of the AR polynomials lie strictly inside the unit circle. In our case, the plot of the inverse roots of the AR polynomial was made. Fourth, from equation (2) a test for the existence of long-run relationship was made. This is called the 'bounds testing' approach to co-integration and it is associated to the hypothesis testing $H_0: \vartheta = \theta_1 = \theta_2 = 0$; *i.e.* the long-run relationship does not exist against the alternative $H_1: \vartheta \neq \theta_1 \neq \theta_2 \neq 0$ *i.e.* the long-run relationship exists. Fifth, assuming that the bound test, described above, is conclusive and there is a cointegrating relationship, the coefficient and its statistical significance of the Error Correction Term (ECT) can be found by estimating:

$$\Delta lnGDP_t = a_0 + \sum_{j=1}^{p} a_j \Delta lnGDP_{t-j} + \sum_{i=1}^{\mu} \sum_{j=0}^{p} \beta_{ij} \Delta DL_{i,t-j} + eECT_{t-1} + \omega_t \quad \textbf{(3)}.$$

The coefficient of the error correction term, *e*, should be negative and statistically significant meaning that there is a co-integration between the dependent and the explanatory variables. The value of this coefficient shows the percentage change of any disequilibrium between the dependent and the explanatory variables is corrected within one period (one quarter).

Finally, the long-run impact of the explanatory variables on the dependent vari-

5. For a more detailed description of the steps of the ARDL method see, among others, Serenis *et.al.* (2014)

able is calculated using the expression (Bardsen 1989):

$$\hat{\gamma}_i = -\frac{\hat{\theta}_i}{\hat{\vartheta}} \qquad \textbf{(4)};$$

where $\hat{\theta}_i$ and $\hat{\vartheta}$ are the estimated long-run coefficients in equation (2). The $\hat{\gamma}_i$s show how the dependent variable, in our case the logarithm of GDP, responds in the long-run to any change in the explanatory variables *i.e.* the logarithm of real money supply and real government expenditure. However, the $\hat{\gamma}_i$s provide a single value to quantify the long-run effect and they do not provide any information about the degree of variability associated to them (Gonzalez-Gomez *et.al.*, 2011). Further, confidence intervals for each coefficient cannot be constructed using traditional statistical inference because they do not follow the normal distribution since they are calculated as the division of two normal variables. Following Efron and Tibshirani (1998) the bootstrap method, which is a non-parametric method, can be used in order to calculate empirically confidence intervals without assuming a specific distribution of the $\gamma_i$s. In our case this was made for 95% level of statistical significance. If the zero is contained in the interval then the effect of the explanatory variable will not be statistically significant.

### *4.3 The Results*

The lag order of the ARDL model, found with the procedure described in the section above, is (5, 7, 5)[6]; the first number represents the distributed lags of *ln*M3, the second the distributed lags of *ln*G and the third the distributed lags of *ln*GDP. The results are presented in the following Table 6.

The Lagrange Multiplier (LM) test was used to test the null hypothesis that the errors in equation (3) are serially independent. The F-statistic of the LM test had a value of 1.345 and it was not statistically significant so the null hypothesis of no-serial correlation was not rejected.

The Breusch-Pagan-Godfrey heteroskedasticity test was also performed; the F-statistic had a value of 0.459, it was not statistically significant and the null hypothesis of homoschedasticity was failed to be rejected.

6. For the determination of the lag order of the ARDL model the maximum number of eight lags (p=8) in equation (2) was considered.

**Table 6:** ARDL results for the effects of money supply on GDP for the Greek Economy

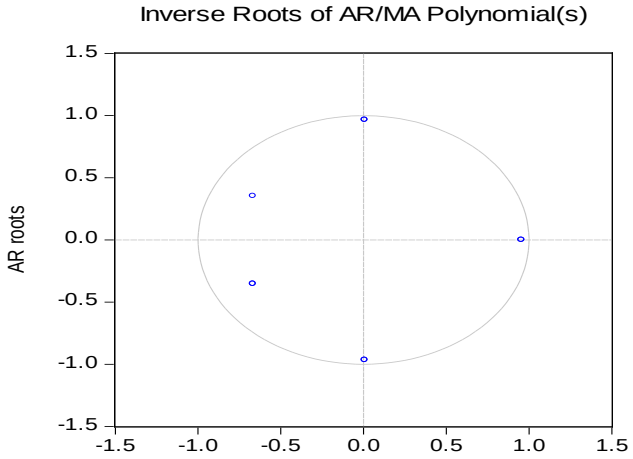
| Dependent Variable: *Δ ln GDP* | | | | | | | |
|---|---|---|---|---|---|---|---|
| Variable | Coefficient | Std. Error | t-Statistic | Variable | Coefficient | Std. Error | t-Statistic |
| *ln* $gdp_{t-1}$ | **-0.766438** | 0.156520 | -4.896727 | *Δ ln g* | 0.138097 | 0.086663 | 1.593485 |
| *ln* $m3_{t-1}$ | **0.483125** | 0.052092 | 9.274485 | *Δ ln* $g_{t-1}$ | **0.894573** | 0.188119 | 4.755353 |
| *ln* $g_{t-1}$ | **0.528499** | 0.197864 | 2.671020 | *Δ ln* $g_{t-2}$ | **0.628638** | 0.099805 | 6.298656 |
| *@trend* | -0.016316 | 0.033876 | -0.481656 | *Δ ln* $g_{t-3}$ | **0.962983** | 0.173261 | 5.557993 |
| *constant* | 8.612315 | 5.935252 | 1.451045 | *Δ ln* $g_{t-4}$ | **0.263718** | 0.073452 | 3.590370 |
| *D1* | -0.263691 | 0.236862 | -1.113268 | *Δ ln* $g_{t-5}$ | **0.641258** | 0.092911 | 6.901850 |
| *D3* | 0.169312 | 0.338806 | 0.499731 | *Δ ln* $g_{t-6}$ | **0.158913** | 0.070911 | 2.241039 |
| *D4* | -0.140977 | 0.195767 | -0.720125 | *Δ ln* $g_{t-7}$ | **0.285381** | 0.041991 | 6.796318 |
| *Δ ln m3* | **0.619314** | 0.124947 | 4.956600 | *Δ ln* $GDP_{t-1}$ | -0.360410 | 0.179147 | -2.011811 |
| *Δ ln* $m3_{t-1}$ | **-0.402802** | 0.094050 | -4.282835 | *Δ ln* $GDP_{t-2}$ | -0.220459 | 0.279754 | -0.788046 |
| *Δ ln* $m3_{t-2}$ | **-0.953564** | 0.152074 | -6.270394 | *Δ ln* $GDP_{t-3}$ | **0.179368** | 0.067600 | 2.653381 |
| *Δ ln* $m3_{t-3}$ | **-0.763895** | 0.197031 | -3.877023 | *Δ ln* $GDP_{t-4}$ | **0.648922** | 0.051400 | 12.62498 |
| *Δ ln* $m3_{t-4}$ | **0.733105** | 0.259717 | 2.822708 | *Δ ln* $GDP_{t-5}$ | **0.506824** | 0.042597 | 11.89817 |
| *Δ ln* $m3_{t-5}$ | **-1.197831** | 0.230873 | -5.188262 | $ect_{t-1}$ | **-0.291051** | 0.085142 | -3.418418 |

Notes: The period examined is 2002q1 to 2013q1; GDP is Gross Domestic Product in constant prices, M3 is total money supply in real terms, G is real total government expenditure, D1, D3, D4 are seasonal dummies. The results for ECT are from the estimation of (3) in step 4. Statistically significant coefficients of at least 5% level of statistical significance are presented in bold.

*Source:* Authors' estimations

The next step was to establish the dynamic stability of the model. When a model has AR terms it will be dynamically stable when the roots of the AR polynomials lie strictly outside the unit circle or the inverse roots of the AR polynomials lie strictly inside the unit circle. In our case, the plot of the inverse roots of the AR polynomial was made and it is seen in Figure 2, below:

**Figure 2:** Dynamic stability test




*Source:* Authors' estimations

All the inverse roots of the AR polynomials lie strictly inside the unit circle, therefore the model is stationary.

The next step was to test for the existence of long-run relationship between the dependent and the explanatory variables. The Wald 'bounds test', described in the fourth step above, was performed and its results are reported in Table 7. According to the computed F-statistic which is higher than the appropriate upper bound of the critical value, the null hypothesis of no-cointegration is rejected and the alternative is adopted and it is concluded that there is a long run relationship between the variables. In other words, total money supply and government expenditure are affecting the long-run dynamic of the GDP.

**Table 7:** Wald 'bounds test' for the existence of co-integration Wald Test
Equation: ARDL_5_7_5

| Test Statistic | Value | df | Probability |
|---|---|---|---|
| F-statistic | 12.61930* | (3, 13) | 0.0004 |
| Chi-square | 37.85789 | 3 | 0.0000 |

Null Hypothesis: C(1)=C(2)=C(3)=0

Note: Restrictions are linear in coefficients; the asterisk indicates statistical significance at least 5% level.

*Source:* Authors' estimations

After establishing, by the Wald test, that there is a cointegrating relationship, the coefficient and its statistical significance of the Error Correction Term (ECT) was estimated and they are presented in Table 6. The coefficient of the ECT, *e*, should be negative and statistically significant meaning that there is a co-integration between the dependent and the explanatory variables. The value of this coefficient shows the percentage change of any disequilibrium between the dependent and the explanatory variables is corrected within one period (one quarter). In our case the sign of the ECT coefficient is of the expected value, it is negative, and it is statistically significant. Its value of 0.29 shows that any disequilibrium between the dependent and the explanatory variables is corrected in less than a year.

**Table 8:** Long-run impact of money supply (M3) and government expenditure (G) on GDP

| Explanatory variable | $\hat{\gamma}_i$ | Confidence interval |
|---|---|---|
| lnM3 | 0.63035* | [0.451829 0.808873] |
| lnG | 0.68955* | [0.295618 1.08349] |

Note: The bootstrap confidence interval was calculated using the accelerated bias-corrected method using 10,000 replications and a confidence interval of 95%.

*Source:* Authors' estimations

Finally, the long-run impact of the explanatory variables to the dependent variable is calculated using the expression given in (4). The $\hat{\gamma}_i$s show how the dependent variable, in our case the logarithm of GDP, responds in the long-run, to any change in the explanatory variables *i.e.* the logarithm of real money supply and real government expenditure. The results are reported in Table 8. A detailed analysis of this table allows us to reach some important conclusions about the Greek economy: (a) the elasticity of GDP in respect to the total money supply is estimated to be 0.63; this means that there is a positive impact of the money supply on GDP in the Greek economy for the period examined. Further, it means that a 1% increase (or decrease) in the money supply will lead to a 0.63% increase (or decrease) in GDP. The confidence interval calculated according to the bootstrap technique is (0.45 0.81), thus the impact of money supply on GDP in the Greek economy is statistically significant since it does not include the value of zero. This is an important result, because it shows that the recession during the period of the crisis was deepened

by the steep decrease in money supply. It shows further, that if the institutional setting of the ECB were different, allowing the application of monetary policy to keep money supply stable during the crisis, a significant portion of the GDP decline would have been prevented. (b) The elasticity of GDP in respect to government expenditure is 0.69, meaning that a 1% change in government expenditure will affect GDP by 0.69% in the same direction. That is, if there is a 1% decrease in government expenditure GDP will be decreased by 0.69% or to rephrase, for each percentage cut in government expenditure there will be an approximately 0.7% recession in the Greek economy. The confidence interval calculated according to the bootstrap technique is (0.30 1.08), thus the impact of government expenditure on GDP in the Greek economy is statistically significant since it does not include the value of zero. This is an expected result, in the methodological construction of the GDP government expenditure is a part of it. However, the high value of the coefficient (approximately 0.7) shows the large impact of government expenditure on the total GDP produced in Greece.

A final point can be made from Table 8; the IMF has recently admitted that the effects of the austerity policy measures from the cut in government expenditure (G) on the GDP were greatly underestimated. The multiplier for the government expenditure was calculated by the IMF to be about 0.5 while now it has admitted that the multiplier for G is ranging from 1.5 to 1.7. From the elasticity[7] estimated for G in Table 8, the multiplier (d*GDP*/d*G*) for G can be calculated and it has the value of approximately 1.60 proving that the IMF was indeed wrong in its original estimations.[8]

## 5. Conclusions: Institutional changes – a solution to the problem

This study attempts to quantify the effects of the implicit restrictive monetary policy exercised by the ECB in the case of Greece, during the world financial crisis. We considered the ARDL bounds testing approach to verify the existence of a long-run relationship between the GDP and the total money supply and government expenditure in the Greek economy for the period from the formation of the Eurozone to the first quarter of 2013. The main findings are of interest to professional economists and policy makers in the EU and provide an indication that the institutional

7. $e_G = {dGDP}/{dG} \cdot {G}/{GDP}$; for the calculation of the multiplier, *G* and *GDP* values are taken to be the average values of the period.
8. The multiplier for *M3* has a value of approximately 0.17.

settings of the Eurozone and specifically the ECB should allow the application of monetary policy, in times of crisis, in order to mitigate the effects of recession. Monetary policy is a powerful tool in influencing Greek GDP. If the institutional setting of the ECB were different, allowing the application of monetary policy so that money supply remained stable during the crisis, a significant portion of the GDP decline would have been prevented. Furthermore, the high value of the elasticity of the GDP to G (approximately 0.7) shows the large impact of the government expenditure on the total GDP produced in Greece.

To conclude:

- The ECB should be allowed to control the monetary base with Eurobond issues in order to provide a solution to the Eurozone debt crisis and opportunity for a fiscal policy alignment.
- The axiom that the ECB should promote stability against growth should be reconsidered.
- Eurobonds will provide Greece (and other Eurozone countries with public debt problems) with the necessary time to make the required structural reforms and to sell other assets (e.g. public property) to reduce debt.

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# ON THE INTERPLAY BETWEEN INTERGENERATIONAL TRANSFERS AND NATURAL RESOURCES

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**Abstract**
This paper studies an overlapping generations model with selfish agents, natural resources and human capital externalities. The initial result is to quantify the economic effects of intergenerational transfers by comparing a complete markets allocation with transfers to an allocation without transfers due to incomplete markets. The core contribution is then to show that a higher resource regeneration rate boosts the effect of transfers on economic growth for both allocations, although it also implies a higher gap in growth performances between them. Finally, it is shown that transfers can be financed through a constant lump-sum tax relative to the output level.

**JEL Classification:** H23, H55, Q32
**Key words:** Overlapping generations, intergenerational transfers, natural resources, endogenous growth

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## 1. Introduction

In the last few decades, large investments have been carried out around the globe in order gradually to satisfy higher fractions of energy demand through more renewable natural resources. At the same time, economies abundantly endowed with exhaustible resources are preparing themselves to face the challenge of upcoming resource depletion. As an example of this, large policy debates started in resource-rich countries (e.g. Norway, Venezuela) as regards the long-term sustainability of social security policies (Harding & van der Ploeg, 2013). In light of these facts, the impact of the degree of resource renewability on modern economies −and more precisely on intergenerational transfers− qualifies as a relevant economic question.

The paper analyzes this topic in a model of endogenous growth for a closed economy with overlapping generations of selfish agents, natural resources and human capital externalities. The initial result is to quantify the effects of intergenerational transfers on economic growth. The core contribution of the paper is then to investigate whether and how the degree of resource renewability influences the economic effects of intergenerational transfers. Intergenerational transfers consist of transfers that a given cohort bestows upon a different cohort (either voluntarily or as a result of a transfers scheme implemented by a planner): unlike bequests motivated by dynastic altruism, such transfers reflect the existence of potential individual gains from trading with adjacent generations (e.g. young and old agents may increase private utility by trading education versus health care, long-lasting assets versus pensions) and may arise as political equilibria (Sjoblom, 1985) or as Pareto-improving intergenerational contracts (Esteban and Sakovics, 1993) in the standard overlapping generations model with finite lives and selfish agents (Boldrin and Rustichini, 2000; Rangel, 2003; Boldrin and Montes, 2005).

The following is a brief summary of the analysis. At first, the benchmark framework of the competitive economy with complete markets (Complete Markets Allocation, CMA hereafter) and intergenerational transfers is developed. Consider a simple three-period economy in which young agents overlap with adult workers and retired old agents. A stock of resources is necessary[1] for producing consumption goods and is initially owned by old agents under full property rights: resource assets are transmitted to the adult generation via a standard competitive market.[2] As a

1. A resource is defined as *necessary* if output is zero whenever the quantity of the resource used in production is zero, i.e. $F(H, 0) = 0$.

2. In this environment, sustained consumption is not guaranteed: the market valuation of oil assets

factor of production, natural resources differ in essence from physical capital inasmuch as they are destroyed and get depleted rather than being accumulated through investment. Although natural resources that are essential for production are scarce, growth can be sustained through the accumulation of human capital that spills over across generations in the form of public knowledge. However, the knowledge stock only grows if old agents invest in the education of the newborn generation. This mechanism creates potential gains for intergenerational transfers independently of the problem of resource scarcity. An intergenerational transfer scheme financing education and pensions is therefore implemented by agents in the decentralized economy with complete markets (CMA). This benchmark framework is subsequently simulated and compared with the case of incomplete markets allocation (IMA, hereafter) without transfers. This comparison highlights the substantial positive effects of intergenerational transfers on economic growth and constitutes the first contribution of this paper.

The main contribution is summarized as follows. Intuitively and other things being equal, a higher resource regeneration rate would imply that one (natural capital) of the two productive factors of the economy (the other being labor) becomes more widely available. In turn, this would determine a factor reallocation away from labor and would call for a lower degree of human capital accumulation. If this were the mechanism at work, the higher regeneration rate would translate into a lower fraction of intergenerational transfers with respect to output (since education transfers are necessary to accumulate human capital). Generally, the intention is to fully investigate which mechanisms tend to prevail as a response to a change in the degree of resource renewability. The results show that a higher resource regeneration rate magnifies the volume and the positive effects of transfers on growth performances. This happens through the regeneration rate's effects on the rate of return on resource wealth, resource use and output growth rate. Last but not least, from the analysis of the revenue side it is shown that the planner can replicate the CMA growth performances by implementing a period-by-period intergenerational

limits the rate of depletion of the oil stock only to the extent that selling oil assets to the adults is actually profitable to the retiring agent. In other words, future generations may be bound to experience declining consumption levels because the distribution of resource wealth is inevitably biased in favor of the "first father". More generally, neither sustainability nor resource preservation are guaranteed when natural capital is private property. This result holds in general equilibrium models with infinitely lived agents (Dasgupta and Heal, 1974), and is furthermore valid when assuming selfish agents with finite lifetimes (Mourmouras, 1991, 1993).

transfers scheme financed through lump-sum taxation.[3] It is finally also shown that such a transfer policy can be financed through a constant lump-sum tax relative to the output level.

The paper proceeds as follows: Section 2 introduces the model. The potential gains from implementing intergenerational transfers are shown by comparing the efficiency properties of the CMA (developed in Section 3) with the IMA (developed in Section 4) in which neither education to the young nor pay-as-you-go pensions to the old are implemented. In Section 5, I address the issue of how resource renewability affects the features of intergenerational transfers by simulating the model under different parameterizations and by implementing different taxation instruments. Section 6 concludes.

## 2. The Model

### *2.1 Production, Resources and Human Capital*

The production sector consists of an indefinite number of competitive firms that produce a homogeneous consumption good using human capital and a primary resource under constant returns to scale. Aggregate output is denoted by $Y_t$ in physical terms and is the numeraire good. The technology is a well-behaved production function displaying strictly decreasing marginal productivities and satisfying the Inada conditions:

$$Y_t = F\left(H_t, X_t\right), \tag{1}$$

where $t = \{0,1,2,\ldots\infty\}$ is the period index in discrete time, $H_t \equiv h_t \ell_t$ is aggregate human capital – given by the current stock of knowledge per worker $h_t$ times the number of workers $\ell_t$ –and $X_t$ is resource use– i.e., a flow of primary resource extracted from a natural stock and destroyed in the production process. Denoting the wage rate by $w_t$ and the resource price by $p_t$, the profit-maximizing conditions imply:

$$w_t = F_{H_t} \quad \text{and} \quad p_t = F_{X_t}, \tag{2}$$

where constant returns to scale ensure zero profits in the final sector.

With respect to resource use, the analysis is inspired by the sustainability liter-

3. This result draws in part on Boldrin and Montes (2005), in which public financing of education and pensions is shown to be implemented by a transfer scheme and financed through a lump-sum tax. However, the benchmark framework in Boldrin and Montes (2005) differs from the current model since they do not contemplate the use of natural resources as factor of production.

ature (Dasgupta and Heal, 1974; Solow, 1974; Stiglitz, 1974): economic growth may be negative as a result of natural scarcity – a scenario that is surely compelling when the resource stock is non-renewable. However, for the sake of generality, I allow for the possibility of natural regeneration: the resource stock $R_t$ obeys the dynamic law

$$R_{t+1} = (R_t - X_t)(1+\gamma), \tag{3}$$

where $\gamma \geqslant 0$ is a constant marginal rate of biological renewal. Setting $\gamma = 0$, equation (3) reduces to the standard law for exhaustible resources like oil and minerals. In each period, the part of the resource stock that is not destroyed in production constitutes resource assets, $A_t$, that will be used for production in the future: agents exchange shares of $A_t$ on a perfectly competitive financial market. The resource stock thus equals, in each period:

$$R_t = X_t + A_t. \tag{4}$$

The dynamics of aggregate human capital $H_t \equiv h_t \ell_t$ and of individual knowledge $h_t$ are linked to the demographic structure, which comprises three overlapping generations: in each period $t = \{0,1,2,\ldots\infty\}$, there are $N_t^y$ young, $N_t^a$ adult and $N_t^o$ old agents, with a constant exogenous population growth rate:

$$N_{t+1}^y / N_t^y = N_{t+1}^a / N_t^a = N_{t+1}^o / N_t^o = 1+n. \tag{5}$$

For simplicity, young agents do not work and do not consume: in the first period of life, $t$, each agent studies to acquire $h_{t+1}$ units of knowledge that will determine her productivity as a worker during adulthood. In the second period of life, $t$+1, agents supply inelastically their human capital to the production sector. In the third period of life, $t$+2, agents do not work. The number of workers thus coincides with the mass of adults, $\ell_t = N_t^a$. Each worker's knowledge is determined by the generic learning technology

$$h_{t+1} \equiv \eta(h_t, \varepsilon_t), \qquad \frac{\partial \eta_t}{\partial \varepsilon_t} > 0, \tag{6}$$

where $\varepsilon_t$ is the economy's propensity to spend on education. Denoting by $e_t$ the investment per young person in education expressed in units of final output, and by $y_t = Y_t / N_t^y$ output per young person, the education spending share can be rewritten as

$$\varepsilon_t \equiv \frac{e_t}{y_t}. \tag{7}$$

Assume further that knowledge grows if and only if the economy spends a positive amount of output on education: when $\varepsilon_t$=0, human capital is constant at the previous level (for simplicity, we rule out knowledge depreciation over time). A convenient function that incorporates this hypothesis is

$$h_{t+1} = \eta\left(h_t, \frac{e_t}{y_t}\right) = h_t \cdot \left(1 + \mu \frac{e_t}{y_t}\right), \tag{8}$$

Where $\mu > 0$ is a constant exogenous parameter reflecting the marginal impact of the propensity to spend on education for future knowledge growth.

### *2.2 Household Behavior*

Assume that agents are homogeneous, endowed with perfect foresight, and selfish: each agent seeks to maximize her own lifetime utility. To simplify the discussion, the consumer problem is split into two logical steps. First, agents decide how to trade resource assets with adjacent generations in order to maximize the present-value of net income from resource ownership. Second, the consumer decides how to allocate total lifetime income between consumption and savings when adult, and consumption when old. The reason for this distinction is that I will consider different variants of step two.

Considering the first step, the typical adult in period $t$ saves in the form of resource assets – i.e., she purchases from old agents a fraction $1/N_t^a$ of $A_t$ at unit price $q_t$. In period $t$+1, the same agent is old, she owns a fraction $1/N_{t+1}^o$ of the existing resource stock $R_{t+1}$, and sells $X_{t+1}/N_{t+1}^o$ units as "resource use" to production firms at price $p_{t+1}$, and $A_{t+1}/N_{t+1}^o$ units as "resource assets" to adult agents at price $q_{t+1}$. Consequently, the present value of net resource incomes over the life-cycle is

$$\frac{1}{N_t^a} \cdot \left(\frac{q_{t+1}A_{t+1} + p_{t+1}X_{t+1}}{1+i_{t+1}} - q_t A_t\right), \tag{9}$$

where $i_{t+1}$ is the implicit rate of return on resource wealth. Given the resource constraints (3) and (4), the maximization of net resource income implies two basic conditions of no arbitrage (see the Mathematical Appendix for details). On the one hand, there must be price equalization between resource assets and resource use, $p_t$=$q_t$, in each period. On the other hand, the dynamics of resource rents must satisfy

the generalized Hotelling rule

$$\frac{p_{t+1}}{p_t} = \frac{q_{t+1}}{q_t} = \frac{1+i_{t+1}}{1+\gamma}, \tag{10}$$

whereby the resource price grows (declines) over time if the rate of return exceeds (falls short of) the regeneration rate. If the natural stock is non-renewable, $\gamma = 0$, expression (10) declines to the standard Hotelling's (1931) rule, according to which the resource price must grow at the rate of return in order to guarantee intertemporal no-arbitrage. These results allow us to define individual savings during adulthood as $s_t = q_t A_t / N_t^a$, associated to the gross return $(1+i_{t+1})$ in the subsequent period of life.

In the second step, agents decide how to allocate total lifetime income between consumption and savings in order to maximize lifetime utility. Because young agents do not work and do not consume, preferences are defined over two periods only: the lifetime utility of the young born in period $t-1$ reads

$$u_{t-1}(c_t, d_{t+1}) = v(c_t) + \beta \cdot v(d_{t+1}), \tag{11}$$

where $c_t$ is consumption when adult, $d_{t+1}$ is consumption when old, $\beta \in (0,1)$ is the private discount factor, and $v(\cdot)$ is a well-behaved utility function implying positive and strictly decreasing marginal utility, and satisfying the Inada conditions.

Importantly, I can consider different specifications of the consumer problem depending on the structure of credit markets and the possible existence of inter-generational transfers. The benchmark scenario (CMA) is a world in which there are complete credit markets: young agents are able to borrow in their first period of life the amount of output they wish to invest in education and they repay the debt at the prevailing interest rate during adulthood. The alternative scenario is represented by a world in which credit markets for education financing are missing, and the accumulation of human capital hinges on the existence of intergenerational transfers (IMA). In the next section, I present the complete markets allocation (CMA).

## 3. The case of complete markets

Suppose that there exist complete credit markets for education financing: each young agent born in period $t-1$ borrows $b_{t-1}$ units of output for financing her education investment $e_{t-1}$, and repays the amount $b_{t-1}(1+i_t)$ during adulthood. Accordingly, the $N_t^a$ adults in period $t$ finance current education investment $N_t^y b_t$ and receive, in the aggregate, $N_t^y b_t (1+i_{t+1})$ units during old age. Consequently, the

typical consumer maximizes utility (11) subject to

$$c_t = w_t h_t - s_t - b_{t-1}\left(1+i_t\right) - b_t\left(1+n\right), \tag{12}$$

$$d_{t+1} = s_t\left(1+i_{t+1}\right) + b_t\left(1+n\right)\left(1+i_{t+1}\right), \tag{13}$$

$$h_t = \eta\left(h_{t-1}, e_{t-1}/y_{t-1}\right) \quad \text{with} \quad e_{t-1} = b_{t-1}, \tag{14}$$

where (12) and (13) are the budget constraints for the second and third period of life, respectively, and (14) is the knowledge accumulation constraint where education investment is determined by the initial debt, and the knowledge and labor productivity of the previous generation ($h_{t-1}$ and $y_{t-1}$) are taken as given. The solution to this problem yields the conditions (see the Mathematical Appendix):

$$\frac{v'\left(c_t^\star\right)}{\beta v'\left(d_{t+1}^\star\right)} = 1 + i_{t+1}^\star, \tag{15}$$

$$w_t^\star \cdot \frac{\partial \eta\left(h_{t-1}, e_{t-1}^\star / y_{t-1}\right)}{\partial e_{t-1}^\star} = 1 + i_t^\star, \tag{16}$$

where superscript '$\star$' denotes equilibrium variables in the CMA, equation (15) is the usual Euler condition for consumption growth, and equation (16) establishes that the marginal private benefit from education investment –that is, the increase in wage income generated by higher individual knowledge– must match the private marginal cost of borrowing in the first period of life. Combining equations (15, 16) with the profit-maximizing conditions in the production sector (2) and the Hotelling rule (10), we can characterize the equilibrium arising under complete credit markets. It is essential to provide a full characterization of the CMA when preferences and technologies take simple forms that yield neat solutions for the equilibrium path. Consider the following:

**Log-linear model** *Production equals* $F\left(H_t, X_t\right) = H_t^\alpha X_t^{1-\alpha}$*, and static utility is* $v(\cdot)=\ln(\cdot)$.

In the log-linear model, the simplifying role of Cobb-Douglas production technology and logarithmic utilities is obvious and well-established in the growth literature: output, resource use and human capital will all grow at constant growth rates in each period $t = \{0,1,2,\ldots\infty\}$. The competitive equilibrium with complete markets is characterized as follows (full derivation of equilibrium characterization in the Mathematical Appendix):

**Remark 1** *A competitive equilibrium with complete markets is defined by (10, 15, 16); by the aggregate constraint and focs (17); by the propensities to invest in human capital (18) and to consume (19); by the equilibrium interest rate (20) and by the growth rates of aggregate human capital (21), resource use (22) and output (23):*

$$F\left(H_t^\star, X_t^\star\right) = N_t^y e_t^\star + N_t^a c_t^\star + N_t^o d_t^\star, \qquad w_t = F_{H_t} \quad \text{and} \quad p_t = F_{X_t}, \tag{17}$$

$$\frac{N_t^y e_t^\star}{Y_t^\star} = \frac{1}{\mu} \cdot \frac{h_{t+1}^\star - h_t^\star}{h_t^\star}, \tag{18}$$

$$\frac{N_t^a c_t^\star}{Y_t^\star} = \frac{\alpha}{(1+\beta)(1+n)\left(1+\mu\varepsilon^\star\right)}, \quad \frac{N_t^o d_t^\star}{Y_t^\star} = \frac{\beta\alpha}{(1+\beta)(1+n)^2\left(1+\mu\varepsilon^\star\right)^2}, \tag{19}$$

$$\left(1+i^\star\right) = \left(\alpha\mu\right)^\alpha \left(1+\gamma\right)^{1-\alpha}, \tag{20}$$

$$\frac{H_{t+1}^\star}{H_t^\star} = (1+n)\left(1+\mu\varepsilon^\star\right), \tag{21}$$

$$\frac{X_{t+1}^\star}{X_t^\star} = \frac{1+\gamma}{\alpha\mu}(1+n)\left(1+\mu\varepsilon^\star\right), \tag{22}$$

$$\frac{Y_{t+1}^\star}{Y_t^\star} = \left(\frac{1+\gamma}{\alpha\mu}\right)^{1-\alpha}(1+n)\left(1+\mu\varepsilon^\star\right). \tag{23}$$

*This equilibrium defines the dynamic system* $\Phi : (e_{t-1}^\star, h_t^\star, y_t^\star, X_t^\star) \mapsto (e_t^\star, h_{t+1}^\star, y_{t+1}^\star, X_{t+1}^\star)$. *Given initial conditions* $(e_{t-1}^\star, h_{t-1}^\star, y_{t-1}^\star, X_0^\star)$ *and parameters* $(\alpha, \beta, \mu, n, \gamma)$*, the system* $\Phi$ *evolves along the equilibrium path* $\left\{(e_t^*, h_{t+1}^*, y_{t+1}^*, X_{t+1}^*)\right\}_{t=0}^{\infty}$*; given this equilibrium path all remaining factor prices and quantities are determined.*

As is shown in (20) in Remark 1, the equilibrium interest rate factor $\left(1+i^\star\right)$ turns out to be a constant weighted average of the regeneration rate $\gamma$ and of the marginal impact of the propensity to spend on education $\mu$. The intuition behind this result is that a higher regeneration rate $\gamma$ would allow a more sustainable resource use, postponing stock depletion and thereby contributing to providing a higher gross return on resource wealth.

## 4. The incomplete markets allocation

In this section the allocation with incomplete markets (IMA) is developed. Suppose

therefore that credit markets for education financing are missing or incomplete: young agents are not able to borrow to finance their education. Consequently, intergenerational transfers do not take place and the economy moves to an inefficient equilibrium. More precisely, (16) is now violated and profitable investment in human capital cannot any longer be achieved. The typical consumer will now maximize utility (11) subject to

$$c_t = w_t h_t - s_t, \tag{24}$$

$$d_{t+1} = s_t\left(1+i_{t+1}\right), \tag{25}$$

$$h_t = h_{t-1}, \tag{26}$$

where (24) and (25) are the budget constraints for the second and third period of life, respectively, and (26) is the knowledge accumulation constraint anchored at a given past value. The solution to this problem yields the following conventional Euler condition for consumption growth (see the Mathematical Appendix):

$$v'\left(c_t\right) = \beta\left(1+i_{t+1}\right)v'\left(d_{t+1}\right). \tag{27}$$

Assuming a log-linear model as in the CMA case and combining equation (27) with the profit-maximizing conditions in the production sector (2) and the Hotelling rule (10), we can characterize the equilibrium arising under incomplete credit markets. Let us start to observe that, absent any educational expenditure allowing the young generation to invest in education and accumulate human capital, the growth rate of human capital will no longer be endogenously determined by the model:

$$\frac{H_{t+1}^{\#}}{H_t^{\#}} = \frac{h_{t+1}\ell_{t+1}}{h_t\ell_t} = \left(1+n\right)\frac{h_{t+1}}{h_t} = (1+n), \tag{28}$$

where superscript '#' denotes equilibrium variables in the IMA. The absence of intergenerational transfers due to incomplete markets determined a slow-down in human capital accumulation with respect to the CMA allocation, creating a source of inefficiency. Human capital accumulation is however still positive due to population growth. The equilibrium characterization for the IMA is summarized as follows (full derivation of equilibrium characterization in the Mathematical Appendix):

**Remark 2** *A competitive equilibrium with incomplete markets is defined by (10, 27); by the aggregate constraint and focs (29); by the propensities to consume (30); by the equilibrium interest rate (31) and by the growth rates of aggregate human*

*capital (32), resource use (33) and output (34):*

$$F_t(H_t^{\#}, X_t^{\#}) = N_t^a c_t^{\#} + N_t^o d_t^{\#}, \qquad w_t = F_{H_t} \quad \text{and} \quad p_t = F_{X_t}, \tag{29}$$

$$\frac{N_t^a c_t^{\#}}{Y_t^{\#}} = \frac{\alpha}{1+\beta}, \qquad \frac{N_t^o d_t^{\#}}{Y_t^{\#}} = \frac{1+\beta-\alpha}{1+\beta}, \tag{30}$$

$$\left(1+i^{\#}\right) = \left[\frac{(1+\beta-\alpha)(1+n)}{\alpha\beta}\right]^{\alpha} (1+\gamma)^{1-\alpha}, \tag{31}$$

$$\frac{H_{t+1}^{\#}}{H_t^{\#}} = (1+n), \tag{32}$$

$$\frac{X_{t+1}^{\#}}{X_t^{\#}} = \frac{\alpha\beta}{1+\beta-\alpha}(1+\gamma), \tag{33}$$

$$\frac{Y_{t+1}^{\#}}{Y_t^{\#}} = (1+n)^{\alpha}\left[\frac{\alpha\beta(1+\gamma)}{1+\beta-\alpha}\right]^{1-\alpha}. \tag{34}$$

*This equilibrium defines the dynamic system* $\Omega: (h_t^{\#}, y_t^{\#}, X_t^{\#}) \mapsto (h_{t+1}^{\#}, y_{t+1}^{\#}, X_{t+1}^{\#})$. *Given initial conditions* $(h_{t-1}^{\#}, y_{t-1}^{\#}, X_0^{\#})$ *and parameters* $(\alpha, \beta, n, \gamma)$*, the system* $\Omega$ *evolves along the equilibrium path* $\left\{(h_{t+1}^{**}, y_{t+1}^{**}, X_{t+1}^{**})\right\}_{t=0}^{\infty}$*; given this equilibrium path all remaining factor prices and quantities are determined.*

As is shown in (31), this time the interest rate factor ($1+i^{\#}$) turns out to be a constant weighted average of the regeneration rate $\gamma$ and of the population growth rate $n$. Relatively to the CMA benchmark allocation, the impossibility of financing education limits human capital accumulation and has detrimental effects on the long-run growth scenario for the economy. An estimation of the magnitude of this detrimental effect will be computed in the next section on resources and intergenerational transfers.

## 5. Resources and intergenerational transfers

The scope of this section is threefold. At first, the dynamics of resource use is presented (Section 5.1). Later on, I proceed by simulating the gap in growth performances between the CMA and the IMA induced by intergenerational transfers and the effects on this gap induced by a higher resource regeneration rate (Section 5.2). In conclusion, the interaction of lump-sum taxation with resource regeneration rate and growth performances is explored (Section 5.3).

*5.1 Resource use dynamics*

Before specifying parameters and initial conditions of the calibration exercise, let us show the framework in which the different levels of the regeneration rate $\gamma$ will be inserted. Starting from the accumulation law (3) and iterating the stock equation we obtain:

$$R_T = R_0(1+\gamma)^T - \sum_{t=0}^{T-1} X_t(1+\gamma)^{T-t}. \tag{35}$$

Next, consider the resource use dynamics: for CMA and IMA we have that $X_t$ grows at constant rates which we redefine as $\Delta^\star$ and $\Delta^\#$. Therefore, we have in general that $X_{t+1} = \Delta \cdot X_t$ so that $X_t = \Delta^t \cdot X_0$. Substituting this into the resource constraint and rearranging we have

$$R_T(1+\gamma)^{-T} = R_0 - X_0 \sum_{t=0}^{T-1} \left( \frac{\Delta}{1+\gamma} \right)^t. \tag{36}$$

An important condition to be imposed is the following transversality condition, not allowing the stock to grow faster than the regeneration rate:

$$\lim_{T\to\infty} R_T(1+\gamma)^{-T} = 0, \tag{37}$$

from which we get

$$R_0 = X_0 \lim_{T\to\infty} \sum_{t=0}^{T-1} \left( \frac{\Delta}{1+\gamma} \right)^t = X_0 \frac{1}{1-\frac{\Delta}{1+\gamma}}. \tag{38}$$

Note that in order to obtain a solution we must have $\frac{\Delta}{1+\gamma} < 1$. This is certainly true in the IMA since from (33) we observe that $\frac{\Delta^\#}{1+\gamma} = \frac{\alpha\beta}{1+\beta-\alpha} < 1$. In the CMA equilibrium instead, (22) implies that $\frac{\Delta^\star}{1+\gamma} = \frac{(1+n)(1+\mu\varepsilon^\star)}{\alpha\mu}$, which satisfies $\frac{\Delta^\star}{1+\gamma} < 1$ if and only if

$$\alpha\mu > (1+n)(1+\mu\varepsilon^\star). \tag{39}$$

This inequality has to be strictly verified in order for the model to exhibit a solution. In other words, if and only if the joint choice of parameters ($\varepsilon^\star$, $\mu$) in the parameterization below satisfies the inequality (39), we can finally obtain the initial rate of resource use for all allocations:

$$X_0 = \frac{1+\gamma-\Delta}{1+\gamma} R_0. \quad \textbf{(40)}$$

Given endowments $R_0$,$H_0$, and the CMA and IMA's resource use dynamics $\Delta^{\star}$ and $\Delta^{\#}$, we can therefore obtain the initial values of $X_0$ and output since $Y_0 = F(H_0, X_0)$. After that, it will be possible to compare the gaps between the constant growth rates of output for the different allocations.

*5.2 A simulation of the economic effects of transfers*

This subsection calibrates the model in order to simulate the economic effects of transfers when a jump in the resource regeneration rate occurs. The model is parameterized as if each time interval $(t, t+1)$ would be equal to 25 years. This time span is realistically sufficient to allow the young generation at *t* to grow adult at *t*+1 and later on to become old at *t*+2. As regards the share of human capital in production, assume $\alpha$=0.85. The corresponding share of resources is then (1−$\alpha$)=0.15.[4] In order to obtain an implicit corresponding annual level of $\beta$=0.98 we have to set the generational private discount factor at $\beta$=0.61. The growth of population is set without loss of generality at the lower bound *n*=0. For both allocations, the initial level of human capital has been arbitrarily set at $H_0$=10, whilst the initial resource stock is endowed with an amount of resource given by $R_0$=100.[5]

As regards the resource regeneration rate $\gamma \geq 0$, I intend to compare two cases:

$$\gamma_{low} = 0.5, \quad \textbf{(41)}$$

$$\gamma_{high} = 0.8. \quad \textbf{(42)}$$

In other words, I intend to evaluate the effects of a 60 percent increase in the

4. $\alpha$=0.85 and (1−$\alpha$)=0.15 are commonly used shares within the literature of growth models for resource-rich economies with no physical capital (Valente, 2008, 2011).

5. A numerical exercise provided the range of values for $(\varepsilon^{\star}, \mu)$ which satisfies simultaneously the stationarity condition for $\varepsilon^{\star}$ given in the Mathematical Appendix and the inequality given in (39). The Maple code for this numerical exercise is available on request. Within this range of values for $(\varepsilon^{\star}, \mu)$, the pair ($\varepsilon^{\star}$ = 0.012577; $\mu$ = 1.8) was chosen in order to prioritize acceptable values for the equilibrium interest rates.

resource regeneration rate on intergenerational transfers and growth performances.[6] The following tables present and summarize the results,[7] which are discussed in more detail below:

| **CMA** | $i^{\star}$ | Annual $i^{\star}$ | $X_0^{\star}$ | $g^{\star}$ |
|---|---|---|---|---|
| $\gamma_{high} = 0.8$ | 0.5255 | 0.0170 | 55.44 | 0.0196 |
| $\gamma_{low} = 0.5$ | 0.5678 | 0.0181 | 33.16 | 0.0478 |

**(43)**

| **IMA** | $i^{\#}$ | Annual $i^{\#}$ | $X_0^{\#}$ | $g^{\#}$ |
|---|---|---|---|---|
| $\gamma_{high} = 0.5$ | 0.4709 | 0.0156 | 54.51 | 0.0035 |
| $\gamma_{high} = 0.5$ | 0.5116 | 0.0167 | 31.77 | 0.0312 |

**(44)**

in which $g^{\star} = \frac{Y_{t+1}^{\star}}{Y_t^{\star}} - 1$ and $g^{\#} = \frac{Y_{t+1}^{\#}}{Y_t^{\#}} - 1$.

### 5.2.1 The case of $\gamma_{low} = 0.5$

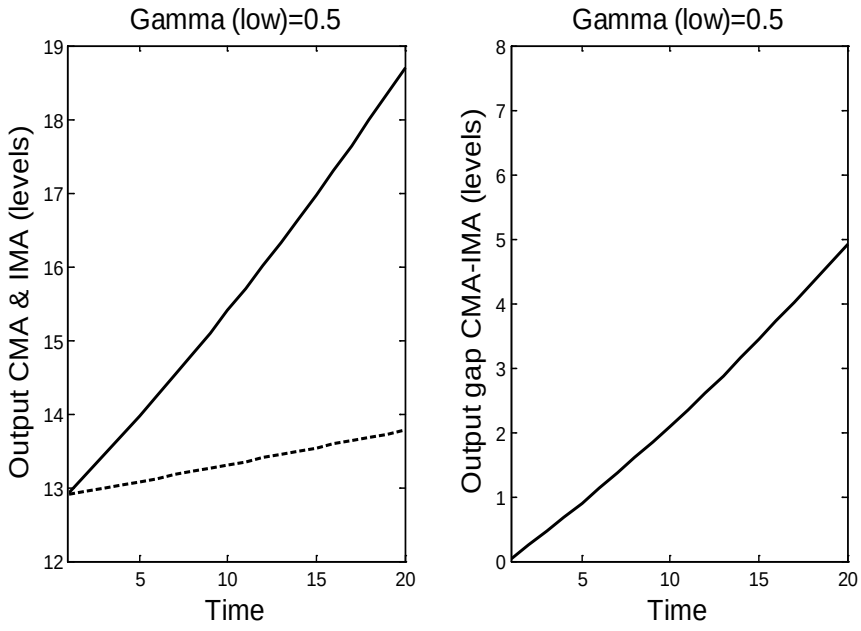
At first, let us verify that the allocations indeed exhibit interior solutions. The constant values for the interest rates (time indexes are thereby dropped) for the CMA and IMA allocations are given respectively by $i^{\star} = 0.5255$ and $i^{\#} = 0.4709$, ensuring the presence of interior solutions. These are generational interest rates on a time span of 25 years and they correspond respectively to $i^{\star} = 0.0170$ and $i^{\#} = 0.0156$ on a yearly basis. Following the procedure presented in the previous subsection 5.1, endowments $R_0$ and $H_0$ together with the resource-use dynamics in the CMA and IMA allow us to obtain the initial values of $X_0$, given by $X_0^{\star} = 55.44$ and $X_0^{\#} = 54.51$. Subsequently, by recalling that $Y_0 = F(H_0, X_0)$, we can simply simulate output time series. The following Figure 1 shows output time series (in levels,

6. A few more words are needed in order to fully justify the choice of these specific regeneration rate levels. Note that the above mentioned values for the parameters $\alpha$, $\beta$, $n$ imply that the IMA exhibits approximately negative output growth for $\gamma \leq 0.46$. The lower threshold of the resource regeneration rate has therefore been set at $\gamma_{low}$=0.5 in order to make a comparison between allocations implying exclusively positive growth rates.

7. The MATLAB code used for this simulation is available from the author on request.

left-hand side) for CMA (solid line) and IMA (dashed line) and the positive output gap (also in levels, right-hand side) that intergenerational transfers create between the two allocations:

**Figure 1:** The case of $\gamma_{low}$




More interestingly, we can observe the results in terms of constant growth rates. The constant growth rate of income for the CMA allocation is given by $g^{\star} = 0.0196$, whilst for the IMA we have $g^{\#} = 0.0035$. As expected, the poorer growth performance of the IMA is due to the impossibility of financing education and the subsequent limited growth in human capital accumulation. This initial result can be summarized as follows:

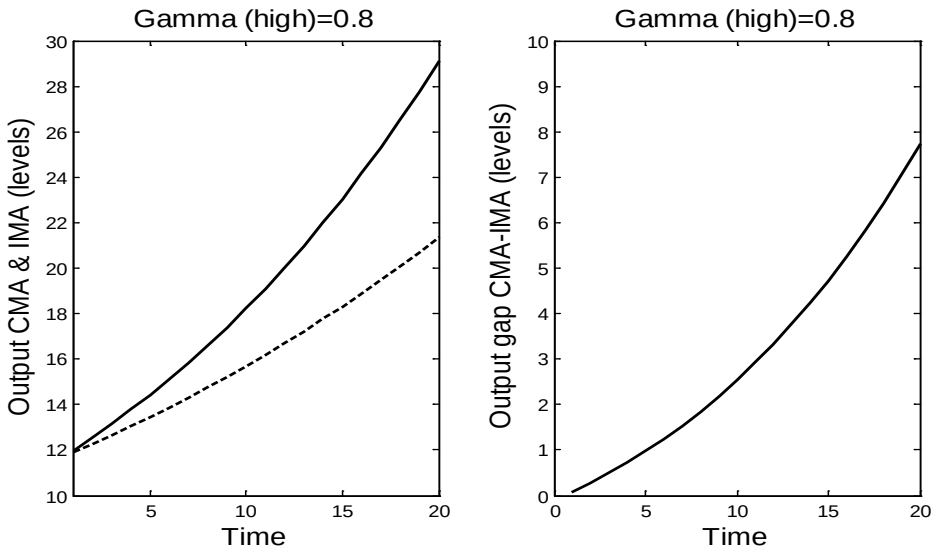
**Remark 3** *Given the regeneration rate level $\gamma_{low}$, the economic effects of intergenerational transfers are estimated by the positive gap in growth rates given by the difference between $g^{\star}$ and $g^{\#}$.*

Let us now move to the alternative scenario and observe how these growth rates and the transfers scheme will respond to a higher regeneration rate.

5.2.2 The case of $\gamma_{high} = 0.8$

Higher resource regeneration rate $\gamma$ implies at first that the rate of return on resource wealth is increased. The constant values for the interest rates are now given respectively by $i^{\star} = 0.5678$ and $i^{\#} = 0.5116$, that correspond respectively to $i^{\star} = 0.0181$ and $i^{\#} = 0.0167$ on a yearly basis. In addition, the initial values of $X_0$ are now given by $X_0^{\star} = 33.16$ and $X_0^{\#} = 31.77$ indicating a more sustainable resource depletion path than under $\gamma_{low}$. As anticipated above, the intuition behind these results is that a higher regeneration rate $\gamma$ makes it possible to postpone resource depletion and thereby contributes to providing a higher gross return on resource wealth, as can be observed in both (20) and (31). The following Figure 2 shows the output series (left-hand side, again solid line for the CMA and dashed for the IMA) and the output gap (right-hand side) between the two allocations, for the case of $\gamma_{high}$:

**Figure 2:** The case of $\gamma_{high}$

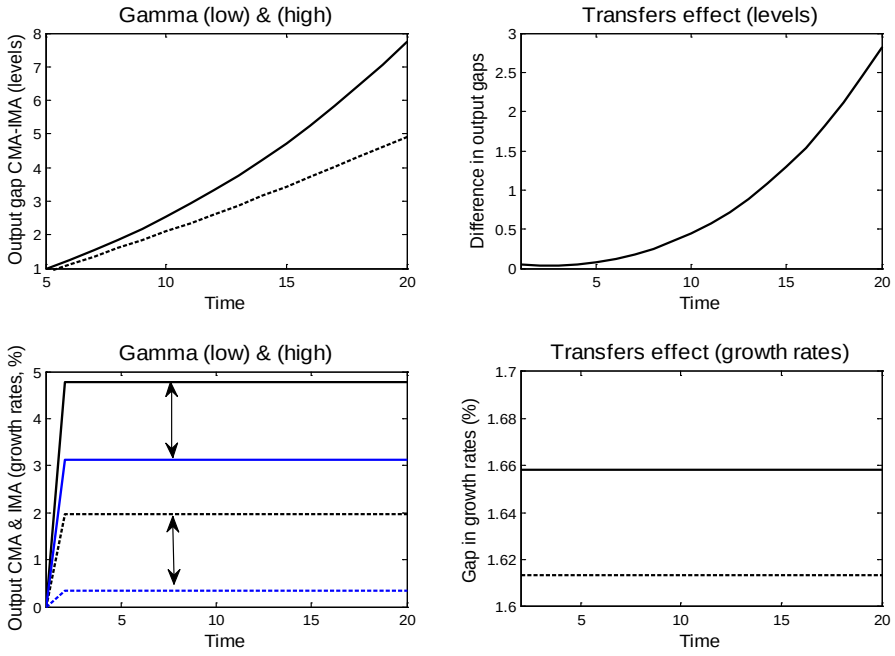



The constant income growth rate for the CMA allocation jumped to $g^{\star}$=0.0479, whilst for the IMA it increased to $g^{\#}$=0.0313. The intuition for the mechanisms driving this result goes as follows. A higher resource regeneration rate $\gamma$ implied more abundant resources and higher rates of return on resource wealth. Now, for the CMA allocation the latter determined larger transfers, as can be seen in (12) and

(13). Larger intergenerational transfers imply stronger human capital accumulation which, combined with more abundant resources, boosted economic growth as summarized by the analytical formulation in (23). On the other hand, higher growth rate for the IMA was simply determined by more abundant resources as shown in (34). This unbalanced impact on growth rates implies that the gap in growth performances between the CMA and IMA allocations induced by the transfers has increased with the new regeneration rate $\gamma_{high}$.

In order to visualize this result, Figure 3 plots (in levels in the upper-left plot and in growth rates in the lower-left plot) the output gaps between allocations for different levels of $\gamma$ (dashed lines for $\gamma_{low}$, solid for $\gamma_{high}$); jointly with the "Transfers effect" series (in levels in the upper-right plot and in growth rates in the lower-right plot) which show the period-by-period difference between them:

**Figure 3**




The series in Figure 3 show a positive effect of intergenerational transfers on the output gaps between allocations (both in levels and in growth rates) in response to a higher resource regeneration rate $\gamma$. In conclusion, Figure 3 and this subsection

more generally have shown that:

**Remark 4** *Other things being equal, a higher resource regeneration rate $\gamma$ boosts the positive effect of transfers on economic growth for both allocations, although it also implies a higher gap in growth performances between them.*

Interestingly, it can also be investigated whether intergenerational transfers increased as well as a fraction of total output. This is precisely one of the objectives of the next section in which financing of the transfers scheme is analyzed.

### *5.3 The revenue side: financing transfers*

Let us now go into more detail about how the intergenerational transfers scheme actually works. In a parallel way to the theoretical result obtained by Boldrin and Montes (2005), I will show that the CMA equilibrium and efficiency can be fully implemented by the planner through a period-by-period scheme of intergenerational transfers financed through a lump-sum tax.

In each period *t*, a lump-sum tax $\tau_t$ is levied on adults and revenues $\Pi_t(\tau_t)$ are subsequently utilized to finance pensions to the old and education to the young. On the expenditure side, define $Z_t(z_t^P, z_t^E)$ as the total expenditure for transfers respectively of (PAYG) pensions $z_t^P$ and education $z_t^E$. Consider the following government budget, balanced at any point in time:

$$\Pi_t(\tau_t) = Z_t(z_t^E, z_t^P), \qquad \forall t, \tag{45}$$

$$N_t^a \cdot \tau_t = N_t^y \cdot z_t^E + N_t^o \cdot z_t^P. \tag{46}$$

The budget constraints for the representative agent born in period *t*−1 would then read:

$$e_{t-1} = b_{t-1}, \tag{47}$$

$$c_t = w_t h_t - s_t - \left[ z_t^E + z_t^P \right], \tag{48}$$

$$d_{t+1} = (1 + i_{t+1})\left( s_t + z_t^P \right). \tag{49}$$

Let us now compare (47-49) with the constraints faced by the representative member in the CMA allocation (12-14) and observe that, as long as pensions $z_t^P$ and education transfers $z_t^E$ are defined exactly as follows:

$$z_t^P = b_t (1+n), \qquad z_t^E = e_{t-1}^{\star} \left(1 + i^{\star}\right). \tag{50}$$

then the competitive equilibrium under the transfer policy achieves again the efficiency level of the CMA allocation.

Once the feasibility of introducing intergenerational transfers financed through a lump-sum tax has been assured, let us now investigate whether and how resource regeneration rate interacts with the transfer scheme (50). Recalling from the model calibration in the previous subsections that the growth of population has been set at the lower limit $n = 0$, let us therefore further assume without loss of generality that the mass of young, adult and old individuals is given by $N_t^y = N_t^a = N_t^o = 1$. This implies that (46) simplifies to $\tau_t = z_t^P + z_t^E = b_t + e_{t-1}^\star\left(1+i^\star\right)$. By dividing both sides for $y_t^\star$ we obtain:

$$\frac{\tau_t}{y_t^\star} = \frac{b_t}{y_t^\star} + \frac{e_{t-1}^\star}{y_t^\star}\left(1+i^\star\right) = \varepsilon^\star + \frac{\varepsilon^\star \cdot y_{t-1}^\star}{y_t^\star}\left(1+i^\star\right) = \varepsilon^\star\left[1+\frac{y_{t-1}^\star}{y_t^\star}\left(1+i^\star\right)\right], \qquad \textbf{(51)}$$

Now recall (20) and (23); inserting back into $\frac{\tau_t}{y_t^\star}$ provides:

$$\frac{\tau_t}{y_t^\star} = \varepsilon^\star\left(1+\frac{\alpha\mu}{1+\mu\varepsilon^\star}\right). \qquad \textbf{(52)}$$

This result can be summarized as follows:

**Remark 5** *The intergenerational transfer scheme given by (50) can be financed through a constant lump-sum tax relative to the output level* $\frac{\tau_t}{y_t^\star}$*, as shown in (52).*

In other words and for the case of transfers financed through lump-sum tax, higher resource regeneration rate does not influence the relative fraction of output devoted to their financing. To what extent was this result expected? Recall (18) in which the propensity to invest in human capital with respect to income was found *not* to be a function of the equilibrium interest rate. Now, the simulation of the previous subsection showed that the resource regeneration rate influences the levels of transfers only through its effect on the equilibrium interest rate. It is therefore straightforward to logically infer that (at least for the current case of lump-sum taxation) the propensity to invest in human capital (18) in respect to output does not vary in response to the resource regeneration rate $\gamma$.

## 6. Concluding remarks

This paper presented a model of a closed economy with overlapping generations of selfish agents, natural resources and human capital externalities. Resources are assumed to be necessary for production of consumption goods, they are initially owned by old agents and further transmitted to the adult generation via a standard competitive market of resource assets. Intuitively, natural resources differ from physical capital as a factor of production since they are gradually depleted rather than being accumulated through investment.

The question becomes then how to sustain economic growth in the longer run. Although natural resources that are essential for production are scarce, growth can be sustained through the accumulation of human capital that spills over across generations in the form of public knowledge. The crucial point is that the knowledge stock only grows if old agents invest in the education of the younger generation. This mechanism creates potential gains for intergenerational transfers independently of the problem of depleting resources. An intergenerational transfer scheme financing education for the young and pensions for the old is therefore implemented voluntarily by agents in the competitive economy with complete markets. The first step was to analytically pin down the properties of this bench-mark framework.

I proceeded by supposing that credit markets for education financing are instead missing or incomplete: young agents are no longer able to finance their education. Consequently, intergenerational transfers do not take place and the economy moves to an inefficient equilibrium. This framework was labeled as the IMA and was described in detail. The initial result was to quantify the substantial positive effects of transfers on economic growth. This was done by comparing (for a given level of the resource regeneration rate) the complete markets allocation with intergenerational transfers to the incomplete markets allocation without transfers.

The core contribution of the paper was then to investigate whether and how the degree of resource renewability influences intergenerational transfers. The qualitative intuition behind this question goes as follows. A higher resource regeneration rate implies that one of the two productive factors of the economy becomes more abundant. How does this variation impact the features of transfers, their effects on the growth performances between allocations and ultimately the fraction of output needed to finance them? The results showed that a higher resource regeneration rate $\gamma$ expands the positive effects of transfers on growth performances

for both allocations but also on the gap in output growth rates between them. In addition, it is shown that transfers are financed at any point in time through a constant lump-sum tax relative to the output level. Notwithstanding their beneficial effects on economic growth, this means that whenever the degree of resource renewability varies, financing transfers does not employ a higher/lower fraction of output.

Let us now outline some possible directions for future research in this area. At first, considering different and more realistic taxation instruments to finance transfers might increase the variety and robustness of results for the benchmark framework developed in the current paper. Another natural step forward would be to ask what is the other side of the story. In other words, to look at how intergenerational transfers between generations of selfish agents affect the speed of resource depletion. Using a somewhat different framework from that of the current paper, Valente (2008) analyzed this problem in an overlapping generations model in which natural capital is owned by selfish old agents. He shows that transfers from old to young agents have the effects of increasing growth for all generations (except that of the first resource owner) and reducing the rate of resource depletion, hence preserving sustainability. A thorough theoretical analysis of these and related aspects combined with an empirical application regarding specific resource-rich economies would qualify as an interesting complementary study to the current paper.

## MATHEMATICAL APPENDIX

### 1. No-arbitrage and Hotelling rule

*1.1 No-arbitrage conditions and Hotelling rule: derivation of (10).* Starting from expression (9), substitute the physical resource constraint (4) as $X_{t+1} = R_{t+1} - A_{t+1}$ to obtain

$$\frac{1}{N_t^a} \cdot \left( \frac{q_{t+1}A_{t+1} - p_{t+1}A_{t+1}}{1+i_{t+1}} + \frac{p_{t+1}R_{t+1}}{1+i_{t+1}} - q_t A_t \right).$$

Combining (4) with (3), substitute $R_{t+1}=A_t\ (1+\gamma)$ in the above expression to obtain

$$\frac{1}{N_t^a} \cdot \left( \frac{q_{t+1}A_{t+1} - p_{t+1}A_{t+1}}{1+i_{t+1}} + \frac{1+\gamma}{1+i_{t+1}} p_{t+1}A_t - q_t A_t \right). \quad \textbf{(53)}$$

Maximizing (53) with respect to $A_{t+1}$ yields the static no-arbitrage condition $q_{t+1} = p_{t+1}$. Maximizing (53) with respect to $A_t$ and substituting $p_{t+1} = q_{t+1}$ yields the generalized Hotelling rule (10) in the text.

### 2. Complete markets: full equilibrium characterization

*2.1 Consumer Problem.* Under complete credit markets, the typical young agent born in period $t-1$ maximizes utility (11) subject to (12, 13, 14) taking $h_{t-1}$ and $y_{t-1}$ as given and using $\left(c_t, d_{t+1}, s_t, b_{t-1}\right)$ as control variables. The problem can be simplified as follows. Substituting $h_t$ in (12) by means of (14) and using (13) to eliminate $s_t$ from the resulting expression yields the lifetime budget constraint

$$c_t + \frac{d_{t+1}}{1+i_{t+1}} = w_t \eta\left(h_{t-1}, e_{t-1}, y_{t-1}\right) - e_{t-1}\left(1+i_t\right). \quad \textbf{(54)}$$

Maximizing (11) subject to (54) using $\left(c_t, d_{t+1}, e_{t-1}\right)$ as control variables, the Lagrangian reads

$$L \equiv v\left(c_t\right) + \beta \cdot v\left(d_{t+1}\right) + \lambda\left[ w_t \eta\left(h_{t-1}, e_{t-1}, y_{t-1}\right) - e_{t-1}\left(1+i_t\right) - c_t - \frac{d_{t+1}}{1+i_{t+1}} \right],$$

and the first-order conditions $L_{c_t} = 0$, $L_{d_{t+1}} = 0$ and $L_{e_{t-1}} = 0$ yield equations (15) and (16) in the text.

*2.2 Equilibrium characterization.* I will proceed to demonstrate that, in the log-linear model, output, resource use and human capital all grow at constant growth rates in each period $t = \{0,1,2,\ldots\infty\}$. Given the assumed learning technology (8), the

partial derivative with respect to education reads

$$\frac{\partial \eta\left(h_{t-1}, e^{\star}_{t-1} / y_{t-1}\right)}{\partial e^{\star}_{t-1}} = \mu \cdot \frac{h_{t-1}}{y_{t-1}}. \tag{55}$$

Consequently, the utility-maximizing condition for education investment (16) implies

$$w^{\star}_{t} = \left(1 + i^{\star}_{t}\right) \frac{1}{\mu} \cdot \frac{y_{t-1}}{h_{t-1}}, \tag{56}$$

so that the growth rate of wages is

$$\frac{w^{\star}_{t+1}}{w^{\star}_{t}} = \frac{1 + i^{\star}_{t+1}}{1 + i^{\star}_{t}} \cdot \frac{y_{t}}{y_{t-1}} \cdot \frac{h_{t-1}}{h_{t}} = \frac{1 + i^{\star}_{t+1}}{1 + i^{\star}_{t}} \cdot \frac{Y^{\star}_{t}}{Y^{\star}_{t-1}} \cdot \frac{H^{\star}_{t-1}}{H^{\star}_{t}}. \tag{57}$$

Results (56) and (57) are the crucial relationships telling us that, under the assumptions of the log-linear model, the economy exhibits constant growth rates of output and inputs in each period, from time zero to infinity. First, consider resource use. From the profit-maximizing condition on resource use in (2), the Hotelling rule (10) can be written as

$$\frac{X^{\star}_{t+1}}{X^{\star}_{t}} = \frac{Y^{\star}_{t+1}}{Y^{\star}_{t}} \cdot \frac{1 + \gamma}{1 + i^{\star}_{t+1}}. \tag{58}$$

Similarly, from the profit-maximizing condition on human capital in (2), the growth rate of wages is

$$\frac{w^{\star}_{t+1}}{w^{\star}_{t}} = \frac{Y^{\star}_{t+1}}{Y^{\star}_{t}} \cdot \frac{H^{\star}_{t}}{H^{\star}_{t+1}}, \tag{59}$$

where we can substitute (57) to obtain

$$\frac{1}{1 + i^{\star}_{t}} \cdot \frac{Y^{\star}_{t}}{Y^{\star}_{t-1}} \cdot \frac{H^{\star}_{t-1}}{H^{\star}_{t}} = \frac{1}{1 + i^{\star}_{t+1}} \cdot \frac{Y^{\star}_{t+1}}{Y^{\star}_{t}} \cdot \frac{H^{\star}_{t}}{H^{\star}_{t+1}}. \tag{60}$$

Hence, defining the convenient variable

$$\phi_{t+1} \equiv \frac{1}{1 + i^{\star}_{t+1}} \cdot \frac{Y^{\star}_{t+1}}{Y^{\star}_{t}}, \tag{61}$$

we can re-write the growth rates of inputs (58) and (61) as

$$\frac{X^{\star}_{t+1}}{X^{\star}_{t}} = \left(1 + \gamma\right) \cdot \phi_{t+1}, \tag{62}$$

$$\frac{H^{\star}_{t+1}}{H^{\star}_{t}} = \frac{\phi_{t+1}}{\phi_{t}} \cdot \frac{H^{\star}_{t}}{H^{\star}_{t-1}}. \tag{63}$$

The crucial step to show that these growth rates are constant over time is to combine the utility-maximizing condition for education investment (16) with firms' demand for human capital – that is, the profit-maximizing condition on human capital in (2). In fact, combining $w^{\star}_{t} = \left(1+i^{\star}_{t}\right)\frac{1}{\mu}\cdot\frac{y_{t-1}}{h_{t-1}}$ with $w^{\star}_{t} = \alpha\frac{Y^{\star}_{t}}{H^{\star}_{t}}$, and recalling that $\frac{y_{t-1}}{h_{t-1}} = \frac{Y_{t-1}}{H_{t-1}}$, we can eliminate the wage rate and rearrange terms to get

$$\frac{1}{\alpha\mu}\cdot\frac{H^{\star}_{t}}{H_{t-1}} = \frac{Y^{\star}_{t}}{Y_{t-1}}\cdot\frac{1}{1+i^{\star}_{t}} = \phi_{t}. \tag{64}$$

Substituting this result into (63) we obtain

$$\frac{H^{\star}_{t+1}}{H^{\star}_{t}} = \alpha\mu\cdot\phi_{t+1}. \tag{65}$$

*2.3 Equilibrium value of the interest rate.* Now, the growth rate of output is by definition equal to

$$\frac{Y^{\star}_{t+1}}{Y^{\star}_{t}} = \left(\frac{H^{\star}_{t+1}}{H^{\star}_{t}}\right)^{\alpha}\left(\frac{X^{\star}_{t+1}}{X^{\star}_{t}}\right)^{1-\alpha}. \tag{66}$$

Starting from (66), let us substitute the growth rates of human capital and resource use by means of (65) and (62), to obtain an expression that only contains $\frac{Y^{\star}_{t+1}}{Y^{\star}_{t}}$ and $\phi_{t+1}$:

$$\frac{Y^{\star}_{t+1}}{Y^{\star}_{t}} = \left[\alpha\mu\cdot\phi_{t+1}\right]^{\alpha}\left[\left(1+\gamma\right)\cdot\phi_{t+1}\right]^{1-\alpha} = \left(\alpha\mu\right)^{\alpha}\left(1+\gamma\right)^{1-\alpha}\phi_{t+1}. \tag{67}$$

Therefore, we can utilize (61) and solve for the interest factor:

$$\left(1+i^{\star}\right) = \left(\alpha\mu\right)^{\alpha}\left(1+\gamma\right)^{1-\alpha}. \tag{68}$$

Hence the interest rate factor $\left(1+i^{\star}\right)$ turns out to be a constant weighted average of the regeneration rate and of the marginal impact of the propensity to spend on education. But then, since the interest rate factor is constant in every period, output, resource use and human capital will grow at constant rates in every period as well.

*2.4 Equilibrium value of the propensity to invest in education.* To find the equilib-

rium propensity to invest in education, we need to follow a few sub-steps. At first, I obtain the aggregate budget constraint of the economy (a), total consumption of adult agents (b), total investment in education (c) and total consumption of old agents (d):

**(a) the aggregate budget constraint of the economy.** Substituting $b_{t-1} = e^{\star}_{t-1}$ in each period as well as the definition of aggregate savings of the adult $N^a_t s_t = q_t A_t$ in the budget constraints (12) and (13), the CMA is characterized by

$$N^a_t c^{\star}_t = w^{\star}_t h^{\star}_t N^a_t - q^{\star}_t A^{\star}_t - N^a_t e^{\star}_{t-1}\left(1+i^{\star}\right) - N^a_t e^{\star}_t\left(1+n\right), \tag{69}$$

$$N^o_{t+1} d^{\star}_{t+1} = q^{\star}_t A^{\star}_t\left(1+i^{\star}\right) + N^o_{t+1} e^{\star}_t\left(1+n\right)\left(1+i^{\star}\right). \tag{70}$$

Notice that setting (70) at time $t$ and using the Hotelling rule (10), we have

$$N^o_t d^{\star}_t = q^{\star}_t A^{\star}_t + p^{\star}_t X^{\star}_t + N^o_t e^{\star}_{t-1}\left(1+n\right)\left(1+i^{\star}\right). \tag{71}$$

Hence, summing the aggregate consumption levels of adult and old agents, we obtain

$$N^a_t c^{\star}_t + N^o_t d^{\star}_t = w^{\star}_t h^{\star}_t N^a_t + p^{\star}_t X^{\star}_t - N^a_t e^{\star}_t\left(1+n\right),$$

where we can substitute $w^{\star}_t h^{\star}_t N^a_t + p^{\star}_t X^{\star}_t = Y^{\star}_t$ in view of constant returns to scale, and write the aggregate expenditure constraint of the economy as

$$Y^{\star}_t = N^y_t e^{\star}_t + N^a_t c^{\star}_t + N^o_t d^{\star}_t. \tag{72}$$

**(b) total consumption of adult agents.** Re-arranging terms in (70) we obtain

$$q^{\star}_t A^{\star}_t + N^o_{t+1} e^{\star}_t\left(1+n\right) = \frac{N^o_{t+1} d^{\star}_{t+1}}{1+i^{\star}}, \tag{73}$$

which can be substituted in (69) to get

$$c^{\star}_t + \frac{d^{\star}_{t+1}}{1+i^{\star}} = w^{\star}_t h^{\star}_t - e^{\star}_{t-1}\left(1+i^{\star}\right). \tag{74}$$

In the log-linear model, the utility function $v(\cdot) = \ln(\cdot)$ implies that the Euler condition (15) reduces to

$$\frac{d^{\star}_{t+1}}{1+i^{\star}} = \beta c^{\star}_t. \tag{75}$$

Substituting (75) in (74) yields

$$c^{\star}_t = \frac{w^{\star}_t h^{\star}_t - e^{\star}_{t-1}\left(1+i^{\star}\right)}{1+\beta}. \tag{76}$$

Notice that, multiplying both sides of (56) by $h_t^\star$ and substituting the learning technology (8), we obtain

$$w_t^\star h_t^\star - e_{t-1}^\star\left(1+i^\star\right) = \frac{1}{\mu}\cdot\left(1+i^\star\right)\cdot y_{t-1}. \tag{77}$$

Substituting (77) in (76), we obtain

$$c_t^\star = \frac{1+i^\star}{\left(1+\beta\right)\cdot\mu}\cdot y_{t-1}. \tag{78}$$

Multiplying both sides of (78) by $N_t^a = N_{t-1}^y$ we obtain the total consumption of adult agents

$$N_t^a c_t^\star = \frac{1+i^\star}{\left(1+\beta\right)\cdot\mu}\cdot Y_{t-1}^\star. \tag{79}$$

**(c) total investment in education.** From the learning technology (8), we have

$$\frac{e_t^\star}{y_t^\star} = \frac{1}{\mu}\cdot\frac{h_{t+1}^\star - h_t^\star}{h_t^\star}, \tag{80}$$

so that, multiplying both sides of (80) by $N_t^y$, we obtain the economy's total expenditure in education as

$$N_t^y e_t^\star = \frac{1}{\mu}\cdot\frac{h_{t+1}^\star - h_t^\star}{h_t^\star}\cdot Y_t^\star. \tag{81}$$

**(d) total consumption of old agents.** From (75) we have

$$d_t^\star = c_{t-1}^\star\cdot\beta\left(1+i^\star\right),$$

$$N_t^o d_t^\star = N_{t-1}^a c_{t-1}^\star\cdot\beta\left(1+i^\star\right),$$

where we can substitute equation (79) to obtain total consumption of old agents

$$N_t^o d_t^\star = \frac{\beta\left(1+i^\star\right)^2}{\mu\left(1+\beta\right)}\cdot Y_{t-2}^\star. \tag{82}$$

The next step: substitute total consumption of adult agents (b), total investment in education (c) and total consumption of old agents (d) into (a) and divide by output, obtaining propensities and therefore an expression linking output growth to human capital growth. Substitute (79), (81) and (82) into the aggregate constraint (72) obtaining

$$Y_t^\star = N_t^y e_t^\star + N_t^a c_t^\star + N_t^o d_t^\star, \tag{83}$$

$$Y_t^\star = \frac{1}{\mu}\cdot\frac{h_{t+1}^\star - h_t^\star}{h_t^\star}\cdot Y_t^\star + \frac{1+i^\star}{(1+\beta)\cdot\mu}\cdot Y_{t-1}^\star + \frac{\beta\left(1+i^\star\right)^2}{\mu(1+\beta)}\cdot Y_{t-2}^\star, \tag{84}$$

which, recalling the definition $\phi_t = \frac{1}{1+i^\star}\cdot\frac{Y_t^\star}{Y_{t-1}^\star}$, can be rearranged as

$$\frac{h_{t+1}^\star}{h_t^\star} = 1+\mu - \frac{1}{1+\beta}\cdot\frac{1}{\phi_t} - \frac{\beta}{1+\beta}\cdot\frac{1}{\phi_{t-1}}\cdot\frac{1}{\phi_t}. \tag{85}$$

Because $\frac{H_{t+1}^\star}{H_t^\star} = \alpha\mu\cdot\phi_{t+1}$ by (65), I can substitute

$$\phi_t = \frac{h_t^\star}{h_{t-1}^\star}\cdot\frac{1+n}{\alpha\mu} \text{ and } \phi_{t-1} = \frac{h_{t-1}^\star}{h_{t-2}^\star}\cdot\frac{1+n}{\alpha\mu}, \tag{86}$$

to obtain

$$\frac{h_{t+1}^\star}{h_t^\star} = 1+\mu - \frac{\alpha\mu}{(1+\beta)(1+n)}\cdot\frac{1}{\frac{h_t^\star}{h_{t-1}^\star}} - \frac{(\alpha\mu)^2\beta}{(1+\beta)(1+n)^2}\cdot\frac{1}{\frac{h_{t-1}^\star}{h_{t-2}^\star}}\cdot\frac{1}{\frac{h_t^\star}{h_{t-1}^\star}}. \tag{87}$$

Recall that the learning technology (8) defines $\frac{h_{t+1}^\star}{h_t^\star}$ as a function of the propensity to spend in education,

$$\frac{h_{t+1}^\star}{h_t^\star} = 1+\mu\varepsilon_t \equiv \Lambda(\varepsilon_t). \tag{88}$$

As a consequence, rewrite (87) as

$$\Lambda(\varepsilon_t) = 1+\mu - \frac{\alpha\mu}{(1+\beta)(1+n)}\cdot\frac{1}{\Lambda(\varepsilon_{t-1})} - \frac{(\alpha\mu)^2\beta}{(1+\beta)(1+n)^2}\cdot\frac{1}{\Lambda(\varepsilon_{t-1})}\cdot\frac{1}{\Lambda(\varepsilon_{t-2})}. \tag{89}$$

Equation (89) exhibits a steady state $\varepsilon^\star$ determined by the stationarity condition

$$\Lambda(\varepsilon^\star) = 1+\mu - \frac{\alpha\mu}{(1+\beta)(1+n)}\cdot\frac{1}{\Lambda(\varepsilon^\star)} - \frac{(\alpha\mu)^2\beta}{(1+\beta)(1+n)^2}\cdot\frac{1}{\Lambda(\varepsilon^\star)^2}. \tag{90}$$

This steady state is unstable:[8] if we start from $\varepsilon_0 \neq \varepsilon^\star$ at time zero, the dynamic

8. Importantly, note that the fact that equation (89) is an unstable (second-order) difference equation is good news: it implies that there exists one and only one value of $\varepsilon_t = \varepsilon^\star$ that is consistent with a bounded propensity to invest in education $0<\varepsilon_t<1$ in each $t = \{0,1,2,\ldots\infty\}$. If (89) were stable around some long-run steady state $\lim_{t\to\infty}\varepsilon_t = \tilde{\varepsilon} \in (0,1)$, agents could choose any initial value $\varepsilon_0$ at time zero, and then let the subsequent values $\varepsilon_1$, $\varepsilon_2$, assume the values dictated by equation (89), to end up with the long-run propensity $\tilde{\varepsilon} \in (0,1)$. But then, the whole

equation brings all subsequent values of $\varepsilon_t$ away from the steady state $\varepsilon^\star$, implying

$$\text{either } \varepsilon_t = 0 \text{ or } \varepsilon_t = 1 \text{ at some finite time } t. \quad \textbf{(91)}$$

Is (91) possible in equilibrium? No. Given that I have shown that the interest rate is constant in each period, from time zero to infinity, it must be the case that the propensity to invest in education is bounded between zero and unity in each period $t$, from zero to infinity:

$$0< \varepsilon_t <1 \quad \text{in each} \quad t =\{0,1,2,\ldots\infty\} \quad \textbf{(92)}$$

The above condition must be true because, if $\varepsilon_t$ diverges to zero or unity in finite time, there is no equilibrium interest rate in the economy (there is no human capital accumulation or there is no demand for human capital and resources). Given that (92) must be true, the only case in which we can satisfy equation (92) with $0< \varepsilon_t <1$ in each $t =\{0,1,2,\ldots\infty\}$ is that $\varepsilon_t$ jumps at the steady state level $\varepsilon^\star$ at time zero, and remains constant thereafter, thereby satisfying equation (89) by being stuck in the steady state (90).

**Remark 6** *The propensity to invest in education is constant and equal to*

$$\varepsilon_t = \varepsilon^\star \quad \text{in each } t = \{0,1,2,...\infty\},$$

*where $\varepsilon^\star$ is determined by equation (90).*

We can now derive the equilibrium growth rate of knowledge and, therefore, all the rest, as a function of $\varepsilon^\star$.

*2.5 Equilibrium growth rates and propensions to consume.* Given the above result in Remark 6, we can calculate the growth rates of inputs and output as a function of parameters and of $\varepsilon^\star$:

$$\frac{H^\star_{t+1}}{H^\star_t} = \frac{h^\star_{t+1}\ell_{t+1}}{h^\star_t\ell_t} = (1+n)\frac{h^\star_{t+1}}{h^\star_t} = (1+n)(1+\mu\varepsilon^\star). \quad \textbf{(93)}$$

Inserting this into (64) allows us to derive the constant growth rate of output:

$$\frac{Y^\star_{t+1}}{Y^\star_t} = \left(\frac{1+\gamma}{\alpha\mu}\right)^{1-\alpha}(1+n)(1+\mu\varepsilon^\star). \quad \textbf{(94)}$$

In conclusion, it is easy to substitute this result into (61) and in turn (62) to obtain the growth rate of resource use:

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equilibrium path is indeterminate because agents could start from any different $\varepsilon_0$ and end up in the same place $\tilde{\varepsilon} \in (0,1)$.

$$\frac{X_{t+1}^{\star}}{X_t^{\star}} = \frac{1+\gamma}{\alpha\mu}\left(1+n\right)\left(1+\mu\varepsilon^{\star}\right). \tag{95}$$

In order to fully characterize the CMA equilibrium we need also to calculate the propensities to consume of adult and old agents as functions of parameters and of $\varepsilon^{\star}$. Using the previous steps and recalling the aggregate constraint (72), I can calculate residually:

$$\frac{N_t^a c_t^{\star}}{Y_t^{\star}} = \frac{\alpha}{(1+\beta)\left(1+n\right)\left(1+\mu\varepsilon^{\star}\right)}, \tag{96}$$

$$\frac{N_t^o d_t^{\star}}{Y_t^{\star}} = \frac{\beta\alpha}{(1+\beta)\left(1+n\right)^2\left(1+\mu\varepsilon^{\star}\right)^2}. \tag{97}$$

## 3. Incomplete markets: full equilibrium characterization

*3.1 Consumer Problem.* This consumer problem will of course look like a simplified version of the above one. The typical young agent born in period $t-1$ will now maximize utility (11) subject to (24), (25) and (26) taking $h_{t-1}$ as given and using $\left(c_t, d_{t+1}, s_t\right)$ as control variables. The problem can again be simplified as follows. Substituting $h_t$ in (24) by means of (26) and using (25) to eliminate $s_t$ from the resulting expression yields the lifetime budget constraint:

$$c_t + \frac{d_{t+1}}{1+i_{t+1}} = w_t h_{t-1}. \tag{98}$$

Maximizing (11) subject to (98) using $\left(c_t, d_{t+1}\right)$ as control variables, the Lagrangian reads

$$L \equiv v\left(c_t\right) + \beta \cdot v\left(d_{t+1}\right) + \lambda\left[w_t h_{t-1} - c_t - \frac{d_{t+1}}{1+i_{t+1}}\right],$$

and the first-order conditions $L_{c_t} = 0$ and $L_{d_{t+1}} = 0$ yield equation (27) in the above text.

*3.2 Equilibrium characterization.* As regards the aggregate budget of the economy, the allocation with incomplete markets IMA is characterized by

$$N_t^a c_t^{\#} = w_t^{\#} h_t^{\#} N_t^a - q_t^{\#} A_t^{\#}, \tag{99}$$

$$N_{t+1}^o d_{t+1} = q_t^{\#} A_t^{\#}\left(1+i_{t+1}^{\#}\right). \tag{100}$$

Notice that setting (100) at time $t$ and using the Hotelling rule (10), we have

$$N_t^o d_t^\# = q_t^\# A_t^\# + p_t^\# X_t^\#. \tag{101}$$

Hence, summing the aggregate consumption levels of adult and old agents, we obtain

$$N_t^a c_t^\# + N_t^o d_t^\# = w_t^\# h_t^\# N_t^a + p_t^\# X_t^\#, \tag{102}$$

where we can substitute $w_t^\# h_t^\# N_t^a + p_t^\# X_t^\# = Y_t^\#$ in view of constant returns to scale, and write the aggregate expenditure constraint of the economy as

$$Y_t^\# = N_t^a c_t^\# + N_t^o d_t^\#. \tag{103}$$

Total consumption of adult agents. Re-arranging terms in (100) we obtain

$$q_t^\# A_t^\# = \frac{N_{t+1}^o d_{t+1}^\#}{1+i_{t+1}^\#}, \tag{104}$$

which can be substituted in (99) to get

$$c_t^\# + \frac{d_{t+1}^\#}{1+i_{t+1}^\#} = w_t^\# h_t^\#. \tag{105}$$

In the log-linear model, the utility function $v(\cdot)=\ln(\cdot)$ implies that the Euler condition (27) reduces to

$$\frac{d_{t+1}^\#}{1+i_{t+1}^\#} = \beta c_t^\#, \tag{106}$$

Substituting (106) in (105) yields

$$c_t^\# = \frac{w_t^\# h_t^\#}{1+\beta}. \tag{107}$$

Notice that from (2), we obtain

$$w_t^\# h_t^\# = \frac{\alpha Y_t^\#}{\ell_t}. \tag{108}$$

Substituting (108) in (107), we obtain

$$c_t^\# = \frac{\alpha}{(1+\beta)} \frac{Y_t^\#}{\ell_t}. \tag{109}$$

Multiplying both sides of (109) by $N_t^a = \ell_t = N_{t-1}^y$ and rearranging we obtain the propensity to consume of adult agents

$$\frac{N_t^a c_t^\#}{Y_t^\#} = \frac{\alpha}{(1+\beta)}. \tag{110}$$

Now the propensity to consume of old agents. By merging (103) and (109) we

have

$$Y_t^{\#} = \frac{\alpha N_t^a}{(1+\beta)} \frac{Y_t^{\#}}{\ell_t} + N_t^o d_t^{\#},$$

$$Y_t^{\#}\left(1 - \frac{\alpha}{1+\beta}\right) = N_t^o d_t^{\#},$$

$$\frac{N_t^o d_t^{\#}}{Y_t^{\#}} = \frac{1+\beta-\alpha}{1+\beta}. \qquad \textbf{(111)}$$

Set now (111) at $t$+1 and solving for $d_{t+1}^{\#}$ gives:

$$d_{t+1}^{\#} = \left(\frac{1+\beta-\alpha}{1+\beta}\right) \frac{Y_{t+1}^{\#}}{N_{t+1}^o}. \qquad \textbf{(112)}$$

Inserting back again this result and (109) into (106) gives:

$$1 + i_{t+1}^{\#} = \left(\frac{1+\beta-\alpha}{1+\beta}\right) \frac{Y_{t+1}^{\#}}{N_{t+1}^o} \frac{1}{\beta} \frac{(1+\beta)}{\alpha} \frac{N_t^a}{Y_t^{\#}}, \qquad \textbf{(113)}$$

$$1 + i_{t+1}^{\#} = \left(\frac{1+\beta-\alpha}{\alpha\beta}\right) \frac{Y_{t+1}^{\#}}{Y_t^{\#}}. \qquad \textbf{(114)}$$

Keep this result in mind as I move to resource use and output growth rate. Similarly as for the CMA allocation, from the profit-maximizing condition on resource use in (2), the Hotelling rule (10) can be rewritten as

$$\frac{X_{t+1}^{\#}}{X_t^{\#}} = \frac{Y_{t+1}^{\#}}{Y_t^{\#}} \cdot \frac{1+\gamma}{1+i_{t+1}^{\#}}. \qquad \textbf{(115)}$$

Inserting (28) and (115) into the definition of the growth rate of output implies the following:

$$\frac{Y_{t+1}^{\#}}{Y_t^{\#}} = (1+n)\left(\frac{1+\gamma}{1+i_{t+1}^{\#}}\right)^{\frac{1-\alpha}{\alpha}}. \qquad \textbf{(116)}$$

The growth rate of output $\frac{Y_{t+1}^{\#}}{Y_t^{\#}}$ appears to depend crucially on the ratio between resource regeneration and the interest rate. For levels of $\gamma$ such that $\frac{1+\gamma}{1+i_{t+1}} < 1$, the growth rate of output might decrease. We are now just a few steps away from the final determination of the equilibrium interest rate and of the growth rates of the IMA. Recall (116) and substitute it into (114) to get:

$$1+i^{\#}=\left[\frac{(1+\beta-\alpha)(1+n)}{\alpha\beta}\right]^{\alpha}(1+\gamma)^{1-\alpha}. \tag{117}$$

Insert now (117) into (116) to get a final expression for the growth rate of the economy:

$$\frac{Y_{t+1}^{\#}}{Y_t^{\#}}=(1+n)^{\alpha}\left[\frac{\alpha\beta(1+\gamma)}{1+\beta-\alpha}\right]^{1-\alpha}. \tag{118}$$

In conclusion, from the Hotelling rule rewritten as in (115) we obtain the resource use growth rate:

$$\frac{X_{t+1}^{\#}}{X_t^{\#}}=\frac{\alpha\beta}{1+\beta-\alpha}(1+\gamma). \tag{119}$$

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# NEW MONETARY POLICY APPROACH IN TURKEY AGAINST FINANCIAL SYSTEMIC RISK

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**Abstract**
This paper explains the underlying motivation for the decision of the Central Bank of the Republic of Turkey (CBRT) to adopt a flexible monetary policy since 2010. In this context the paper provides an overview of the framework and summarizes the initial results. Specifically, the paper begins by giving a historical perspective to provide motivation, then presents an overview of the key changes to the framework, including both monetary and macro-prudential instruments. Lastly, the study lays out a discussion of the initial outcomes owing to the changes to the new monetary policy framework.

**Jel Classification**: E52, E58, E63, G28
**Key words:** Systemic risk; Monetary policy; Financial stability; Macro-prudential policy; Central Bank of the Republic of Turkey

## 1. Introduction

The Central Bank of the Republic of Turkey (CBRT) has been applying a new approach to monetary policy since the end of 2010. This study explains the underlying motivation for its adoption of such a flexible policy, provides an overview of the framework, and summarizes the initial results.

One of the reasons behind the new policy application efforts was the world-wide debate on the application of monetary policy and the increasing needs for the approaches, connecting monetary policy to financial stability. The other reason for a

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new approach to monetary policy in Turkey was the financial threat to Turkey created by the global economic crisis after 2008.

The expansionary monetary policy, applied by the developed countries after the collapse of Lehman Brothers in September of 2008, created unexpected consequences for the world economy. This monetary policy may in many cases be too expansionary for the developing countries, creating overheated economies with risks of bubbles and other negative consequences. These world-wide developments in the economic environment have threatened the macro-economic and financial stability of the Turkish economy. Increasing capital inflows, resulted in an appreciation of the Turkish Lira and credit expansion in the Turkish economy, ending in a serious foreign trade and current account deficit. Also the quality of the capital inflow deteriorated. The CBRT decided to change the traditional approach to monetary policy to eliminate the negative effects of an uncertain and volatile economic environment. Much more flexible monetary policy was implemented in order to prevent the negative effects of external shocks. The CBRT has modified the conventional inflation-targeting regime by adopting financial stability as a supplementary objective and enriching the set of policy instruments with a particular emphasis on credit and exchange rate channels.

## 2. A Brief History of Monetary Policy in Turkey

### *2.1 Monetary Policy Approach after 2001*

There was economic turbulence during the 1990s in Turkey. In order to understand how the recent Turkish experience differs from the past, taking the grave financial crisis of 2001 as a starting point would be helpful. The year 2001 is associated with fragilities in the banking system and a speculative attack on the fixed exchange rate regime in place at the time. A severe recession ensued. After the 2001 crisis, Turkey embarked on a new IMF-supported arrangement. Two major reforms, related with the monetary policy approach, that were implemented in the aftermath of the crisis are as follows (Alp and Elekdağ, 2011/2014):

- The heavily managed and fixed exchange rates regimes of the past were abandoned in favor of floating exchange rates.
- The CBRT started its transition and, in 2006, officially implemented a fully-fledged inflation-targeting regime which would serve as the economy's nominal anchor.

Monetary policy of the CBRT has become increasingly more transparent since 2001 with many important structural changes transforming the policymaking environment (Demiralp; Kaya and Özlü, 2011:5-9). Turkey adopted the inflation-targeting regime and free float exchange rate policy in February 2001. The new Central Bank Law was enacted in May 2001, which defined the main goal of the CBRT as achieving stability. Along with the passing of the new law, the CBRT was granted operational independence and short-term interest rates became the main operational instrument of monetary policy.

The Law also established a new decision-making body, the Monetary Policy Committee (MPC). The main task of the MPC is to formulate the strategy for monetary policy, which includes setting policy rates and communicating future monetary policy. The CBRT law also defined the MPC as the ultimate body for designing the strategy of monetary policy.

The CBRT implemented implicit inflation targeting as a transition period, during which communication, transparency and the institutional setup would be enhanced gradually. The decision-making process shifted to a more predictable and systematic setup in 2005 with the adaptation of pre-announced fixed decision dates.

The CBRT adopted fully-fledged inflation-targeting at the beginning of 2006. The regime brought in many innovations in terms of the decision-making process and the role of communication. In terms of communication, there were two main innovations: First, the CBRT started to publish the medium term inflation forecasts along with some qualitative information regarding the future policy path. Second, the CBRT enhanced forward-looking information content of the policy statements, providing more specific guidance regarding the revisions in the policy stance. In sum, the implementation of fully-fledged inflation-targeting, coupled with the new strategy adopted by the MPC, has increased the forward-looking component of monetary policy.

The CBRT Law, which was amended in 2001, gives responsibility to the bank for taking necessary measures to contribute to financial stability, alongside its primary mandate of achieving and maintaining price stability. Accordingly, in order to contain macro-financial risks in the domestic economy posed by global imbalances, the CBRT designed and launched a new policy strategy at the end of 2010 (Başçı, 2012:23-26).

*2.2 Monetary Policy Approach after 2010*

The most important reason behind the adaptation of an unconventional approach to monetary policy by the CBRT was the changing attitude to central banking applications in the post-crisis period. One of the major lessons learnt from the global crisis is that while focusing on price stability as a main objective, central banks shouldn't underestimate the importance of risks accumulating in the financial system and bubbles in asset prices. As a result of this alternative approach, the idea that the central banks should attach more weight to financial stability has gradually been highlighted across international platforms like the G-20. Moreover, academic studies advocating the implementation of macro prudential policies in order to escape from the negative effects of economic crisis have increasingly occupied the agenda in the recent economic literature (Bianchi and Mendoza 2011; Jeanne and Korinek 2010).

Besides changing views about central banking and discussions about the increasing necessity of new economic policy approach, prevailing world-wide economic problems and the unusual global economic environment were influential in inducing the search for a new policy mix by the CBRT.

The devastating effects of the global crisis and policies subsequently implemented by advanced economies, as well as prevailing global imbalances, led to unusual dynamics in the global economy. After four years of a painful adjustment process since the outbreak of the crisis, a deleveraging process in advanced economies still continues. Downside risks in advanced economies remain critical, causing them to maintain expansionary monetary policies, while domestic demand remains strong in emerging economies amid capital inflows (CBRT, 2011-II:1). The divergence between advanced and emerging economies accelerates capital inflows to countries like Turkey, with strong economic fundamentals and relatively low risk. Rapid credit expansion and widening current account deficit fueled by short-term capital inflows feed risks to financial stability and may hamper price stability over the medium term, hence giving rise to the adoption of different approaches that incorporate financial stability into the monetary policy framework.

Post-crisis responses by the major central banks complicate the policy-making process in emerging economies. Substantial volatility in capital flows in recent years has resulted in increasing uncertainty and risk. These developments constitute a major challenge to macroeconomic and financial stability in emerging economies, especially those with sizeable external financing needs. This environment calls for more flexible policies to ensure timely and effective responses to external shocks.

The new strategy preserves the main objective of achieving and maintaining price stability while safeguarding financial stability as a supporting objective. In this context, in addition to the interest rate, complementary tools such as reserve requirement ratios and the interest rate corridor are also used in order to cope with financial imbalances. These policies aim to ensure sounder economic growth in a gradual way without hampering the medium-term inflation outlook. Accordingly, policies are pursued to prevent excessive deviation of the exchange rate from economic fundamentals, while the necessary measures are taken in collaboration with other regulatory institutions, to avoid excessive credit growth (Başçı, 2012: 24).

## 3. Reasons behind the New Policy Approach: Global Imbalances, Capital Flows and the Turkish Economy

Reviewing post-crisis dynamics of the Turkish economy would be helpful for understanding the importance of capital flows in the macroeconomic stability of Turkey and the reasons behind the new monetary policy approach of the CBRT after 2010.

After contracting in 2009, the Turkish economy experienced a rapid recovery on the back of strong fundamentals and solid domestic demand. The surge in capital inflows fuelled by expansionary monetary policies of developed countries and historically low interest rates supported credit growth and led to an excessive appreciation in the Turkish lira. Rapid expansion in credit facilities reinforced the growth in domestic demand. Appreciation of the Turkish lira resulted in increasing demand for imports. However, there was no positive improvement in exports under the prevailing conditions of weak external demand and the stronger Turkish lira. As a result the foreign trade deficit and current account balance deteriorated notably and resulted in increasing vulnerability of the economy to sudden reversals in global risk appetite. The excessively volatile nature of global risk appetite in the post-crisis world, together with the increasingly short-term nature of current account finance, raised further concerns about financial stability in the Turkish economy. Since 2010, the current account deficit has been financed almost completely through short-term capital and portfolio investments (Kara, 2012:3). The years 1994, 2001, and 2008 were times of severe economic crisis for Turkey. The common problem of those years was the sudden suspension of capital flows. The history of Turkey's economic crises provides enough evidence of the importance of capital flows for achieving macro-economic stability and sustainable economic growth. This histori-

cal perspective points out the need for enhancing the resilience of the economy against abrupt changes in global risk appetite. It also suggests that a more flexible approach would be useful in monetary policy, paving the way for a new policy framework.

## 4. New Monetary Policy of the Central Bank of the Republic of Turkey

### *4.1 Financial Stability and Monetary Policy*

Since the end of 2010, a new policy framework implemented by the CBRT takes into account macro financial risks. In this respect, the general framework of the inflation-targeting regime was modified and additional policy instruments were developed to support the adaptation of financial stability as a complementary objective (CBRT, 2012-IV: 1). Policies implemented in this period aimed at managing macro financial risks without prejudice to the price stability objective. Accordingly, additional policy tools were developed in order to pursue multiple objectives. The new policy design aimed at constructing a framework to enhance the resilience of the economy against fragilities that are particularly driven by external balance, credit expansion and capital flows. The current account balance and the course of capital flows in Turkey entail noteworthy conclusions about financial stability and macro financial risks (Kara, 2012: 5). For example, higher risk appetite in times of strong global growth accelerates capital inflows and results in rapid credit growth. Credit growth increases maturity and exchange rate mismatches on balance sheets, leading to accumulation of risks by distorting resource allocation. Appreciation of the local currency and rapid credit expansion deteriorates the current account balance. The deterioration in the current account and the volatility in external financial flows increase the risk of a sudden cessation, which can be regarded as some form of systemic risk. Therefore, the current account balance and capital flows are at the center of the new policy design alongside with traditional variables like credit. Accordingly, policies implemented since the end of 2010 concentrated on alleviating the potential adverse effects of capital flow volatility, aiming at soft landing and improving the external financing structure.

### *4.2 New Policy Instruments*

In the traditional inflation-targeting framework, central banks mainly aim at keeping inflation in line with the target by using a single policy instrument of short-term interest rates. However, in the new policy approach, because of the tradeoff that

may occasionally arise between financial stability and price stability, additional tools are needed besides the interest rate. As a result CBRT diversified its policy tools before adapting the new policy mix. The new policy mix entailed the joint use of the interest rate corridor between overnight borrowing and lending rates, liquidity policies and required reserves in addition to short term interest rates. Kara (2012:6), summarizes the main tools utilized in the new policy framework as follows:

- Interest rate corridor; one-week repo rate and liquidity management tools.
- Required reserves and more recently reserve option mechanism.

*4.3 Intermediate Variables: Credit and Exchange rates*

Since the policy was newly implemented, the existing economic literature provided little information about the channels through which the new policy tools like the interest rate corridor or required reserves affected price and financial stability. Insufficient information about the effects of the tools on the objectives of CBRT required an additional effort in terms of communication policy.

To increase communication about the transmission mechanism the CBRT defined and highlighted two intermediate variables: credit and exchange rates (Kara, 2012:7). By the help of these variables the new policy of CBRT became much more explicit for the economic agents. Since these variables are directly observable and relevant data are announced without delay, they can be easily and directly monitored by the economic agents. This approach facilitated more reliable and effective communication regarding policy implementation, as it provided a clear and observable transmission from policy instruments to final objectives.

If the CBRT has financial stability concerns, increasing the policy rate may not be desirable as it would lead to exchange rate appreciation which may conflict with the financial stability objective. Therefore, the presence of financial stability as an explicit objective may require the use of credit and exchange rate channels separately (Kara, 2012:7). Accordingly, monetary authority may need to resort to other instruments besides short-term interest rates in order to affect both credit and exchange rate channels in the desired direction.

### *4.4 Effects of Policy Instruments on Intermediate Variables*

#### 4.4.1 Effects of Liquidity Management and Interest Rate Corridor on Credit and Exchange Rates

Liquidity management and the interest rate corridor are the key instruments for understanding the CBRT's new policy framework.

In order to affect the amount of liquidity and interest rates in the interbank money market, the CBRT has alternative instruments. The CBRT provides short-term funds (daily, weekly or monthly) to banks that are short of liquidity or borrows from banks that have excess liquidity by using different instruments.

The main instrument the CBRT uses to manage the liquidity of the system and to change the stance of monetary policy is the one-week repo auctions. The interest rate corridor is the area that lies between the rates at which the CBRT can borrow and lend overnight in the money market.

In the traditional inflation-targeting framework, the repo rate and the interest rate corridor are revised by the Monetary Policy Committee (MPC) on a monthly basis. As a result short-term interest rates stay unchanged until the next meeting. Since the interest rate for the main funding operation (one week repo) is predetermined, the average funding rate of the CBRT stays flat throughout the whole month.

On the other hand, under the new system, there is no short-term commitment to the level of market rates or average cost of funding by the CBRT. The key feature of the interest rate corridor is that the market interest rates can be changed on a daily basis by adjusting the quantity of funds provided through one-week repo auctions. The width of the interest rate corridor signals the maximum possible change that can be engineered in the short-term market rates via daily liquidity operations. Under this framework volatility of short-term interest rates can be used as an additional policy instrument. The new corridor system allows the short-term money market rates to persistently deviate from the average funding cost of the CBRT. This differential, coupled with the active liquidity policy and interest rate corridor, allows the CBRT to affect the credit and exchange rate channels in separate ways. Within the new setup, the interest rate corridor provides an important role in the conduct of monetary policy. New policy approach facilitates a swift response to rapid changes in risk appetite and provides a much-valued flexibility against uncertainties surrounding the global economy.

#### 4.4.1.1 Effects on Credit

Through the use of the corridor and liquidity facilities, the CBRT controls the marginal cost of credit at a high frequency for banks that have liquidity shortfall. Also, the CBRT uses uncertainty regarding the funding rate as a policy instrument. In the case of an undesired acceleration (deceleration) in credit growth, the CBRT can increase (decrease) the uncertainty regarding the amount and cost of funding provided to banks and lead to a tightening (loosening) in credit supply (Kara, 2012:10). In a market in which the CBRT is a net creditor, it can have a significant effect on credit rates and credit growth.

#### 4.4.1.2 Effects on Exchange Rates

A wide interest rate corridor and liquidity facilities make it possible for the CBRT to adjust overnight interest rates on a daily basis so as to smooth out volatility in short term capital flows and the exchange rate. For example, in periods of high global risk aversion, during which emerging countries like Turkey are likely to experience capital outflows, the CBRT can prevent an excessive depreciation of the Turkish lira by supplying less liquidity than demanded by the market and let the short-term rates rise. This policy also works by inducing banks to sell foreign exchange to meet liquidity needs, which would also ease the depreciation pressure on domestic currency. The width of the corridor can play an important role in smoothing exchange rate volatility and the system can be adopted to smooth the flow of capital in both directions.

### 4.4.2 Effects of Required Reserves on Credit and Exchange Rates

#### 4.4.2.1 Effects on Credit

Required reserves are mainly used for liquidity purposes and also for affecting credit supply. Capital inflows are typically associated with easing supply conditions, falling interest rates and rapid credit growth. Higher required reserve ratios can limit the acceleration in credit supply and contain macro financial risks. On the other hand, during a deceleration in capital inflows or increased risk perception, reduction of required reserves can reduce the risk of a credit crunch.

#### 4.4.2.2 Effects on Exchange Rates

As an additional tool, the CBRT allows the banks to keep a certain ratio of Turkish lira required reserves in foreign exchange or gold (Mimir; Sunel; Taşkın, 2012: 1-6). This flexibility, which is called the Reserve Option Mechanism has the potential to smooth out the effects of fluctuations in capital flows on the exchange rate and financial markets. For example, a rise in foreign exchange liquidity and a fall in foreign interest rates in times of accelerated capital inflows will lead banks to keep a larger part of their required reserves in foreign exchange. This can alleviate the appreciation pressure on the exchange rate and can support financial stability by reducing the excess lending in foreign exchange. In that sense this mechanism would not only act as an automatic stabilizer for the foreign exchange, but also reduce the sensitivity of the credits to capital flows.

### *4.5 Effects of Intermediate Variables on Final Monetary Objectives*

#### 4.5.1 Effects on Price Stability

The CBRT sets its monetary policy stance to ensure that the medium-term inflation outlook is consistent with the inflation target. To this end, the CBRT makes use of the demand and cost channels. Credit plays an important role for the demand channel, while the exchange rate is the main determinant of the cost channels.
The credit channel has a prominent role in financing consumption and investment. As a result it is the main transmission mechanism to affect the output gap and medium term inflation dynamics.

The exchange rate is a key variable for the cost channel. Given that imported intermediate inputs are intensely used in production in Turkey, exchange rate pass-through is typically the main channel for the short-term inflation outlook.

Therefore credit and exchange rates are important determinants of inflation dynamics through demand and cost channels.

#### 4.5.2 Effects on Macro-financial Risks

The financial stability notion that the CBRT considers reflects a macro perspective. Rapid credit growth, external imbalances and misalignment of the exchange rate can be listed as the most important macro financial risks of Turkey in recent years.
In fact credit and exchange rates directly interact with the current account balance and macro financial risks. Studies find a close relationship between the current account balance and credit use in Turkey (Çebi, 2011). On the other hand, excessive

appreciation in the exchange rate fuels the demand for directly imported goods. As a result both credit expansion and over appreciation of the local currency deteriorate the current account balance and may increase the fragility of the economy against abrupt changes in capital movements. Credits and exchange rates have also been considered as direct indicators for the health of the overall economic environment. In this context, rapid credit growth and excessive appreciation of the local currency are found to be primary leading indicators for a possible crisis (Tornell and Westermann 2005; Mendoza and Terrones 2008; Reinhart 2012; Elekdag and Wu, 2013).

## 5. Implementation and Outcomes of the New Monetary Policy

The new policies implemented since the end of 2010 can be discussed under three periods.

- November 2010-August 2011: Strong capital inflows
- August 2011-October 2011: Euro area depth crisis and increasing uncertainty
- Post October 2011 Period: Surge in inflation and monetary tightening

### *5.1 First Period (November 2010-August 2011)*

Rapid capital inflows threatened the macro financial stability of the Turkish economy in the first period. Thanks to a favorable inflation outlook, monetary policy could focus on discouraging short-term capital inflows and preventing excessive appreciation of the exchange rate. Policies implemented in this period aimed at containing domestic credit growth and rebalancing domestic and external demand to minimize macro financial risks caused by the rapid deterioration in the current account deficit and the quality of its finance. In this respect, widening of the interest rate corridor downwards created a marked volatility in overnight interests and helped prevent very short-term capital inflows by increasing downside risks on overnight interests. Also during the same period, reserve requirement ratios were significantly increased with the goal of preventing excessive credit growth and controlling domestic demand. Moreover, foreign exchange buying auctions were held regularly to take advantage of strong capital inflows in reserve build-up.

These measures made a significant contribution in mitigating excessive appreciation pressures on the Turkish lira. Meanwhile, a notable deceleration was observed in loan growth after mid-2011. As a consequence, the composition of aggregate

demand and the quality of capital inflows started to improve, allowing the Turkish economy to follow a rebalancing path as of mid-2011.

### *5.2 Second Period (August 2011-October 2011)*

Due to increasing uncertainty over the global growth outlook and sovereign depth problems in some European economies, as of August 2011 global risk aversion escalated and volatility in risk appetite reached historic highs. As capital outflows from developing countries accelerated in this period, the CBRT used the same policy tools but in the opposite direction than during the period of rapid capital inflows (Başçı, 2012: 25). The CBRT acted by narrowing the interest rate corridor to decrease the volatility in short-term interest rates with a view to limiting the extent of capital outflows. Turkish lira reserve requirements were revised to decrease the liquidity requirement of the banking sector. One week repo rates were also cut to reduce the downside risks on economic activity driven by unfavorable external demand conditions. In addition, ample foreign exchange liquidity was provided to the market to avoid the possibility of a sudden cessation.

### *5.3 Third Period (Post October 2011)*

Starting from October 2011, developments on the inflation front have dominated the implementation of monetary policy. The rise in inflation was higher than expected because of excessive depreciation of the Turkish lira stemming from the deterioration of the global risk appetite since August 2011, as well as from adjustments in administered goods prices in the final quarter. Overnight, lending rates were raised considerably in October in order to prevent deterioration in the medium-term inflation expectations. The CBRT implemented a strong tightening by widening the interest rate corridor upwards and reducing the amount of funding provided by one-week repo auctions (so-called additional tightening). In order to avoid an undesired tightening in liquidity and credit conditions, reserve requirement ratios were lowered.

Accordingly, the measures taken since October 2011 have significantly contributed to alleviate the adverse effects of global problems on the Turkish economy. The CBRT's measures regarding the foreign exchange market and decisions related to the interest rate corridor in August and October 2011 reduced the degree of fluctuations in the exchange rate compared to that of other emerging market economies. Meanwhile, the monetary tightening implemented since October 2011 has also contributed to moderating the excessive credit growth.

## 6. Conclusion

The CBRT has designed and implemented a new monetary policy framework incorporating financial stability with a macro perspective since 2010. Two main developments since the global crisis of 2008, affected the policy-making process of the MPC:

- The changing landscape of central banking on a global scale
- The extraordinary global conditions and increasing capital flow volatility

Depending on the related literature and research on the implementation of the new monetary policy approach of the CBRT, the outcomes of the new policies can be summarized as follows:

- The new policy framework has proved quite efficient in smoothing out the adverse effects of capital flow mobility.
- The new policy mix has been successful in engineering a soft landing and rebalancing of the economy without hampering the price stability objective.
- The current account deficit started shrinking without undergoing crisis for the first time in the recent history of the Turkish economy.
- The Turkish experience deserves close attention as an example of how the existing inflation-targeting frameworks can be modified to allow for more room regarding macroeconomic and financial stability.

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South-Eastern Europe Journal of Economics 2 (2014) 215-241

# ANALYZING UNLEADED GASOLINE RETAIL PRICE PATTERNS IN GREECE: APR. 2011-DEC. 2012

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**Abstract**
The paper studies the daily price patterns of unleaded gasoline across fueling stations in Greece during April 2011-December 2012 by (a) econometrically estimating the impact of refinery prices, brands, geography, the number of competitors in the area, the day of the week, seasonality and transportation strikes on average gasoline prices at the local community level (194 thousand observations), and (b) exploring price-leadership among vendors in Athens, Thessaloniki and a number of other large municipalities via Granger causality tests.

**JEL Classification:** C23, D40, L81
**Key words:** Unleaded gasoline, Retail prices, Regression of disaggregated data, Granger causality, Greece

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## 1. Introduction

The paper provides insights into two applied economics literature topics regarding the formation of gasoline prices. In particular, it investigates through standard OLS econometric regressions the factors that determine gasoline prices in Greece, and explores via Granger causality tests the price-setting behavior of retailers. To achieve these objectives it utilizes a rich database of daily observations reported between April 1st 2011 and December 31st 2012 from petrol stations across the country.

With the retail price of gasoline featuring among the most important determinants of rising consumer prices in Greece at a time when incomes have declined dramatically (Petralias and Prodromidis, 2014), and most studies on gasoline prices looking into aggregate (average) adjustments in retail vis-à-vis crude oil prices (Karagiannis *et al*., 2011; Bragoudakis and Sideris, 2012; and works cited therein), the paper visits the issue from a rather disaggregated, micro-regional angle that also pays attention to the distinct behaviors of the vendors who operate in local communities.

It is organized as follows: Section 2 presents the data and methods employed. Section 3 describes the market at the national and regional level. Section 4 engages in an econometric analysis of the average prices observed at the municipal level. Section 5 studies the price change patterns in the six largest towns of Greece; while Section 6 supplies the conclusions.

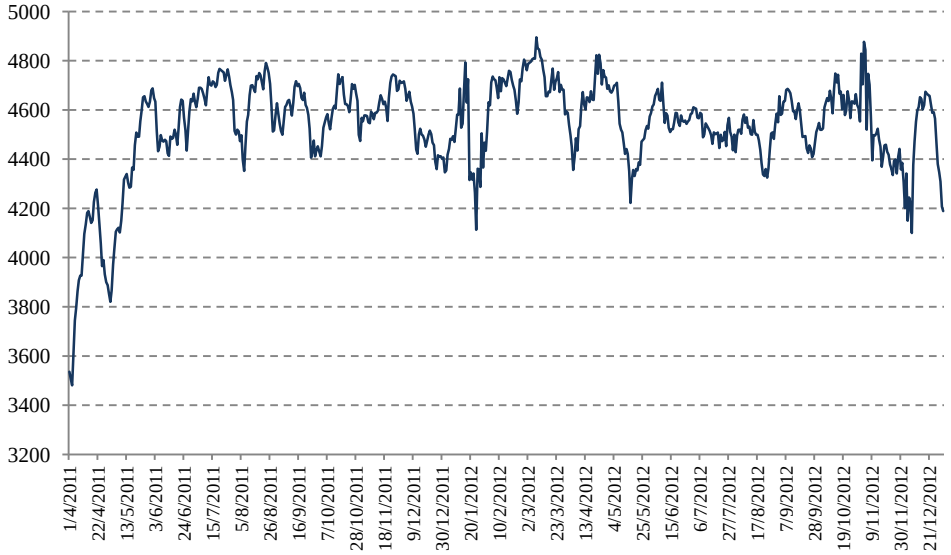
## 2. A short presentation of the data and of the methods employed

The paper makes use of the daily prices reported from a good number of petrol stations across the country via the Fuel Price Observatory (FPO) of the Ministry of Development and Competitiveness (www.fuelprices.gr) between early April 2011 (when petrol station participation in the FPO exceeded 50%)[1] and late December 2012 (see Figure 1). That is some 1.25 million observations in the form of unique prices solicited every 24 hours,[2] or some 194 thousand daily average prices esti-

1. According to the Hellenic Petroleum Marketing Companies Association (2010) there were approximately 7,000 petrol stations in Greece at the time.
2. Understandably, the number of observations would double or multiply if solicited twice or more times in a day. However, a preliminary investigation of the data showed a lack of multiple intraday price changes by participating stations. The remaining stations will be brought into the system in the immediate future together with the introduction of a real-time fuel input-output monitoring system.

mated by the FPO at the municipal level after the annual volumes consumed at the prefectural (NUTS 3) level.[3]

**Figure 1:** The number of petrol stations that participated in the FPO between Apr. 1st 2011and Dec. 31st 2012




*Descriptives: Initial figure: 3,536. Lowest: 3481 (Apr. 3rd 2011). Highest: 4895 (Mar. 8th 2012). Final: 4,189.*

The territorial dimension is probed to a considerable extent via two OLS regressions: one that relies on the conventional NUTS level 3 organization of the country and another that does not. (The juxtaposition reveals an interesting side issue, namely, that if the conventional spatial organization is not assumed or imposed on the data, then it may not emerge at all). The other determinants consist of refinery prices, seasonal and daily categorical (dummy) variables, market structure factors

3. The *Nomenclature des Unités Territoriales Statistiques* (NUTS) is the five-tier hierarchical structure used in the EU to standardize territorial units. In Greece, the administrative regions (*periferies*) correspond to NUTS level 2 sized-districts; prefectures (*nomoi*) correspond to NUTS level 3 sized-district; municipalities (demoi) to upper level local administrative units, occasionally termed NUTS level 4; and communities or wards to lower level local administrative units, occasionally referred to as NUTS level 5. The NUTS level 2 and 3 districts of Greece are supplied in the Appendix (in Map 1 and Table A, respectively).

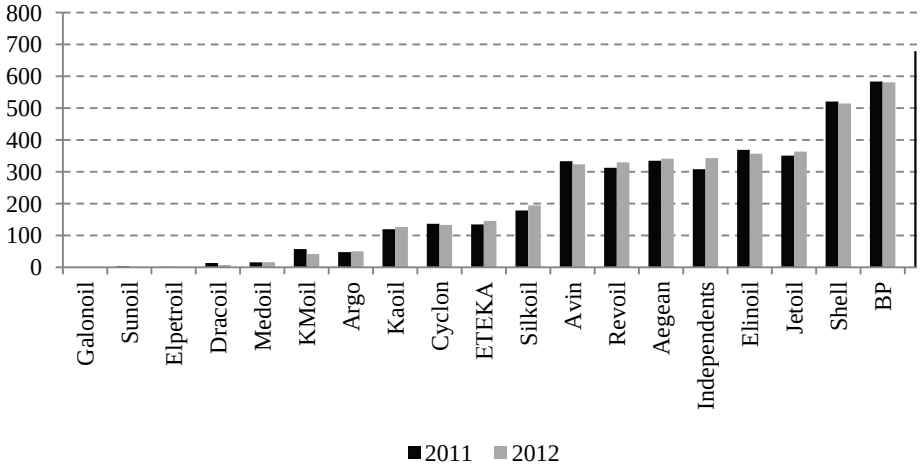
such as the number and brands of petrol stations in local communities, along with the strikes reported in the various modes of transportation.

The analysis is complemented by Granger causality tests on the price leadership roles of the distribution-and-trade companies; tests which are carried out (not at the national but rather) at the local level: one in Athens, another in Thessaloniki, additional tests in other large municipalities. The discovery of dissimilar results implies that the price-setting behavior under examination varies from one place to another.

## 3. Description of the market at the national and regional level

In Greece the demand for gasoline is accommodated by 18 distribution-and-trade companies, each with its own network of petrol stations, as well as independent retailers, all of which are ultimately supplied with fuel by two oil refinery companies, Hellenic Petroleum (ELPE) and Motor Oil Hellas (MOH), with the former setting the ex factory price: A market structure and practice which from time to time sparks off concerns regarding (implicit) anticompetitive agreements and concerted practices (e.g., Bragoudakis and Sideris, 2012).[4]

**Figure 2:** Number of chain-owned and independent petrol stations in the FPO database in 2011-12




4. A comprehensive overview of the industry is supplied by the IEA (2011). According to the figures cited in the report, in the second quarter of 2011 Greece had the second highest price and tax rate for unleaded gasoline among 24 OECD member-states.

According to the FPO database, about half the petrol stations (50% in 2011, 49% in 2012) operate under the trademarks of EKO and BP, owned by ELPE; and Shell, Avin and Cyclon, owned by MOH. (See Figure 2). The regional distribution of their outlets, both at the beginning and the end of the period, is supplied in Table 1. (a) The number of ELPE-owned stations increased considerably in Crete, the North Aegean, South Aegean, Ionian islands (by 46, 28, 24, 19, respectively), Central Macedonia, Western Greece, the South, Central and East Peloponnese (by 36, 24, 14); remained the same in Attiki; and decreased somewhat (by 3 to 11 stations) in the other regions of continental Greece. (b) The number of MOH-owned stations increased considerably in Central Macedonia, Western Greece, the South, Central and East Peloponnese, and Ionian islands (by 27, 25, 17, 10, respectively); increased somewhat (by 3 to 8) in Epiros, West Macedonia, the South Aegean islands, Crete, and Central Greece − Euboea; remained the same in Attiki, and the North Aegean islands; and decreased somewhat (by 5 to 4) in Thessaly and East Macedonia - Western Thrace. (c) The number of independently owned stations increased considerably in Western Greece, Central and West Macedonia (by 37, 37, 10, respectively); increased somewhat (by 3 to 9) in Attiki, the South, Central and East Peloponnese, the Ionian islands, East Macedonia - Western Thrace, Epiros, Crete; remained the same in Central Greece − Euboea, the North and South Aegean islands; and decreased somewhat (by 4) in Thessaly. (d) The number of stations owned by other companies increased considerably in Central Macedonia, Western Greece, Attiki, the Ionian islands (by 59, 58, 19, 12, respectively); increased somewhat (by 2 to 9) in the South Aegean islands, South, Central and East Peloponnese, and West Macedonia; decreased somewhat (by 1 to 3) in Crete and Central Greece - Euboea; and decreased considerably (by 12-50) in the other regions of Greece.

## 4. Econometric analysis of the price observed at the municipal level

From a microeconomic, theoretical point of view (e.g., Allen, 1967; Kreps, 1990), the factors that determine the price of any one good or service are associated with its demand (e.g., the number of consumers, their demographics, incomes and other characteristics), its cost of production and transportation, the amount supplied, the availability of information, the structure of the market (e.g., competitive, oligopolistic), the imposition of taxes and controls, as well as the manner in which bargaining between buyers and seller takes place.

**Table 1:** Distribution of FPO chain-owned and independent petrol stations at the beginning and at end of the period in April 1st 2001 and December 31, 2012

| | Attiki | Central Macedonia | Central Greece and Euboea | Thessaly | East Macedonia and West Thrace | South, Central, East Peloponnese | Western Greece | Crete | West Macedonia | Epiros | North Aegean Islands | South Aegean Islands | Ionian Islands | ***Total*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Apr. 1st 2011** | | | | | | | | | | | | | | |
| Aegean | 56 | 58 | 12 | 7 | 65 | 21 | 16 | 18 | 12 | 7 | 3 | 4 | 5 | **284** |
| Argo | | 10 | | | | | | | 14 | | | 7 | | **31** |
| Avin | 42 | 29 | 28 | 17 | 13 | 48 | 19 | 9 | 9 | 11 | 3 | 4 | 6 | **238** |
| BP | 105 | 50 | 62 | 31 | 53 | 42 | 32 | 29 | 14 | 24 | 21 | 6 | 1 | **470** |
| Cyclon | 19 | 22 | 16 | 12 | 5 | 2 | 6 | 3 | 7 | 2 | 2 | 2 | | **98** |
| Dracoil | 5 | 11 | 4 | 10 | | | 5 | | 1 | 4 | | | 1 | **41** |
| EKO | 123 | 50 | 44 | 46 | 37 | 34 | 23 | 77 | 15 | 16 | 16 | 29 | 16 | **526** |
| El Petroil | | | | | | | | | | | | | | **0** |
| Elinoil | 20 | 40 | 29 | 29 | 33 | 24 | 19 | 11 | 16 | 11 | 20 | 21 | 12 | **285** |
| ETEKA | 48 | 21 | 8 | 16 | | 2 | 9 | | | 6 | | | | **110** |
| Galonoil | 2 | | 1 | | | | | | | | | | | **3** |
| Jetoil | 37 | 51 | 23 | 22 | 8 | 22 | 17 | 5 | 13 | 10 | 27 | 18 | 14 | **267** |
| Kaoil | | 51 | 1 | 18 | 3 | | | | 10 | | | | | **83** |
| Kmoil | 4 | 4 | 3 | 1 | | 14 | 5 | | 3 | 3 | | | | **37** |
| Medoil | | 2 | | 1 | | 7 | 2 | | | | | | | **12** |
| Revoil | 36 | 21 | 20 | 21 | 19 | 22 | 30 | 1 | 8 | 9 | 8 | 1 | 7 | **203** |
| Shell | 117 | 73 | 30 | 31 | 40 | 32 | 47 | 48 | 17 | 27 | 5 | 13 | 24 | **504** |
| Silkoil | 12 | 24 | 24 | 3 | 9 | 11 | 14 | 21 | 3 | 2 | 4 | 1 | 2 | **130** |
| Sunoil | | | 2 | | | | | | | 1 | | | | **3** |
| Independ. | 28 | 38 | 29 | 38 | 14 | 7 | 22 | 13 | 11 | 7 | | 1 | 3 | **211** |
| ***Total*** | ***654*** | ***555*** | ***336*** | ***303*** | ***299*** | ***288*** | ***266*** | ***235*** | ***153*** | ***140*** | ***109*** | ***107*** | ***91*** | ***3536*** |
| **Dec. 31st 2012** | | | | | | | | | | | | | | |
| Aegean | 50 | 82 | 14 | 9 | 66 | 14 | 17 | 16 | 11 | 7 | 3 | 5 | 3 | ***297*** |
| Argo | | 17 | 1 | 2 | | | | | 11 | | | 12 | | ***43*** |
| Avin | 46 | 54 | 20 | 19 | 15 | 59 | 37 | 14 | 9 | 23 | 2 | 6 | 14 | ***318*** |
| BP | 104 | 64 | 53 | 29 | 46 | 48 | 46 | 45 | 13 | 20 | 19 | 8 | 14 | ***509*** |
| Cyclon | 16 | 31 | 19 | 10 | 3 | 6 | 8 | 4 | 9 | 2 | 3 | 2 | | ***113*** |
| Dracoil | 1 | 4 | | | | | | | | 2 | | | | ***7*** |
| EKO | 125 | 72 | 42 | 40 | 33 | 42 | 33 | 107 | 13 | 13 | 46 | 51 | 22 | ***639*** |
| El Petroil | 1 | 1 | | | | | | | | | | | | ***2*** |
| Elinoil | 24 | 55 | 36 | 28 | 34 | 28 | 26 | 21 | 18 | 8 | 15 | 23 | 16 | ***332*** |
| ETEKA | 57 | 32 | 10 | 18 | | 4 | 14 | | | 6 | | | | ***141*** |
| Galonoil | | | | | | | | | | | | | | ***0*** |
| Jetoil | 31 | 73 | 30 | 19 | 12 | 29 | 40 | 6 | 15 | 10 | 24 | 22 | 24 | ***335*** |
| Kaoil | | 72 | 1 | 18 | 7 | | | | 15 | | | | | ***113*** |
| Kmoil | 2 | 1 | 1 | | | 19 | 6 | | 1 | 3 | | | | ***33*** |
| Medoil | | 3 | | | | 4 | 2 | | | | | | | ***9*** |
| Revoil | 55 | 47 | 22 | 22 | 25 | 30 | 55 | 3 | 17 | 12 | 3 | 3 | 11 | ***305*** |
| Shell | 98 | 66 | 38 | 24 | 35 | 34 | 52 | 46 | 20 | 23 | 5 | 15 | 26 | ***482*** |
| Silkoil | 18 | 47 | 23 | 3 | 9 | 16 | 32 | 25 | 5 | | 5 | 1 | 2 | ***186*** |
| Sunoil | | | | | | | | | | | | | | ***0*** |
| Independ. | 37 | 75 | 29 | 34 | 18 | 16 | 59 | 16 | 21 | 10 | | 1 | 9 | ***325*** |
| ***Total*** | ***665*** | ***796*** | ***339*** | ***275*** | ***303*** | ***349*** | ***427*** | ***303*** | ***178*** | ***139*** | ***125*** | ***149*** | ***141*** | ***4189*** |

Accordingly, whenever disaggregated gasoline prices at the pump are empirically analyzed via single equation models (i.e., within a non-game framework), they tend to be explained in terms of: (i) brands (Eckert and West, 2004; Foros and Steen, 2009; Pennerstorfer, 2009); (ii) wholesale prices (Atkinson, 2009; Foros and Steen, 2009), taxes (Foros and Steen, 2009); (iii) average household incomes (Eckert and West, 2004) or territorial dummies (Eckert and West, 2004; Foros and Steen, 2009); (iv) population densities (or proxies, such as urban/rural and municipality-size classification measures) and the number of petrol stations per capita (Pennerstorfer, 2009); (v) the ratio of unbranded to branded or independent to allied (or chain-run) stations in the area (Eckert and West, 2004; Pennerstorfer, 2009); (vi) the attributes of the petrol stations involved (i.e., their sizes, the type of road by which they are located, the services they provide (Eckert and West, 2004; Pennerstorfer, 2009), the distance from competitors and from the refinery (Pennerstorfer, 2009)); (vii) the time of day (Eckert and West, 2004), the day of the week (Atkinson, 2009; Davis, 2010; Foros and Steen, 2009), holidays (Davis, 2010), as well as broader time-trends (Atkinson, 2009; Foros and Steen, 2009).

In the present case the data permit an OLS analysis of the unleaded gasoline price averages supplied by the FPO at the municipal level, in terms of (a) after-tax refinery prices (which include the cost of production and the profit or other optimization goals of the two producers);[5] (b) territorial idiosyncrasies (i.e., dummy variables associated with the product's transportation cost, the applicable VAT rates across the country, and local demand); (c) the number of independent and chain-run petrol stations in the area (capturing features of local competition and the marketing strategies of the distribution-and-trade companies); (d) the strikes in various modes of transportation (e.g., buses, trolleys, taxis, intercity rail etc., denoting the suspension of substitute forms of transportation); (e) the trend (capturing general economic developments); (f) the season and day of the week (associated with other demand- and supply related idiosyncrasies, such as daily routines, regular holidays, work patterns).

With regard to the spatial dimension, it turns out that the model which assumes a prefectural organization of the municipal data provides an inferior fit ($R^2$ = 81.4%

5. In Greece, after-tax refinery prices (i.e., prices that include special tax and surcharges) are nearly twice as high as pre-tax refinery prices, VAT notwithstanding. According to the Hellenic Petroleum Marketing Companies Association (2010), the distribution-and-trade margin accounted for (90:978 =) 9% of the average retail price. By contrast, in the UK the margin was in the order of 6% (United Kingdom Petroleum Industry Association, 2012).

by making use of 53 spatial dummies, see Appendix A) compared to a model that groups the data into territorial zones after the similitude of the disaggregated coefficients ($R^2$ = 92.6% by making use of just 25 spatial dummies). Against the tendency to rely on the conventional territorial division of the country, the implication is fairly clear: Retail prices vary across space and by and large do not follow the administrative delineation of the country.[6] In view of the above, the second model is the one that we will rely on, present and discuss below. See Table 2. According to its results, prices are:

(a) lowest in three western suburbs of Athens and a southern suburb of Thessaloniki (see coefficients #12-13); slightly higher across most of Athens' suburbs and the rest of the Attic peninsula, in the city of Thessaloniki and across most of the homonymous prefecture, the prefecture of Kilkis and neighboring areas; as well as in several towns and transportation junctions on the mainland (#14);

(b) progressively higher:

- on most of the mainland and parts of Euboea island, the islands of Salamis, Lefkas, Zakinthos (#16);
- in Athens and three eastern suburbs (#11);[7]
- in a number of remote areas of the mainland and Euboea island, and on the isles of Elafonisos and Meganision, off the mainland (#15);
- across Crete (#17-20),[8] the remaining Ionian islands (#21-23),[9] and most of the Aegean archipelago (#24-25, 30-32);[10]
- in a number of peripheral sites in the Aegean sea (#26-28, 33-34);[11]

6. The finding confirms the central result of other analyses regarding economic phenomena in Greece that also utilize disaggregated data (e.g., Prodromídis, 2006, 2012).
7. With space at a premium in Athens, understandably, rents are higher.
8. Lower in the island's two principal urban centers (Iraklion, Hania), higher in the central part, even higher in the eastern and western parts, highest in the southern municipality of Viannos. Each of the four estimated coefficients is statistically different from the others.
9. Namely, Corfu, Kefallinia, the smaller islands (Ithaca, Paxi), in this order. As in the previous footnote, each estimated coefficient is statistically different from the others.
10. Lower in the islands near the Attic peninsula (Aegina, Agkistrion, Spetse, Kea etc.) and progressively higher (i) across a group of islands immediately south of them (Paros, Antiparos, Naxos), (ii) the county's third-to-fifth largest islands (after Crete and Euboea), i.e., Lesvos, Rhodes, Hios, and the island of Thasos (where Greece's crude oil field is located), (iii) two islands off the coast of Asia Minor (Samos, Kos), and (iv) a few isles near them (Lipsi, Simi).
11. I.e., a group of islands south of those listed under (ii) in the previous footnote (i.e., Kithira, Astipalea, etc.), and two sets of islands situated one south of it (Karpathos, Tilos), the other north (Amorgos, Patmos, Ikaria), two islands in the north Aegean (Limnos, Samothrace), and the island of Skopelos is the central Aegean.

**Table 2:** Econometric analysis via a robust variance estimator of the average unleaded gasoline Retail prices in Greek municipalities as supplied daily by the FOP (in eurocents per litre, Apr. 2011-Dec. 2012)

| *Explanatory variables* | *Estimated coefficients* | *p values* |
|---|---|---|
| 1. Constant | 17.74 | 0.000 |
| 2. Ex factory price (including taxes) | 94.69 | 0.000 |
| 3. Time trend | 0.00 | 0.000[1] |
| 4. Time trend squared (to capture the rate of change) | -0.00 | 0.000 |
| *Seasonal factors (categorical dummies)* | | |
| 5. Mid December – mid April (reference period) | | |
| 6. Mid April – end of June | 1.97 | 0.000 |
| 7. Early July – mid September | 0.34 | 0.000 |
| 8. Mid September – mid December | 1.47 | 0.000 |
| *Daily factors (categorical dummies)* | | |
| 9. Wednesday, Thursday | -0.02 | 0.078 |
| 10. Other days of the week (reference days) | | |
| *Spatial factors (categorical dummies)* | | |
| 11. Athens and the eastern suburbs of Viron, Caesariani, Zografos (reference area) | | |
| 12. Thermi (a suburb of Thessaloniki near the airport) | -6.87 | 0.000 |
| 13. Agia Varvara, Haidarion, Perama (west Athenian suburbs near Elefsis refinery) | -6.28 | 0.000 |
| 14. Other areas near Athens and Thessaloniki, along with the main towns and transportation junctions on the mainland [a] | -4.18 | 0.000 |
| 15. Remote areas on the mainland and of Euboea island,[b] the isles of Elafonisos and Meganision off the mainland | 1.93 | 0.000 |
| 16. Rest of the mainland and of Euboea, Lefkas (the islands of Euboea and Lefkas are linked to the mainland by bridges), the islands of Salamis (near Piraeus) and Zakinthos (in the Ionian sea) | -1.26 | 0.000 |
| 17. The towns of Iraklion and Hania in Crete | 2.02 | 0.000 |
| 18. The central portion of Crete [c] | 4.71 | 0.000 |
| 19. The eastern and western parts of Crete [d] | 7.14 | 0.000 |
| 20. The municipality of Viannos in Crete | 11.75 | 0.000 |
| 21. Island of Corfu (in the Ionian sea) | 3.09 | 0.000 |
| 22. Island of Kefallinia (in the Ionian sea) | 6.38 | 0.000 |
| 23. Islands of Ithaca and Paxi (in the Ionian sea) | 11.46 | 0.000 |
| 24. Islands close to the Attic peninsula: Aegina, Agkistrion, Spetse, the northern Cyclades (Kea, Andros, Tinos, Siros) | 6.67 | 0.000 |
| 25. Islands of the central Cyclades (Paros, Antiparos, Naxos) south of item #24 | 9.29 | 0.000 |
| 26. Belt of islands in the south Aegean Sea: Kithira, Astipalea, Kalimnos, Leros, the rest of the Cyclades except Sikinos and Amorgos | 14.55 | 0.000 |
| 27. Group of islands north of those listed under item #26: Amorgos, Patmos, Ikaria | 17.16 | 0.000 |
| 28. Group of islands south of those listed under item #26: Karpathos, Tilos | 18.45 | 0.000 |
| 29. Remote isles in the south and central Aegean sea: Sikinos, Fourni | 21.38 | 0.000 |
| 30. The 3rd-5th largest islands after Crete and Euboea (Lesvos, Rhodes, Hios), the medium-sized island of Thasos (off the northern part of the mainland) | 7.37 | 0.000 |
| 31. The two Aegean islands closest to Asia Minor: Samos, Kos | 10.91 | 0.000 |
| 32. Aegean isles close to those listed under item #31: Lipsi, Simi | 13.05 | 0.000 |
| 33. Medium-sized islands in the north Aegean sea: Limnos, Samothrace | 15.02 | 0.000 |
| 34. Medium-sized Skopelos island (off the Thessalian coast in the central Aegean) | 16.12 | 0.000 |
| 35. The islands of Alonnisos, Skiathos, Skiros in the central Aegean sea | 20.09 | 0.000 |
| 36. Remote isle of Agios Efstratios (along with #34-35 forms the Sporades group) | 26.95 | 0.000 |

**Table 2** (continued)

| *Explanatory variables* | *Estimated coefficients* | *p values* |
|---|---|---|
| *Commercial-competition factors: number of stations under a trade mark in the area* | | |
| 37. Sunoil | -0.91 | 0.000 |
| 38. Medoil | -0.16 | 0.000 |
| 39. Aegean | -0.02 | 0.000 |
| 43. Independently owned stations | 0.01 | 0.002 |
| 40. Elinoil | -0.02 | 0.000 |
| 41. EKO | -0.01 | 0.000 |
| 42. ETEKA | 0.00 | 0.668 |
| 44. Shell | 0.01 | 0.000 |
| 45. Silkoil | 0.02 | 0.000 |
| 46. Jetoil | 0.02 | 0.000 |
| 47. Revoil | 0.03 | 0.000 |
| 48. Argo | 0.03 | 0.000 |
| 49. BP | 0.03 | 0.000 |
| 50. Avin | 0.04 | 0.000 |
| 51. Cyclon | 0.05 | 0.000 |
| 52. Kaoil | 0.05 | 0.000 |
| 53. Galonoil | 0.14 | 0.066 |
| 54. Dracoil | 0.15 | 0.000 |
| 55. KMoil | 0.21 | 0.000 |
| 56. El Petroil | 0.38 | 0.000 |
| *Strikes in other modes of transportation measured in 24hour equivalents* [e] | | |
| 57. Taxis (34 daily equivalents) | 0.26 | 0.000 |
| 58. Coastal shipping [f] (23 daily equivalents) | -0.21 | 0.000 |
| 59. Suburban rail of Attiki and of neighboring prefectures [f] (23 daily equivalents) | 0.39 | 0.000 |
| 60. Subway of Athens and its suburbs [f] (25 daily equivalents) | 0.11 | 0.000 |
| 61. Lagged residuals by one day (to deal with autocorrelation in the dependent variable) | 1.99 | 0.000 |

Number of observations: 193,656. Model fit: $R^2 = 92.55\%$.

*Notes*

[a] *The Attic peninsula excl. Megara, Mandra and Oropos, the prefecture of Thessaloniki excl. Volvi, the prefecture of Kilkis, the municipalities of Xanthi, Drama, Serre and Emmanuel Pappas, Almopia, Pella, Beria, Alexandria, Pidna-Kolindros, Katerini, Larisa and Tirnavos, Volos and Rigas Fereos, Lamia and Makrakomi, Karditsa, Trikala, Ioannina, Preveza, Patras and West Achaia, Kalamata, Nafplion, Velos-Voha.*

[b] *The municipalities of Orestias, Didimotihon, Souflion, Arriana, Miki, Kato Nevrokopion, Pogonion, Dodoni, Metsovo, Deskati, Limni Plastira, Agrafa, Amfilohia, Thermon, Karpenision, Doris, Meganision, Kalavrita, Pilos-Nestor, Mani (east and west), Elafonisos, Kinouria (north and south), Troezin, Karistos, south Pelion, Zagora-Mouresion, Agia.*

[c] *The municipalities of Apokoronos, Platanias, Agios Vasilios, Anogia, Amarion, Milopotamos, Rethimnon, Arhane-Asterousion, Gortin, Malevizion, Minoa-Pedias, Phaestos, Chersonesos.*

[d] *The municipalities of Kandanos-Selinos, Kissamos, Sfakia, Agios Nikolaos, Ierapetra, Oropedion, Sitia.*

[e] *Net of the effects #2-9 the vectors of which exhibited a modest level of correlation, 15-25%.*

[f] *Net of the strike effects listed above.*

- on the isles of Sikinos and Fourni in the south and central Aegean,respectively (#29), on the islands of Alonnisos, Skiathos, Skiros in the central Aegean (#35), and the isle of Agios Efstratios, the remotest of all (#36).

Overall there is noticeable intra-prefectual heterogeneity, with islands and inaccessible or remote inland areas being more expensive than the rest, the reduced VAT applied in the insular communities of the Aegean notwithstanding.

The spatial results aside: (i) A marginal increment in ex-factory (after-tax refinery) prices is generally passed on to the final consumer. (ii) The distribution-and-trade margin (from factory to pump) in the country's capital, Athens, is estimated at about 18 cents per litre or 18.7% on the after-tax refinery price. (iii) In the course of the twenty months under examination the margin increased over time at a decreasing rate, was subject to seasonality (generally lower from mid-December to early April and from early July to mid-September), and, possibly, daily patterns (lower in Wednesdays and Thursdays). (iv) Strikes in certain modes of urban transport (in particular, taxis, the capital's suburban-rail and subway system) appear to stimulate the public's need to use private vehicles, thus pushing the price of gasoline upwards. On the other hand, dock and other shipping-related strikes appear to discourage roaming and the use of private vehicles, thus affecting a reduction in demand for gasoline and, hence, gasoline price. (v) Price differentials do not appear to depend so much on the number of petrol stations operating in local communities as much as brands. Of the three major brands EKO's stations are generally cheaper, Shell's stations are more expensive, and BP's even more expensive.

## 5. Indications of price leadership exercised by some companies

Next, in order to gain additional insights into the operation of the market, we turn to Granger causality tests. Through these we may investigate the sequence of price or price-change patterns for evidence of systematic price leadership among distribution-and-trade companies (or chains of petrol stations) (Gujarati, 1995). In theory, price leadership may (a) be attributed to either market dominance (i.e., market power) or to a firm's ability to read market conditions and, therefore, act as a barometer which other firms follow or (b) serve to mask some sort of collusive behavior (in lieu of overt collusion) (Rotemberg and Saloner, 1986). Yet, in practice, Granger causality tests cannot tell which of the three takes place and, hence, of the presence of market power. As a result they ought to be treated as instruments which

may help competition authorities identify areas of further market investigation (Bishop and Walker, 2002).

In the paragraphs that follow, we look into whether the current price change of a seller, $\Delta Y_t$, depends not only on past price changes of the same seller, $\Delta Y_{t-1}$, $\Delta Y_{t-2}$, etc., but also on past price changes of other sellers, $\Delta X_{t-1}$, $\Delta X_{t-2}$, etc. and *vice versa*. We commence by carrying out regressions for each and every possible pair of sellers. Note that in order to prevent the violation of the stationary time series assumption we confine the analysis to price changes (i.e., to first differences between prices).[12] In terms of the shorthand notation employed in such cases, we specify two equations for every empirical test. In the first equation we check whether the lag of $\Delta X$ affects $\Delta Y$, and in the second equation the opposite: i.e., whether the lag of $\Delta Y$ affects $\Delta X$:

$$\Delta Y_t=b_0+b_1*\Delta Y_{t-1}+c*\Delta X_{t-1}+e_t \quad \textbf{(1)}$$

$$\Delta X_t=\beta_0+\beta_1*\Delta X_{t-1}+\gamma*\Delta Y_{t-1}+\varepsilon_t \quad \textbf{(2)}$$

with $b$, $\beta$, $c$ and $\gamma$ standing for coefficients, $e$ and $\varepsilon$ for random errors, and $t$ denoting time (here: days). The Wald F test of the hypothesis $c = \gamma = 0$ is employed to ensure that price changes do not depend on one's own past price changes alone; while the notation associated with the price change of the other seller suggests the presence of a one-day time lag (i.e., that the price change carried out by the first seller at time $t$ is to some or a considerable extent attributed to a price change carried out by the second seller on the previous day, $t-1$). Indeed, this is the case in Athens and the neighboring port of Piraeus. As we shall see just below, in other urban centers, an initial price change usually takes two or more days to be replicated by other vendors.

To determine the lag's duration, and to better study the effect of each and every seller not only separately but also simultaneously with the effects of other sellers we also turn to the multivariate, the so-called Vector Autoregressive (VAR), version of the Granger causality test. (For what may appear as a systematic causal relationship in a study of pairs, in a broader context may emerge as a pair of responses to the moves of third seller.) This allows us to consider:

12. The Levin et al. (2002) test suggests that while prices, i.e., $X$ and $Y$, are not stationary their first differences, i.e. $(X_t-X_{t-1})$ και $(Y_t-Y_{t-1})$, are.

(a) VAR lag order selection criteria.[13] They reveal the presence of one lag in the cases of Athens and Piraeus, two lags in the cases of Thessaloniki and Heraklion, three lags in the case of Patras, five lags in the case of Larisa.

(b) The two causality test versions together. This way, instead of running the price-change regression on the lagged values first of one seller (or chain of petrol stations), then on the lagged value of another seller and so on, one can also run it on the lagged values of all (other) sellers, and by and large base the analysis on the shared (i.e., the common) results emerging from both versions of the causality test which are statistically significant at the 1% level. Thus, the effects that appear in the simple (i.e., the paired) causality tests but are not verified via the VAR causality test may be played down.

In mathematical form, the VAR-based Granger causality test can be expressed in terms of first differences between prices (or price changes) as follows:

$$\Delta Y_t = b_0 + b_1 \Delta Y_{t-1} + \sum_{j=1}^{k} \theta_{1j} \Delta X_{j,t-1} + e_t \,, \qquad \textbf{(3)}$$

$$\Delta X_t = \beta_0 + \beta_1 \Delta X_{t-1} + \sum_{j=1}^{k} \varphi_{1j} \Delta Y_{j,t-1} + u_t \,, \qquad \textbf{(4)}$$

with k standing for the number of all other sellers, and the significance of the statistical independence among these sellers being estimated via the Wald F test of $\theta_{11} = \theta_{12} = \ldots = \theta_{1j} = \varphi_{11} = \varphi_{12} = \ldots = \varphi_{1j} = 0$, for j ranging between 1 and *k*.

According to the data, Athens is served by twelve chains of petrol stations as well as independently owned petrol stations, with the latter being grouped into an additional vending channel for the purpose of our analysis. The shared results of the two causality tests which are statistically significant at the 1% level (see Table 3; there are no significant results present in one test that are not present in the other test) suggest that (a) Shell, Revoil and KMoil (listed here in the descending order provided in Figure 2) by and large change prices first; (b) BP, Jetoil, Aegean, ETEKA and Dracoil sometimes influence and at other times are influenced by other vendors' price-changes; (c) EKO, Elinoil, the independents, Silkoil and Cyclon systematically follow other vendors. Of the three major vendors, Shell systematically initiates price changes, BP sometimes leads and sometimes follows, while EKO generally follows.

13. Namely, the sequential modified Likelihood Ratio test statistic with significance level of 5%, the Final Prediction Error and the Akaike Information Criterion.

**Table 3:** Granger causality test results regarding retail gasoline price changes in Athens (as per the FOP dataset between April 1st 2011 and December 31st 2012)

i. Simple version. Pairs in which at least one result (rendered in bold) is statistically significant at the 1% level.

Ho: The price change by vendor A does not cause a price change by vendor B

| A | B | p value | A | B | p value |
|---|---|---|---|---|---|
| Cyclon | Aegean | 0.9929 | Aegean | Cyclon | **0.0019** |
| Elinoil | Aegean | 0.9406 | Aegean | Elinoil | **0.0000** |
| Jetoil | Aegean | 0.2799 | Aegean | Jetoil | **0.0023** |
| Shell | Aegean | **0.0071** | Aegean | Shell | 0.9777 |
| Dracoil | ΑΠ | **0.0001** | ΑΠ | Dracoil | 0.9999 |
| Dracoil | BP | 0.0278 | BP | Dracoil | **0.0060** |
| ETEKA | BP | **0.0000** | BP | ETEKA | **0.0001** |
| Jetoil | BP | 0.0355 | BP | Jetoil | **0.0070** |
| Silkoil | BP | 0.8613 | BP | Silkoil | **0.0030** |
| ETEKA | Dracoil | **0.0003** | Dracoil | ETEKA | 0.0480 |
| Jetoil | Dracoil | **0.0009** | Dracoil | Jetoil | 0.5857 |
| KMoil | Dracoil | **0.0075** | Dracoil | KMoil | 0.8847 |
| Revoil | EKO | **0.0000** | EKO | Revoil | 0.9677 |
| Shell | EKO | **0.0004** | EKO | Shell | 0.9799 |
| Silkoil | ETEKA | 0.9391 | ETEKA | Silkoil | **0.0000** |
| Silkoil | KMoil | 0.9986 | KMoil | Silkoil | **0.0001** |
| Silkoil | Revoil | 0.9804 | Revoil | Silkoil | **0.0000** |
| Silkoil | Shell | 0.0835 | Shell | Silkoil | **0.0001** |

ii. Multivariate version. Results which are statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| $A_1$ (p value) | $A_2$ (p value) | $A_3$ (p value) | | B |
|---|---|---|---|---|
| Shell (0.0034) | | | | Aegean |
| Dracoil (0.0001) | | | | Independ. |
| ETEKA (0.0000) | | | | BP |
| Aegean (0.0011) | | | | Cyclon |
| ETEKA (0.0054) | Jetoil (0.0064) | | | Dracoil |
| Revoil (0.0000) | Shell (0.0009) | | | EKO |
| Aegean (0.0000) | | | | Elinoil |
| BP (0.0046) | | | | ETEKA |
| Aegean (0.0004) | | | | Jetoil |
| ETEKA (0.0051) | KMoil (0.0007) | Revoil (0.0000) | Shell (0.0004) | Silkoil |

The neighboring municipality of Piraeus is served by seven chains of petrol stations and independently owned petrol stations which, much as in the analysis regarding Athens, are grouped into an additional vending channel. Likewise, the

shared results of the two causality tests which are statistically significant at the 1% level (see Table 4; once again, there are no significant results present in one test that are not present in the other test) suggest that (a) Shell, Aegean and Avin generally change prices first; (b) BP, the independents, Revoil and ETEKA generally follow other vendors; (c) EKO moves independently. Of the three major vendors, Shell sometimes leads and sometimes follows, BP generally follows, while EKO moves independently.

**Table 4:** Granger causality test results regarding retail gasoline price changes in Piraeus (as per the FOP dataset between April 1st 2011 and December 31st 2012)

i. Simple version. Pairs in which at least one result (rendered in bold) is statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| A | B | p value | A | B | p value |
|---|---|---|---|---|---|
| BP | Aegean | 0.0865 | Aegean | BP | **0.0002** |
| Avin | Independ. | **0.0017** | Independ. | Avin | 0.8039 |
| BP | Avin | 0.9572 | Avin | BP | **0.0063** |
| ETEKA | Avin | 0.3040 | Avin | ETEKA | **0.0006** |
| ETEKA | BP | **0.0014** | BP | ETEKA | 0.5460 |
| Shell | Revoil | **0.0008** | Revoil | Shell | **0.0041** |

ii. Multivariate version. Results which are statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| $A_1$ (p value) | B |
|---|---|
| Avin (0.0023) | Independ. |
| Aegean (0.0011) | BP |
| Avin (0.0011) | ETEKA |
| Shell (0.0002) | Revoil |

The municipality of Thessaloniki is served by twelve chains of petrol stations and independently owned petrol stations. The Granger causality tests suggest the presence of two time lags. As a result, instead of relying on expressions (1) - (4), here we rely on the following:

$$\Delta Y_t = b_0 + b_1 * \Delta Y_{t-1} + b_2 * \Delta Y_{t-2} + \theta_1 * \Delta X_{t-1} + \theta_2 * \Delta X_{t-2} + e_t \quad \textbf{(5)}$$

$$\Delta X_t = \beta_0 + \beta_1 * \Delta X_{t-1} + \beta_2 * \Delta X_{t-2} + \varphi_1 * \Delta Y_{t-1} + \varphi_2 * \Delta Y_{t-2} + u_t\,, \quad \textbf{(6)}$$

$$\Delta Y_t = b_0 + b_1 \Delta Y_{t-1} + b_2 \Delta Y_{t-2} + \sum_{j=1}^{k} \theta_{1j} \Delta X_{j,t-1} + \sum_{j=1}^{k} \theta_{2j} \Delta X_{j,t-2} + e_t \quad \textbf{(7)}$$

$$\Delta X_t = \beta_0 + \beta_1 \Delta X_{t-1} + \beta_2 \Delta Y_{t-2} + \sum_{j=1}^{k} \varphi_{1j} \Delta Y_{j,t-1} + \sum_{j=1}^{k} \varphi_{2j} \Delta Y_{j,t-2} + u_t \quad \textbf{(8)}$$

The statistically significant results which are common in both causality tests, along with the additional significant results obtained via the multivariate version (Table 5), suggest that: (a) Aegean and Revoil generally change prices first; EKO, BP, ETEKA and Kaoil sometimes influence and other times are influenced by other vendors; (c) Shell, Jetoil, Elinoil and Silkoil generally follow other vendors; (d) the independents, Avin and Cyclon move independently. Of the three major vendors, BP and EKO sometimes lead and sometimes follow, while Shell generally follows.

The municipality of Patras is served by ten chains of petrol stations and independently owned petrol stations. The Granger causality tests suggest the presence of three time lags. The statistically significant results which are common in both causality tests, along with the additional significant results obtained via the multivariate version (Table 6) suggest that: (a) Aegean generally changes prices first; (b) EKO, BP, Elinoil, the independents, Revoil, Silkoil and Cyclon sometimes lead and sometimes follow other vendors; (c) Jetoil and Avin generally follow other vendors; (d) Shell moves independently. Of the three major vendors, EKO and BP sometimes lead and sometimes follow, while Shell moves independently.

The municipality of Iraklion is served by eight chains of petrol stations and independently owned petrol stations. The Granger causality tests suggest the presence of two time lags (as in the case of Thessaloniki). The statistically significant results which are common in both tests, along with any additional significant results obtained via the multivariate version (Table 7), suggest that: (a) EKO and Silkoil generally change prices first; (b) Elinoil, the independents and Revoil sometimes lead and at other times follow other vendors; (c) Avin may act as either type (a) or type (b); (d) BP and Aegean generally follow other vendors; (e) Shell moves independently. Of the three major vendors, EKO generally leads, BP follows, while Shell moves independently.

The municipality of Larisa is served by 13 chains of petrol stations and independently owned petrol stations. The Granger causality tests suggest the presence of five time lags. The statistically significant results which are common in both tests, along with any additional significant results obtained via the multivariate version (Table 8) suggest that: (a) Jetoil, Avin and Cyclon generally change prices first; (b) EKO sometimes leads and at other times follows other vendors; (c) Revoil generally

**Table 5:** Granger causality test results regarding retail gasoline price changes in Thessaloniki (as per the FOP dataset between April 1st 2011 and December 31st 2012)

i. Simple version. Pairs in which at least one result (rendered in bold) is statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| A | B | p value | A | B | p value |
|---|---|---|---|---|---|
| BP | Aegean | **0.0000** | Aegean | BP | **0.0000** |
| EKO | Aegean | **0.0000** | Aegean | EKO | **0.0000** |
| Elinoil | Aegean | **0.0000** | Aegean | Elinoil | **0.0000** |
| ETEKA | Aegean | **0.0000** | Aegean | ETEKA | **0.0004** |
| Jetoil | Aegean | **0.0000** | Aegean | Jetoil | **0.0000** |
| Kaoil | Aegean | **0.0000** | Aegean | Kaoil | **0.0000** |
| Shell | Aegean | **0.0000** | Aegean | Shell | **0.0000** |
| EKO | BP | **0.0000** | BP | EKO | **0.0000** |
| Elinoil | BP | **0.0001** | BP | Elinoil | **0.0093** |
| ETEKA | BP | **0.0000** | BP | ETEKA | **0.0011** |
| Jetoil | BP | **0.0000** | BP | Jetoil | **0.0010** |
| Kaoil | BP | **0.0046** | BP | Kaoil | **0.0000** |
| Revoil | BP | **0.0000** | BP | Revoil | 0.9381 |
| Shell | BP | 0.0176 | BP | Shell | **0.0000** |
| Elinoil | EKO | **0.0010** | EKO | Elinoil | **0.0005** |
| ETEKA | EKO | 0.1213 | EKO | ETEKA | **0.0000** |
| Jetoil | EKO | **0.0006** | EKO | Jetoil | **0.0000** |
| Kaoil | EKO | 0.0136 | EKO | Kaoil | **0.0000** |
| Revoil | EKO | **0.0000** | EKO | Revoil | 0.8987 |
| Shell | EKO | 0.0814 | EKO | Shell | **0.0000** |
| ETEKA | Elinoil | 0.8287 | Elinoil | ETEKA | **0.0000** |
| Jetoil | Elinoil | **0.0002** | Elinoil | Jetoil | **0.0071** |
| Kaoil | Elinoil | 0.1491 | Elinoil | Kaoil | **0.0000** |
| Shell | Elinoil | 0.6308 | Elinoil | Shell | **0.0000** |
| Jetoil | ETEKA | **0.0001** | ETEKA | Jetoil | 0.1164 |
| Kaoil | ETEKA | **0.0000** | ETEKA | Kaoil | 0.0232 |
| Shell | ETEKA | **0.0011** | ETEKA | Shell | 0.0512 |
| Kaoil | Jetoil | **0.0025** | Jetoil | Kaoil | **0.0000** |
| Shell | Jetoil | 0.1417 | Jetoil | Shell | **0.0000** |
| Revoil | Kaoil | **0.0000** | Kaoil | Revoil | 0.9793 |
| Shell | Kaoil | **0.0033** | Kaoil | Shell | **0.0000** |
| Silkoil | Revoil | 0.9976 | Revoil | Silkoil | **0.0000** |

ii. Multivariate version. Results which are statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| $A_1$ (p value) | $A_2$ (p value) | $A_3$ (p value) | | B |
|---|---|---|---|---|
| Aegean (0.0008) | ETEKA (0.0060) | Revoil (0.0000) | | BP |
| BP (0.0024) | Revoil (0.0000) | | | EKO |
| Aegean (0.0009) | | | | Elinoil |
| Kaoil (0.0064) | | | | ETEKA |
| Aegean (0.0000) | EKO (0.0067) | Revoil (0.0045) | | Jetoil |
| Aegean (0.0012) | BP (0.0068) | EKO (0.0000) | Revoil (0.0000) | Kaoil |
| Aegean (0.0009) | | | | Shell |

**Table 6:** Granger causality test results regarding retail gasoline price changes in Patras (as per the FOP dataset between April 1st 2011 and December 31st 2012)

i. Simple version. Pairs in which at least one result (rendered in bold) is statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| A | B | p value | A | B | p value |
|---|---|---|---|---|---|
| Aegean | Independ. | **0.0073** | Aegean | Independ. | 0.1012 |
| Avin | Aegean | 0.1693 | Aegean | Avin | **0.0010** |
| Cyclon | Aegean | **0.0073** | Aegean | Cyclon | 0.0837 |
| Elinoil | Aegean | 0.0259 | Aegean | Elinoil | **0.0000** |
| Jetoil | Aegean | 0.0941 | Aegean | Jetoil | **0.0000** |
| Shell | Aegean | 0.6070 | Aegean | Shell | **0.0036** |
| Silkoil | Aegean | **0.0024** | Aegean | Silkoil | 0.7709 |
| Avin | Independ. | 0.0610 | Independ. | Avin | **0.0000** |
| Cyclon | Independ. | **0.0000** | Independ. | Cyclon | 0.0046 |
| EKO | Independ. | **0.0067** | Independ. | EKO | **0.0094** |
| Elinoil | Independ. | 0.0649 | Independ. | Elinoil | **0.0000** |
| Jetoil | Independ. | 0.0180 | Independ. | Jetoil | **0.0001** |
| Revoil | Independ. | **0.0070** | Independ. | Revoil | **0.0061** |
| Silkoil | Avin | **0.0000** | Avin | Silkoil | 0.0750 |
| Cyclon | BP | **0.0006** | BP | Cyclon | 0.2136 |
| EKO | BP | **0.0000** | BP | EKO | **0.0012** |
| Elinoil | BP | **0.0000** | BP | Elinoil | **0.0028** |
| Revoil | BP | **0.0003** | BP | Revoil | **0.0010** |
| Shell | BP | 0.1717 | BP | Shell | **0.0002** |
| Silkoil | BP | **0.0029** | BP | Silkoil | 0.0371 |
| Jetoil | Cyclon | **0.0034** | Cyclon | Jetoil | 0.1287 |
| Revoil | Cyclon | **0.0000** | Cyclon | Revoil | **0.0026** |
| Shell | Cyclon | **0.0097** | Cyclon | Shell | 0.0735 |
| Silkoil | Cyclon | **0.0006** | Cyclon | Silkoil | **0.0000** |
| Elinoil | EKO | **0.0000** | EKO | Elinoil | 0.0418 |
| Revoil | EKO | **0.0004** | EKO | Revoil | 0.0953 |
| Shell | EKO | 0.0566 | EKO | Shell | **0.0001** |
| Silkoil | EKO | **0.0009** | EKO | Silkoil | **0.0003** |
| Jetoil | Elinoil | **0.0044** | Elinoil | Jetoil | **0.0000** |
| Revoil | Elinoil | 0.0901 | Elinoil | Revoil | **0.0000** |
| Shell | Elinoil | 0.0447 | Elinoil | Shell | **0.0054** |
| Silkoil | Elinoil | **0.0000** | Elinoil | Silkoil | 0.2502 |
| Revoil | Jetoil | 0.0349 | Jetoil | Revoil | **0.0030** |
| Silkoil | Jetoil | **0.0000** | Jetoil | Silkoil | 0.0279 |
| Shell | Silkoil | **0.0003** | Silkoil | Shell | 0.1032 |

ii. Multivariate version. Results which are statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| $A_1$ (p value) | $A_2$ (p value) | $A_3$ (p value) | B |
|---|---|---|---|
| Cyclon (0.0055) | | | Independ. |
| Independ. (0.0004) | Silkoil (0.0020) | | Avin |
| EKO (0.0053) | Elinoil (0.0009) | | BP |
| Revoil (0.0000) | | | Cyclon |
| BP (0.0000) | Elinoil (0.0006) | | EKO |
| Silkoil (0.0002) | | | Elinoil |
| Independ (0.0072) | Aegean (0.0049) | Silkoil (0.0073) | Jetoil |
| BP (0.0073) | Elinoil (0.0002) | | Revoil |
| Cyclon (0.0001) | | | Silkoil |

**Table 7:** Granger causality test results regarding retail gasoline price changes in Iraklion (as per the FOP dataset between April 1st 2011 and December 31st 2012)

i. Simple version. Pairs in which at least one result (rendered in bold) is statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| A | B | p value | A | B | p value |
|---|---|---|---|---|---|
| Independ. | Aegean | **0.0005** | Aegean | Independ. | 0.2468 |
| Revoil | Aegean | **0.0064** | Aegean | Revoil | 0.6535 |
| Silkoil | Aegean | 0.1965 | Aegean | Silkoil | **0.0024** |
| EKO | Independ. | **0.0000** | Independ. | EKO | 0.5059 |
| Elinoil | Avin | 0.1576 | Avin | Elinoil | **0.0091** |
| Elinoil | BP | **0.0015** | BP | Elinoil | 0.0375 |
| Revoil | BP | **0.0000** | BP | Revoil | 0.2476 |
| Shell | BP | 0.0454 | BP | Shell | **0.0068** |
| Silkoil | BP | **0.0001** | BP | Silkoil | 0.1657 |
| Revoil | Elinoil | 0.4617 | Elinoil | Revoil | **0.0043** |
| Silkoil | Elinoil | **0.0079** | Elinoil | Silkoil | 0.0648 |

ii. Multivariate version. Results which are statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| $A_1$ (p value) | $A_2$ (p value) | B |
|---|---|---|
| Independ. (0.0000) | EKO (0.0066) | Aegean |
| EKO (0.0000) | | Independ. |
| Independ. (0.0031) | | Avin |
| Revoil (0.0002) | Silkoil (0.0037) | BP |
| Avin (0.0052) | Silkoil (0.0028) | Elinoil |
| Elinoil ( 0.0056) | | Revoil |

follows other vendors; (d) Elinoil and the independents move independently; (e) Shell and Aegean either change prices first or move independently of other vendors; (f) Kaoil and Argo either sometimes lead and at other times follow other vendors or move independently of other vendors; (g) BP, Silkoil and ETEKA either follow other vendors or sometimes lead and at other times follow other vendors. Of the three major vendors, EKO sometimes leads and at other times follows other vendors, BP either does the same or follows other vendors, while Shell either leads or moves independently of other vendors.

Overall, the Granger causality tests suggest that: (a) Shell and smaller companies exercise price leadership in Athens and Piraeus, while EKO and smaller companies exercise price leadership in Iraklion, and smaller companies exercise price leadership

**Table 8:** Granger causality test results regarding retail gasoline price changes in Iraklion (as per the FOP dataset between April 1st 2011 and December 31st 2012)

i. Simple version. Pairs in which at least one result (rendered in bold) is statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| A | B | p value | A | B | p value |
|---|---|---|---|---|---|
| Independ. | Aegean | 0.0902 | Aegean | Independ. | **0.0007** |
| Jetoil | Aegean | **0.0081** | Aegean | Jetoil | **0.0014** |
| Avin | Independ. | **0.0005** | Independ. | Avin | 0.3275 |
| Jetoil | Independ. | 0.0102 | Independ. | Jetoil | **0.0000** |
| Kaoil | Independ. | **0.0000** | Independ. | Kaoil | 0.3164 |
| Silkoil | Independ. | 0.1745 | Independ. | Silkoil | **0.0002** |
| Elinoil | Argo | **0.0000** | Argo | Elinoil | **0.0000** |
| Kaoil | Argo | **0.0007** | Argo | Kaoil | **0.0003** |
| Silkoil | Argo | 0.0764 | Argo | Silkoil | **0.0000** |
| BP | Avin | 0.8417 | Avin | BP | **0.0073** |
| EKO | Avin | 0.0396 | Avin | EKO | **0.0044** |
| ETEKA | Avin | **0.0016** | Avin | ETEKA | 0.0355 |
| Jetoil | Avin | 0.2065 | Avin | Jetoil | **0.0010** |
| Kaoil | Avin | 0.0895 | Avin | Kaoil | **0.0003** |
| Silkoil | Avin | 0.1510 | Avin | Silkoil | **0.0059** |
| EKO | BP | **0.0009** | BP | EKO | 0.0148 |
| ETEKA | Cyclon | **0.0000** | Cyclon | ETEKA | 0.0855 |
| Jetoil | Cyclon | 0.3144 | Cyclon | Jetoil | **0.0053** |
| Revoil | Cyclon | 0.3889 | Cyclon | Revoil | **0.0000** |
| Shell | Cyclon | 0.8634 | Cyclon | Shell | **0.0001** |
| Silkoil | Cyclon | 0.0523 | Cyclon | Silkoil | **0.0002** |
| Elinoil | EKO | **0.0001** | EKO | Elinoil | 0.0169 |
| Jetoil | EKO | 0.0384 | EKO | Jetoil | **0.0000** |
| Kaoil | EKO | 0.0317 | EKO | Kaoil | **0.0000** |
| Silkoil | EKO | 0.1425 | EKO | Silkoil | **0.0000** |
| Kaoil | Elinoil | **0.0013** | Elinoil | Kaoil | 0.0211 |
| Shell | Elinoil | 0.1188 | Elinoil | Shell | **0.0009** |
| Jetoil | ETEKA | **0.0006** | ETEKA | Jetoil | **0.0000** |
| Silkoil | ETEKA | 0.0215 | ETEKA | Silkoil | **0.0000** |
| Kaoil | Jetoil | 0.2169 | Jetoil | Kaoil | **0.0000** |
| Shell | Jetoil | 0.0662 | Jetoil | Shell | **0.0050** |
| Silkoil | Jetoil | **0.0038** | Jetoil | Silkoil | **0.0000** |
| Silkoil | Kaoil | **0.0003** | Kaoil | Silkoil | **0.0000** |
| Silkoil | Shell | **0.0019** | Shell | Silkoil | 0.1587 |

ii. Multivariate version. Results which are statistically significant at the 1% level.

Ho: The price change by vendor $A_i$ does not cause a price change by vendor B

| $A_1$ (p value) | $A_2$ (p value) | $A_3$ (p value) | $A_4$ (p value) | $A_5$ (p value) | B |
|---|---|---|---|---|---|
| BP (0.0071) | | | | | Argo |
| EKO (0.0054) | Kaoil (0.0076) | | | | BP |
| Avin (0.0032) | BP (0.0023) | | | | EKO |
| Jetoil (0.0026) | | | | | ETEKA |
| ETEKA (0.0056) | | | | | Kaoil |
| Aegean (0.0006) | Argo (0.0000) | Avin (0.0020) | BP (0.0041) | Cyclon (0.0000) | Revoil |
| | | Kaoil (0.0006) | Shell (0.0018) | Silkoil (0.0000) | Revoil |
| Jetoil (0.0002) | | | | | Silkoil |

in Thessaloniki, Patras and Larisa. (b) A number of companies exercise occasional price leadership in certain localities. (c) EKO moves independently in Piraeus, Shell in Patras and Irakion, a couple of smaller companies in Thessaloniki, while a smaller company and the independents move independently in Larisa. (d) In Athens and Piraeus price changes are affected by changes occurring on the previous day (one-day lag), in Thessaloniki and Iraklion reactions are slower (take two-days), and in Patras and Larisa reactions even slower (they exhibit three- and five-day lags, respectively).

## 6. Conclusions

The empirical analysis reveals that: (a) A marginal increment in refinery prices is by and large passed onto the final consumer. (b) The average value from factory to pump in Athens (reference area) is about 18 cents per litre, which in turn is associated with a 18.7% distribution-and-trade margin on the after-tax refinery price. (c) Retail prices vary across space and generally do not follow the conventional (actually, administrative) delineation of the country. Indeed, there is noticeable intra-regional and intra-prefectural heterogeneity. As a rule, islands (despite the reduced VAT) and, especially, inaccessible or remote inland areas are more expensive. However, the price differentials do not seem to depend on the number of petrol stations operating in local communities as much as the brands. Hence, there is probably room for improving consumer welfare from increased competition in retail at the local level, tax reductions and/or the substitution of special taxes with lump-sum taxes or taxes on capital gains.

All retailers are supplied by refineries run either by ELPE or by MOH. The presence of a duopoly raises the question whether social welfare might be widened with increased competition in production. However, the duopolists are actively present in the retail market. Indeed, the retailers with the largest number of petrol stations are Shell, a MOH subsidiary, BP and EKO, two ELPE subsidiaries. Of these, EKO stations are generally cheaper, Shell stations more expensive, and BP stations even more expensive, while: (a) Shell operates as a price leader in Athens, Piraeus and maybe in Larissa, follows other retailers in Thessaloniki, and moves independently of other retailers in Patras and Iraklion. (b) EKO moves first in Iraklion, follows other retailers in Athens, and moves independently of other retailers in Piraeus. (c) BP follows other retailers in Piraeus and Iraklion. At the same time, three medium-size retailers, namely, Aegean, Revoil, and Avin, appear to be in a position to read local market conditions, sense (or signal) when it is time for price change in

(i) Thessaloniki, Piraeus, Patras and, maybe, Larisa, (ii) Athens and Piraeus, (iii) Piraeus, Larisa and, maybe, Iraklion, respectively. On the whole, the findings suggest that price leadership is local rather than nationwide. This means that (a) competition or (b) the ability of the three major and of the other distribution-and-trade firms to read market conditions or (c) the form of collusion among the distribution-and-trade firms (if any), varies across the country; while the occasional exercise of price leadership by some of these vendors might suggest fluctuations (perhaps not so much in (a) and (b), but rather) in (c). These are matters the Competition Authority might want to delve into and sort out.

It also appears that while in Athens and Piraeus price changes are affected by changes that occur on the previous day (one-day time lag), in Thessaloniki and Iraklion reactions are slower (take two days), in Patras reactions take three days and in Larisa five days: differences that may well reflect distinct business cultures across Greece.

According to the findings, in the period under examination distribution-and-trade margins increased at a decreasing rate, displayed seasonality and were probably lower in midweek. At the same time, strikes in the transportation sector (esp. taxis, and the capital's suburban rail and subway system) intensified the public's need to use private vehicles and pushed the price of gasoline upwards. On the other hand, dock and other shipping-related strikes seem to discourage the use private vehicles, resulting in reduced demand for gasoline and, hence, gasoline prices.

From a policy perspective, the advancement of competition in production, distribution and trade (esp. among brands) of unleaded gasoline, reductions in the special taxes levied on unleaded gasoline, and the adoption of collaborative approaches in resolving the kind of disputes that escalate to taxi, rail and subway strikes, would relieve the costs of production and living in Greece. The other important finding is that future studies ought to take into account the micro-regional dimension, as economic data appear to deviate from the conventional territorial organization of the country. Indeed, the price variations within the Attic peninsula, in other parts of the mainland, across Crete, the Aegean and Ionian islands are quite conspicuous.

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## APPENDIX

**Map 1:** The administrative regions of Greece

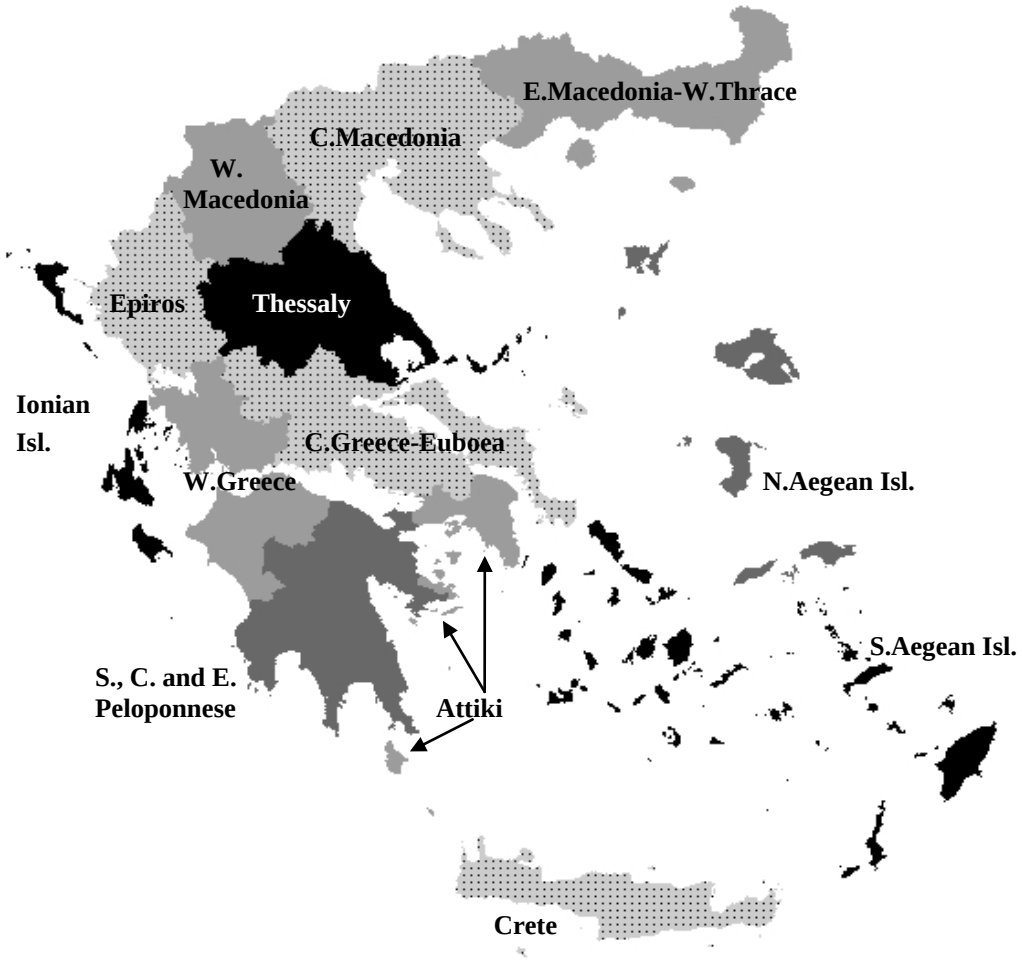

**Table A:** Econometric analysis via a robust variance estimator of the average unleaded gasoline retail prices in Greek municipalities as supplied daily by the FOP (in eurocents per litre, Apr. 2011-Dec. 2012), based on the conventional territorial delineation of the country

| *Explanatory variables* | *Estimated coefficients* | *p values* |
|---|---|---|
| 1. Constant | 22.70 | 0.000 |
| 2. Ex factory prices (including taxes) | 89.33 | 0.000 |
| 3. Time trend | 0.00 | 0.000[1] |
| 4. Time trend squared (to capture the rate of change) | -0.00 | 0.000 |
| *Seasonal factors (categorical dummies)* | | |
| 5. Mid November – mid April (reference period) | | |
| 6. Mid April – end of June | 1.63 | 0.000 |
| 7. Early July – mid September | -0.10 | 0.000 |
| 8. Mid September – mid November | 1.17 | 0.000 |
| *Daily factors (categorical dummies)* | | |
| 9. Friday | 0.00 | 0.153 |
| 10. Other days of the week (reference days) | | |
| *Spatial factors (categorical dummies)* | | |
| *Attiki (subregions ordered as per the values of the coefficients)* | | |
| 11. Athens pref. (reference areas) | | |
| 12. Eastern Attiki pref. | -0.02 | 0.241 |
| 13. Western Attiki pref. | 0.61 | 0.000 |
| 14. Piraeus pref. | 4.72 | 0.000 |
| *C. Greece and Euboea* | | |
| 15. Fthiotis pref. | 2.51 | 0.000 |
| 16. Boeotia pref. | 2.90 | 0.000 |
| 17. Fokis pref. | 5.39 | 0.000 |
| 18. Euboea pref. | 5.52 | 0.000 |
| 19. Evritania pref. | 6.91 | 0.000 |
| *C. Macedonia* | | |
| 20. Thessaloniki pref. | -0.35 | 0.000 |
| 21. Imathia pref. | 0.62 | 0.000 |
| 22. Pella pref. | 1.12 | 0.000 |
| 23. Pieria pref. | 1.38 | 0.000 |
| 24. Serre pref. | 1.39 | 0.000 |
| 25. Kilkis pref. | 1.49 | 0.000 |
| 26. Halkidiki pref. | 3.24 | 0.000 |
| *Crete* | | |
| 27. Rethimnon pref. | 8.90 | 0.000 |
| 28. Hania pref. | 9.58 | 0.000 |
| 29. Iraklion pref. | 9.74 | 0.000 |
| 30. Lasithion pref. | 11.85 | 0.000 |
| *E. Macedonia and W. Thrace* | | |
| 31. Drama pref. | 2.38 | 0.000 |
| 32. Xanthi pref. | 3.13 | 0.000 |
| 33. Rodopi pref. | 3.89 | 0.000 |
| 34. Kavala pref. | 4.25 | 0.000 |
| 35. Evros pref. | 8.25 | 0.000 |
| *Epiros* | | |
| 36. Preveza pref. | 2.64 | 0.000 |
| 37. Arta pref. | 3.01 | 0.000 |
| 38. Ioannina pref. | 3.71 | 0.000 |
| 39. Thesprotia pref. | 3.99 | 0.000 |

**Table A** (continued)

| *Explanatory variables* | *Estimated coefficients* | *p values* |
|---|---|---|
| *Spatial factors(continued)* | | |
| *Ionian Islands* | | |
| 40. Zakinthos pref. | 3.86 | 0.000 |
| 40. Lefkas pref. | 4.56 | 0.000 |
| 41. Kerkira (Corfu) pref. | 10.86 | 0.000 |
| 42. Kefallinia pref. | 13.07 | 0.000 |
| *N. Aegean Islands* | | |
| 43. Hios pref. | 11.96 | 0.000 |
| 44. Lesvos pref. | 15.12 | 0.000 |
| 45. Samos pref. | 19.81 | 0.000 |
| *S. Aegean Islands* | | |
| 46. Cyclades | 17.69 | 0.000 |
| 47. Dodekanese | 18.42 | 0.000 |
| *S., C. and E. Peloponnese* | | |
| 48. Argolis pref. | 1.82 | 0.000 |
| 49. Corinthia pref. | 2.66 | 0.000 |
| 50. Lakonia pref. | 4.68 | 0.000 |
| 51. Messenia pref. | 4.77 | 0.000 |
| 52. Arkadia pref. | 5.38 | 0.000 |
| *Thessaly* | | |
| 53. Karditsa pref. | 2.06 | 0.000 |
| 54. Trikala pref. | 2.45 | 0.000 |
| 55. Larisa pref. | 2.83 | 0.000 |
| 56. Magnesia pref. | 9.44 | 0.000 |
| *W. Greece* | | |
| 57. Achaea pref. | 3.20 | 0.000 |
| 58. Aetolia and Akarnania pref. | 3.87 | 0.000 |
| 59. Ilis pref. | 3.92 | 0.000 |
| *W. Macedonia* | | |
| 60. Kastoria pref. | 2.84 | 0.000 |
| 61. Kozani pref. | 3.51 | 0.000 |
| 62. Florina pref. | 3.56 | 0.000 |
| 63. Grevena pref. | 5.95 | 0.000 |
| *Commercial dimension: number of petrol stations in the area (ordered as per the values of each brand's coefficient)* | | |
| 64. Sunoil | -0.45 | 0.000 |
| 65. Medoil | -0.27 | 0.000 |
| 66. Aegean | -0.08 | 0.000 |
| 67. Elinoil | -0.07 | 0.000 |
| 68. EKO | -0.07 | 0.000 |
| 69. ETEKA | -0.17 | 0.041 |
| 70. Independently owned stations | -0.02 | 0.001 |
| 71. Shell | -0.02 | 0.000 |
| 72. Silkoil | 0.00 | 0.811 |
| 73. Jetoil | 0.01 | 0.000 |
| 74. Revoil | 0.02 | 0.008 |
| 75. Argo | -0.14 | 0.000 |
| 76. BP | -0.02 | 0.000 |
| 77. Avin | -0.04 | 0.000 |
| 78. Cyclon | 0.05 | 0.000 |
| 79. Kaoil | 0.05 | 0.000 |
| 80. Galonoil | -1.85 | 0.000 |
| 81. Dracoil | 0.33 | 0.000 |
| 82. KMoil | 0.17 | 0.000 |
| 83. El Petroil | 0.98 | 0.000 |

**Table A** (continued)

| *Explanatory variables* | *Estimated coefficients* | *p values* |
|---|---|---|
| *Strikes in other modes of transportation measured in 24hour equivalents* | | |
| 84. Taxis [a] (34 daily equivalents) | 0.35 | 0.000 |
| 85. Subway of Athens and its suburbs [a,b] (25 daily equivalents) | -0.22 | 0.000 |
| 86. Lagged residuals by one day (to deal with autocorrelation in the dependent variable) | 7.50 | 0.000 |

Number of observations: 193.656. Model fit: $R^2$ = 81.50%.

*Notes*
[a] *Net of the effects #2-9 the vectors of which exhibited a modest level of correlation, 15-25%.*
[b] *Net of the strike effects listed above.*

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# DEVELOPING A SUSTAINABLE ECONOMY THROUGH ENTREPRENEURSHIP: THE CASE OF ALBANIA

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**Abstract**
Research indicates that access to larger markets, curtailing corruption, and creating an entrepreneurial culture are important ingredients for a successful transformation from a centrally planned economy to a market economy. This paper argues that among those three factors, creating a business culture and cultivating entrepreneurial skills are the most important factors in the case of Albania. Albania's transition during the last two decades is often used as a microcosm to investigate the transformation process toward a market economy. The creation of an entrepreneurial economy can foster economic development, systematically fight corruption, and allow Albania to economically join the rest of Europe. A framework modeling conditions necessary for fostering entrepreneurship in Albania is examined, and several recommendations are offered. There are many lessons that other small economies in transition can learn from Albania's experience.

**JEL Classification:** O1, P2
**Key words:** Economic Development, Socialist Systems and Transitional Economies

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## 1. Introduction

Over two decades have passed since the demise of communism in Central and Eastern Europe (CEE). Considerable attention has been paid in the popular press to the lessons learned from these countries as they made their transition toward a market economy. As a result of this paradigm shift, the economies of the CEE countries have made significant progress and the wellbeing of their citizens has increased substantially. In 2010, the Gallup Organization conducted a world-wide survey and ranked 155 countries according to the wellbeing of their citizens (Gallup, 2010). Table 1 represents an extraction of only the CEE countries from this survey, and compares them along the major indicators of wellbeing with the rest of the countries in the world.

**Table 1.** Summary of the Wellbeing Measures for the CEE Countries

| Country | % Thriving | % Struggling | % Suffering | Daily Experience | Rank |
|---|---|---|---|---|---|
| Average (CEE) | 21.33 | 58.86 | 19.62 | 6.48 | 95.62 |
| Average (World) | 25.61 | 62.33 | 12.05 | 7.07 | 78.00 |
| Albania | 13.00 | 67.00 | 19.00 | 5.60 | 142.00 |
| T-Test (CEE vs. World) | 0.306 | 0.295 | 0.000 | 0.000 | NA |

*Source:* For a detailed ranking of each CEE country see Appendix A

As shown above, CEE countries have been able to catch up to the rest of the world during the last 20 years. Their overall rank (78.9), percentage of people thriving (21.33, p=0.306), and percentage of people struggling (59.05, p=0.323) are almost equal (not significantly different) from the rest of the world. There are still two measures from the CEE countries that are significantly worse than those of the world countries: percentage of people still suffering (19.62, p=0.00021) and daily experience (6.48, p=0.00005). The last measure, the daily experience, indicates the wellbeing averages on a daily basis and is scored dichotomously (0-10 scoring with higher scores representing better days). This measure includes: feeling well-rested, smiling and laughter, being treated with respect, enjoyment, sadness, learning and interest, physical pain, worry, stress, and anger.

As is indicated in Table 1, Albania scores well below the world averages in all measures of wellbeing and scores below CEE countries in all categories. In spite of the current state, however, Albanians continue to be resilient and hopeful. A recent

account notes that, with the exception of Kosovars and younger Albanians (The Economist, 2012, June 19), most people in the Balkans feel relatively miserable.

While the majority of CEE countries have developed their economies and increased the wellbeing of their citizens, Albania appears to be an outlier relative to their progress. As noted in Table 1, Albania's overall rank is 107. Bulgaria is the only CEE country ranked below Albania. The percentage of people thriving in Albania is only 13, significantly lower than the average of CEE countries (21.33), and the percentage of people struggling in Albania is 68, below the CEE average (59.05). The percentage of people suffering in Albania is 19, almost equal (not significantly different) from the rest of the CEE countries. The most troubling measure is daily experience. Albania's overall score is 5.6, which places Albania in the bottom three countries in the world, just above Iraq and Togo. The current level of wellbeing in Albania shows, according to Gallup researchers, that most Albanians feel pretty miserable, with the exception of Kosovars and younger Albanians.

While more than 20 years of transformation has allowed many CEE countries to catch up with the rest of the world and gradually begin joining the European Union, Albania is still struggling to raise the wellbeing of its citizens. Are there lessons to be learned from the Albanian experience of transition? What are some of the pitfalls that other transitioning economies should avoid as they gradually move from monarchies, autocracies, and communist regimes toward more open societies and free market economies? This research attempts to answer these questions.

## 2. Albania's Struggle toward Economic Progress

Three conditions impact the economic development in any given country: access to large free markets, a government generally free of corruption, and a business culture oriented toward entrepreneurship.

### *2.1 Access to Large Markets*

For relatively small countries, such as Albania, lack of access to the large free-market is a barrier for entrepreneurs who wish to create goods and services and sell them for profit. Many small countries often still take advantage of large markets by joining trade agreements (NAFTA, AFTA, APTA, and CEFTA). In the case of Albania, joining the European Union would be an ideal step to removing economic barriers to accessing a larger market. This has proven to be a difficult step for the

Albanians, however, given the level of the country's economic development, lack of infrastructure and bureaucratic institutions (Karameta, 2010).

*2.2 Corruption*

An ongoing problem facing the Albanian transformation is the high level of corruption and bribery. Based on the authors' own observations, the majority of the public believes that corruption in Albania is "widespread" and "somewhat common" and many Albanians admit to having given bribes to obtain public services. Corruption among government officials and state-owned enterprise managers has been a major barrier to Albania's integration with the European Union. On the other hand, this metastatic disease, that started among central and local government officials, is rapidly spreading toward state and private enterprises, causing sluggish organizational performance, lack of transparency, and unfair distribution of results (Karameta, 2010).

*2.3 Entrepreneurial Economy*

Entrepreneurship has been viewed and cited by researchers as an important contributor to a nation's industrial growth, a significant job creation force, and the engine of a nation's overall economic development. Among land, labor, capital, entrepreneurship, and knowledge, entrepreneurship and knowledge are identified as the two most critical factors in the economic development of any country (Kindleberger, 1965; Lewis, 1970). Especially in the case of economies in transition, the role of entrepreneurial ventures, mostly in the form of small and medium-sized enterprises, becomes increasingly vital. Such enterprises have the ability to respond to systemic shocks more rapidly and have the potential to generate jobs and income at a time when large state-owned firms are undergoing a rapid decline (Hashi & Krasniqi, 2011).

## 3. Background of Albania: A Brief History

Located in the heart of the Mediterranean, on the Adriatic and Ionian Seas, Albania is a very small but beautiful country, with a varied climate and topography. A country of about three million citizens, Albania has an area of only 11,000 square miles. It is bordered by Montenegro to the north, Kosovo in the northeast, Macedonia to the west, and Greece to the south. Predominantly a mountainous country, Albania has a wealth of natural resources, including petroleum, natural gas, coal,

bauxite, chromite, copper, iron ore, nickel, salt, timber, hydropower (The World Factbook, 2014).

Albanians are descendants of ancient Illyrians, who are believed to have evolved directly from the Stone Age. Records indicate that Illyrians were sociable and hospitable people, much like Albanians today. During the middle ages, commerce and economy flourished in Albania. During that period many Albanian merchants had agencies in other countries (Biberaj, 2013).

Albania fell under the rule of the Ottoman Turks in 1388. Their subjugation lasted for five centuries, with a brief period (1443-1268) when Gjergj Kastrioti (Skanderbeg), an Albanian military genius, rallied the Albanians and drove out the Turks for 25 years. Skanderbeg is the Albanian national hero and his statue stands in the main square in Tirana, Albania's capital. Turkish dominance hampered Albania's growth and trade exchanges with Western Europe. The Ottoman Empire offered tax incentives and economic assistance to Albanians who would convert to Islamism. Many Albanians refused to pay taxes to the Ottomans and refused to surrender their arms or serve in the army. "The religion of Albanians is Albanianism!" This was the rallying cry of the Albanian League, which was formed in 1878 to unite the country, develop the native language, literature, and education, and adopt a new alphabet. Albania proclaimed its independence in 1912.

During World War II, Albania was invaded by Italian forces in 1939 and by German forces from 1943 to November 1944. Albania was one of the most devastated countries in Europe during the war: 60,000 houses were destroyed and about 10% of the population was left homeless (Jacques, 1995). After its liberation, Albania became part of the communist block and Albanians lived for almost five decades under an oppressive regime that did not believe in freedom of expression or thought. Albanians lived in isolation from the Western world. Military bunkers that were constructed during this time still exist today, scattered throughout the country. New hope for the Albanians came in the early 1990s, when new elections and a parliamentary system replaced the communist regime. The new regime promised radical economic and social reforms in the country.

## 4. Background of Albania: Transition toward Market Economy

The Albanian transition toward a market economy has gone through two distinct phases: horizontal expansion and consolidation.

### *4.1 Phase 1: 1990-1997: Horizontal Expansion*

During this preliminary phase, inexperienced Albanian entrepreneurs explored many business ventures, moving mainly horizontally across industries to find the easiest opportunity for making a profit. The first economic reforms in Albania were dictated by necessity, and included privatization of large and inefficient factories built during the previous regime, dismantling of collective state farms, and the law of land. At this time, many more ambitious Albanians migrated to neighboring Italy and Greece. Reports indicated that remittances from Albanians working abroad were estimated to be more than $450 million a year (Luthans & Riolli, 1997).

Unfortunately, this first stage ended on a sour note for Albanian progress toward a market economy. A combination of failed pyramid schemes, political uncertainty, and lack of democratic experience and culture almost sent the country into a civil war. The Economist pointed out that "Albania will have to be reinvented …better luck second time" (The Economist, 1997, April 10).

### *4.2 Phase 2: 1997-Present: Consolidation*

The second phase of the transformation has two major characteristics: foreign development investment and consolidation of family-owned Albanian businesses. The construction of the Coca Cola factory in Tirana, Greek and Italian textile and shoe manufacturers, international restaurants and hotels in Tirana, and high-tech oil exploration by Shell are some examples of the foreign investment in the country. The cheap labor in Albania attracted several European labor-intensive manufacturers.

In June 2006, the Albanian government signed the Stabilization and Association Agreement with the European Union, a first step in the EU accession process. In April 2009, Albania became a NATO member country, and at the same time submitted its application for EU membership, both considered major milestones in the country's history. Albanian progress is documented in recent years, with the country noted as undergoing a "little-noticed but remarkable transformation" (The Economist, 2006, October 26).

Albania has been largely spared from the severe fallout of the European financial crisis, since its economy is not heavily integrated into the Euro-Atlantic system. In 2011, GDP was estimated to have reached close to $13 billion (Global Edge, 2012). Major contributors to GDP, according to 2010 preliminary data, were: the service sector with 57.6%, including trade, hotels, and restaurants, transport, and communication; agriculture with 20.3%; manufacturing with 11.3%; and construc-

tion with 10.7% (Global Edge, 2012). The government estimated growth reached 3% in 2011 and forecast 4.3% growth for 2012 (Global Edge, 2012).

There is one major conclusion to be drawn from the analysis of the recent and not-so-recent history of Albania: in spite of trials and tribulations, successes and failures, occupations and liberations, communism or democracy, planned or market economy, Albanians still remain resilient and hopeful for the future. Such optimism is rooted in business acumen, entrepreneurial skills, and decision-making ability. The entrepreneurial spirit of Albanian is demonstrated throughout history: from Skanderbeg to Mother Teresa. Mother Teresa, the Albanian born nun known for tirelessly working to help the poor, sick, orphaned and dying, is cited as having "all the makings of a successful entrepreneur" (Vuocolo, 2003).

## 5. Assessing Entrepreneutrial Opportunities in Albania

The history of Albanian transition toward a market economy exemplifies a vicious cycle that often occurs in economies in transition: issues often emerge which focus on tackling the problem of corruption, improving governance, and strengthening the legal, judiciary and regulatory environment −nearly always prerequisites for reaching larger markets, growing business organizations, and generally improving the wellbeing of individuals. On the other hand, a developing and suffering economy with a low standard of living is a clear impediment to joining world markets, as these conditions encourage corruption and bribery among government officials. By creating the necessary culture and climate for an entrepreneurial economy, the vicious cycle may be broken and real economic development can occur. This section of the paper investigates the current state of the Albanian entrepreneurial economy, and suggests recommendations that can be used by the Albanian central and local government to promote entrepreneurial growth and to become a catalyst for economic growth.

### *5.1 Methodology*

This research analysis compares the state of entrepreneurship in Albania to that in more developed countries using Graham's framework of the pillars of an entrepreneurial economy (Graham, 2006). In his work, Graham specifically outlines the factors that allow entrepreneurship to thrive in the U.S. economy, and which can foster entrepreneurship in developing economies.

### 5.1.1 An entrepreneurial economy is open to immigration

An open immigration policy means the best and brightest from many countries, with new ideas and energy, are allowed to immigrate and put their ideas to work. Areas of entrepreneurial excellence like Silicon Valley in the US are examples of thriving entrepreneurship and innovation; with many of these new startups founded by entrepreneurs who had been in the US for ten years or less. For many of the migrants to the entrepreneurial opportunity in the Silicon Valley, English is their second language.

Albania is one of the most striking cases of outward migration. During the post-communist era, roughly one million Albanians fled the country to neighboring Greece and Italy (Global Edge, 2012). In addition, about 40 percent of the highly skilled workforce, mainly lecturers and researchers, have left the country (Horvat, 2004). In spite of the increase in remittances from year to year, the outward migration of Albania's "elite" has caused a serious threat to promotion of knowledge, entrepreneurial skills, and the quality of higher education.

Highly skilled migrants can become both agents of development and valuable resources for their countries of origin. To stimulate entrepreneurial development, Albanians who left the country may need to be encouraged to return and assume new venture leadership roles. They can apply the entrepreneurial mindset and skills they acquired while working and living abroad to the birth of a job-creating Albanian entrepreneurial economy. There is a natural evolution, where those with an entrepreneurial mindset gravitate to areas of opportunity. As the prospects for entrepreneurship in Albania improve, there could be a migration back home. These entrepreneurially oriented and better trained individuals will be an important catalyst to stimulate and re-grow the economy.

### 5.1.2 There is an inherent "speed limit" for entrepreneurial development

A country ready for entrepreneurship, according to Graham (2006), is well developed with an adequate power grid, good roads, utilities, infrastructure, transportation options, and communication facilities. The infrastructure is the key to increasing the velocity of the economy and creating an environment that can easily spawn new ventures. An inadequate infrastructure will limit the progress of entrepreneurs with ideas, and it will reduce the attractiveness of the country to those who might come to Albania to seek opportunity. Companies and industries dealing with a more

primitive infrastructure will struggle to develop and grow because the precursors for natural development are limited or nonexistent.

At the beginning of the transition in Albania, the government advocated the "shock therapy" approach to transition. The argument was that such rapid liberalization avoids a painful and costly period when the old planned economy is already not working. Regrettably, ordinary Albanians lamented that they received "all shock and no therapy (Austin, 2006). Irrigation systems, fruit plantations, agriculture farms, and power grids were destroyed or looted in acts of political retribution, only because they were built during the former regime.

Albania has many outward signs of a limited infrastructure for entrepreneurial development, including abandoned facilities and inadequate power, water, and sewer systems. Lack of infrastructure, including an unreliable electricity supply, is among factors deterring foreign investment in Albania (Oxford Analytica, 2010, February 10). The Czech utility ČEZ took over the operation of the Albanian power distribution company in 2009 when it bought a seventy-six percent share in the utility. This alliance has proven to be very problematic, with a poor payment record by users of power and broken promises regarding reliability and investment by ČEZ. Some predict the imminent collapse of the entire electricity system and the eventual departure of ČEZ from the country (Bardsley, 2012, November 14).

During the last 20 years of transition, the Albanian infrastructure has improved consistently but very slowly. There is an acknowledged link between infrastructure provisions and poverty reduction in Albania (Humpries, Guxho & Ishihara, 2010). While progress has been made on major highways and access corridors throughout the country, there still are poorly served secondary and local road networks, which are often impassable in inclement weather. In 2006, the Albanian government established a program to improve a significant proportion of the secondary and local network, and requested the assistance of the World Bank to prepare for and contribute to the financing of such a program (Humpries, Guxho & Ishihara, 2010). However, the current "speed limit" for entrepreneurship development in Albania can be described as "glacial" when compared to that of more developed European countries, and even many of the CEE countries.

Information and communication technologies (ICT) infrastructure plays a vital role in increasing the "speed limit" of economic development. Many CEE countries have made significant progress toward creating the necessary IT infrastructure and have successfully become equal business partners with Western organizations. The IT infrastructure is an area where Albania has moved with satisfactory speed. For

example, currently, 48.1% of the Albanian population has access to the Internet (Internet World Stats, 2012). While this represents a significant achievement, when compared to the rest of the CEE countries, Albania still ranks low. The presence of several telecommunication companies such as Albanian Mobile Communication (AMC) and Vodafone have created a fertile environment for Albanian business organizations and individuals to take advantage of the accessibility of mobile ICT. This is an asset that can be leveraged for Albanian entrepreneurial progress.

### 5.1.3 Good universities provide good entrepreneurship partners

The highest levels of forward critical thinking exist in universities, which attract the brightest faculty and students to become a resource for nurturing ideas, creating innovation, and developing best business practices via their institutes and various research centers. Research ideas coming out of the best universities set the stage for other colleges and schools to follow and emulate (Graham, 2006). High-quality universities are the key to entrepreneurship. The prerequisite for a business school in a high-quality university is to both allow professional research and curricula to evolve with academic freedom, and to partner with nascent entrepreneurs.

Generally, the Albanian school system is well developed and there is a tradition of sound education. However, during the first decade of the transition, Albanian institutions of higher education were still ill prepared to provide modern business education to future leaders (Lee & Trimi, 2004). While the University of Tirana had skilled professors and qualified students, the curriculum was largely a combination of communism and liberal arts. This narrow perspective on what could be taught needed to be expanded to offer a complete, diversified education.

When Albania started the transition process, there were only a few public and no private universities. Currently, higher education is offered by 13 public universities and over 38 private universities and colleges operating in Albania (Tempus, 2010). This growth is attributed to the new law of higher education, which was approved in 2007 and amended in 2010. Unfortunately, private universities have manifested alarming signs of corruption, which place the future of higher education and the future of Albania in great danger. A recent study (Karameta, 2010) indicates that while "violations of law were found in every private university," the government did not take any measures and no single license was suspended. Unfortunately, the study named several private universities where students have obtained degrees without spending a single day in the classroom. Unless the university environment in Albania emphasizes quality research and high academic standards, the oppor-

tunity for the entrepreneurial environment in Albania to be bolstered by academia will be missed.

5.1.4 Entrepreneurship works best in a dynamic labor market

In an entrepreneurial economy, work is less identified with employment. In such economies, employees feel free to move among occupations, industries, and companies to seek better opportunities, more pay, or more interesting work (Graham, 2006). During the former communist regime, Albanians personally identified with their jobs and may have worked an entire career in only one occupation. A new entrepreneurial economy requires a different mindset. Individuals must feel free to seek better opportunities through changing jobs and creating new business ventures or building a career by evolving through several job options. Simultaneously, business owners and entrepreneurs must be supported with flexible employment policies and be allowed to release unproductive workers, freely seek better talent, and utilize flexible hiring policies to adjust to their business cycles.

5.1.5 Create an entrepreneur-friendly environment

Graham (2006) also suggests that an entrepreneurial environment offers a simple and non-bureaucratic process of obtaining the right to start a business: fewer regulations, and low fees. Table 2 represents the rank of Albania out of 183 economies in the world regarding major indicators of ease of doing business in the country. Overall, Albania is ranked number 82 in the year 2012 and has dropped five places compared to 2011 (International Finance Corporation & World Bank (2012). Compared to the previous year, Albania has improved its rank in two main indicators: enforcing contracts and registering property. All other indicators show that the entrepreneurial climate in Albania has declined.

The most troublesome indicators include dealing with construction permits (Albania dropped to the very bottom of the list in 2012), getting electricity in the workplace (also an indicator of infrastructure as discussed earlier), registering property (in spite of the recent improvement), and paying taxes. Earlier studies (Bitzenis & Nito, 2005) considered unfair competition, changes in taxation procedures, lack of financial resources, and problems related to public order as the main obstacles faced by entrepreneurs in Albania.

It is interesting to note that the same study reports that "bureaucracy and corruption do not appear to represent significant barriers to entrepreneurship" (Bitzenis

& Nito, 2005). This reinforces one of the theses of our paper that entrepreneurship and small businesses are the forces most immune to corruption and bureaucracy in the transition economies, and hence the most effective path toward progress in economic development. Any initiatives directed at adding certainty to both the availability and regulation of business licenses, taxation codes, permit regulation, and work related legislation would greatly benefit the new venture culture in Albania. While the increased energy associated with entrepreneurial business can often overcome many obstacles unfriendly to new venture development, anything that enhances the process would have a very positive impact on a newly forming entrepreneurial economy.

**Table 2.** Doing Business in Albania: Main Indicators

| Topic | Rank in 2011 | Rank in 2012 | Change in Rank |
|---|---|---|---|
| Starting a Business | 56 | 61 | -5 |
| Dealing with Construction Permits | 176 | 183 | -7 |
| Getting Electricity | 154 | 154 | No change |
| Registering Property | 126 | 118 | 8 |
| Getting Credit | 21 | 24 | -3 |
| Protecting Investors | 15 | 16 | -1 |
| Paying Taxes | 150 | 152 | -2 |
| Trading Across Borders | 76 | 76 | No change |
| Enforcing Contracts | 88 | 85 | 3 |
| Resolving Insolvency | 62 | 64 | -2 |

*Source:* International Finance Corporation & World Bank, 2012

5.1.6 Larger domestic markets create more prospective customers for new ventures

Albania's population of just over three million people represents a small domestic market for trade and commerce. For entrepreneurship to thrive, entrepreneurs will need to serve larger markets, obtain supplies internationally, and export to the world market. This will require Albania to create more trade relationships, including a relationship with the developed countries of Europe, especially its neighbor, Italy. In order to reach those markets, Albania needs to follow the example of neighbors

such as Macedonia and Croatia. Two years ago, these two countries launched intensive advertising campaigns on "prominent networks such as the BBC, Euro Sport, Euro News, and CNN," concentrating on their natural beauty and cultural and culinary traditions (Balkan Insight, 2010). In addition to its natural beauties and hospitability, Albania is a country of great economic and human resource potential. The country can offer favorable conditions to foreign companies. These advantages include low wages for relatively skilled and talented workers, favorable tax regulations, and a strategic geographic location.

Additionally, Albania needs to promote global strategic alliances between Albanian companies and companies in other geographic markets. By joining forces, each company opens its domestic market to the other, and overall it is a much more efficient way of gaining access to markets that would otherwise require time and resources for market expansion. These alliances could be as simple as a contractual relationship or actual equity partnerships.

### 5.1.7 Entrepreneurs need some source of funding

Startup capital funding is required to support new business ideas. Most entrepreneurial economies have well-developed banks and business incubators, available loans and grants, angel investors, and venture capital organizations. Similarly, entrepreneurial economies have established rules and procedures for contracts, investments in business structures, legal ways to invest, safeguards, and shareholders. Rules and procedures must also be designed and enforced so investors have confidence to make needed investments. Often, economies in earlier stages of entrepreneurial development must depend almost exclusively on foreign investments. To stimulate the interest of these outside investors, a stable and predictable regulatory environment is a prerequisite, along with a promotional program to make the developing Albanian economy an attractive option.

Albania is a good illustration of Graham's premise regarding the importance of a well-developed banking system and a solid financial sector. During the first transition years, an extremely underdeveloped financial sector was inherited from the communist regime. The new government did little or nothing to enforce regulations and laws to adjust to the new economy. The inefficiency of financial institutions was one of the main factors leading to the creation and rapid expansion of pyramid schemes, in which many Albanians lost their life savings in 1997.

With the support of the International Monetary Fund, a new set of banking regulations were approved in July 1998. Since then, the financial and banking systems have been expanding rapidly. Today more than 524 banks operate in Albania. Table 3 illustrates the portfolio composition in the banking industry and the relative developments from 2006 to 2010.

**Table 3.** Banking Industry Development in Recent Years*

| Year | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| Individual Loans (in Billions) | $1.77 | $2.71 | $3.68 | $4.17 | $4.55 |
| | 100% | 153% | 208% | 236% | 257% |
| Retail Loans (in Billions) | $0.60 | $0.96 | $1.31 | $1.34 | $1.37 |
| | 100% | 161% | 218% | 223% | 229% |
| Corporate Loans (in Billions) | $1.18 | $1.75 | $2.37 | $2.83 | $3.18 |
| | 100% | 148% | 201% | 240% | 270% |
| % of Deposits | $37.66 | $46.4 | $62.04 | $64.8 | $60.1 |
| | 100% | 123% | 165% | 172% | 160% |

*Source:* (KPMG, 2011)

*Albanian currency is converted to US$ using the conversion rate 1 lek = $0.0092773 (as of October 13, 2012)

The data in the table demonstrates a significant increase (two to three times) in the amount of loans the banking sector in Albania has given to individuals, retailers, and corporate organizations. Deposit amounts saw a slight reduction in 2010, which mostly reflects the decline in remittances from immigrants as Greece and other countries in Europe entered financial crisis. However, in spite of the European crisis, banks have continued to support Albanian businesses and individuals. The Albanian financial sector must continue to promote entrepreneurial endeavors, as they can become one of the most important reasons for outside investors to immigrate to Albania.

5.1.8 Being able to freely exchange ideas stimulates creativity and innovation

A culture without the free exchange of ideas will result in an environment unsuitable for entrepreneurship (Graham, 2006). When free thought is forbidden or not highly valued and creativity is discouraged as a way to equalize everyone's position

in the societal hierarchy, the result is a repression of the basic reason that entrepreneurs exist: independent action. Entrepreneurs are moved by their freedom to test new ideas, new technologies and new processes that relate to opportunities they have identified.

The political revolution of the early 1990s in Albania was only the beginning of the transformation process. The legal framework establishing freedom of speech, privatization, land ownership, freedom of movement, and other democratic laws was approved within the first few years of the new parliamentary republic. However, while the legal framework rapidly changed, the establishment of a democratic culture has proven difficult in Albania.

International observers cite examples of media outlets filing libel suits against the prime minister for prejudicial public statements that he allegedly made against them in the Parliament (Bureau of Democracy, Human Rights, and Labor, 2011, April 8). Many journalists complained that their lack of employment contracts frequently hindered their ability to report objectively.

There are many things that collectively create a culture open to new ideas and innovation. Some of them - a strong university system and an objective press - have already been mentioned. It is also critical to have an optimistic forward-looking perspective. It would appear that the Albanians' ability to remain resilient is in part due to their positive attitude. As the new economy leads to even more successful entrepreneurship, it will stimulate even more creative and progressive dialogue.

## 6. Prospects for Entrepreneurship in Albania

Albania has aptly been labeled a "microcosm, a laboratory if you will, for the transformation from central to market economy" (Luthans & Lee, 1994). Considering the current state of Albania's transition toward a market economy, the Albanian example is at best a work in progress. While there are some inherent problems to overcome, there is still reason to believe that Albania has a chance to overcome its difficulties by establishing a more entrepreneurial environment. Graham's framework of prerequisites for an entrepreneurial economy can be used to formulate both a direction and lessons for Albania, as well as other countries that are now entering the transition stage. Recommendations provided in Table 4 can be viewed as prescriptive for countries such as Armenia, Azerbaijan, Belarus, Bulgaria, Cambodia, Kazakhstan, Kyrgyz Republic, Laos, Macedonia, Moldova, Tajikistan, Turkmenistan, Uzbekistan, and Vietnam that are moving towards a market economy. In addi-

tion, the recommendations can be used by many countries in the Middle East that are currently undergoing wars or political changes that will lead to economic reforms.

**Table 4.** Recommendations for Economies in Transition

| Graham's Ingredient | Recommendations for Economies in Transition |
|---|---|
| An entrepreneurial economy is open to immigration | Establish repatriation strategies for the diaspora<br>• Welcome those with skills who are seeking opportunity<br>• Provide motivations to open new businesses<br>• Offer tax incentives<br>• Establish comparative salaries for expatriates<br>• Stipulate attractive contracts and business incentives |
| There is an inherent "speed limit" for entrepreneurial development | Protect and develop modern infrastructure<br>• Avoid "shock therapy" approach<br>• Provide a local and secondary road system<br>• Stable and reliable utility needs: water, electricity, gas, communication<br>• Emphasize mobile ICT<br>• Ensure that the legal and regulatory environment protects property ownership and the sanctity of contracts |
| Good universities provide good entrepreneurship partners | Establish meaningful partnership with universities<br>• Establish accreditation requirements for universities<br>• Promote partnership with international universities<br>• Endorse programs that respond to market skills<br>• Encourage applied research among faculty<br>• Promote strategic alliances between entrepreneurial business and universities |
| Entrepreneurship works best in a dynamic labor market | Create a dynamic labor market<br>• Introduce fixed term or temporary contracts<br>• Create training and retraining opportunities<br>• Promote ability of organizations to hire and fire<br>• Encourage equal opportunity hiring practices |
| Create an entrepreneur-friendly environment | Promote entrepreneurship and new ventures<br>• Develop business incubators<br>• Stimulate fair competition<br>• Allow entrepreneurial business to harvest success<br>• Reduce institutional barriers for business organizations |
| Larger domestic markets create more prospective customers for new ventures | Perform a cross country analysis for strategic positioning<br>• Identify critical success factors for the transition<br>• Create a national agency for advertisements<br>• Promote tourism or other competitive sources<br>• Sign international trade agreements with other countries |

| | |
|---|---|
| Entrepreneurs need some source of funding | Promote banking and venture capital<br>• Encourage pro-growth fiscal policies<br>• Secure saving deposits<br>• Fight corruption and pyramid schemes<br>• Establish foreign exchange markets<br>• Encourage investments by angel and venture capital organizations |
| Being able to freely exchange ideas stimulates creativity and innovation | Protect human rights<br>• Promote democracy and free elections<br>• Promote open innovation and idea exchange<br>• Fight corruption and bribery<br>• Protect freedom of speech, religion, and ethnic rights<br>• Celebrate differences and innovative thinking |

## 7. Conclusions

This paper compared Albania to other CEE countries that have transitioned to a market economy. The evidence shows that while the majority of CEE countries have politically and economically joined the rest of Europe, Albania's transition has failed several times in the past twenty years. In particular, Albania lacks three major factors that promote economic growth: accessing large markets, fighting corruption, and creating a business and entrepreneurial climate. The paper argues that among these three factors, developing a framework to promote an entrepreneurial economy is the most effective approach for breaking out of the vicious circle that very often entraps economies in transition.

A brief study of Albania's rich history indicates the deep entrepreneurial roots inherited by the people of this small country in the Balkans. Entrepreneurial skills are also demonstrated today in Albania, as witnessed by the authors' most recent visit in May 2012. Albanians are resourceful and hard working, both critical factors in positive entrepreneurial outcomes. As such, developing a positive entrepreneurial climate and culture might be the answer to the challenges facing Albania in the transition.

According to Graham's framework, it appears that during the last two decades Albania has made good progress in several areas, such as banking, financial institutions, and major highways. However, several major ingredients of Graham's formula are missing, leading to some practical recommendations. These recommendations serve a twofold purpose. They can be implemented by the Albanian government to move the country toward the entrepreneurial economy that would help achieve the same political and economic progress as that seen in other CEE coun-

tries. These recommendations can be used by other transitional economies that are moving toward a market economy in Europe, Asia, and South America and by other countries in the Middle East that are embracing economic reforms.

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**Appendix A.** Wellbeing Measures for the CEE Countries

| Country | % Thriving | % Struggling | % Suffering | Daily Experience | World Rank |
|---|---|---|---|---|---|
| Albania | 13 | 67 | 19 | 5.6 | 142 |
| Bosnia-Herzegovina | 20 | 59 | 20 | 6.2 | 113 |
| Bulgaria | 6 | 58 | 36 | 6.5 | 144 |
| Croatia | 26 | 60 | 14 | 6.2 | 82 |
| Czech Republic | 39 | 51 | 9 | 6.6 | 51 |
| Estonia | 17 | 62 | 21 | 6.8 | 104 |
| Hungary | 13 | 53 | 34 | 6.9 | 105 |
| Kosovo | 29 | 65 | 6 | 6.2 | 68 |
| Latvia | 11 | 64 | 25 | 6.5 | 140 |
| Lithuania | 25 | 57 | 18 | 6.2 | 85 |
| Macedonia | 14 | 54 | 32 | 6.8 | 110 |
| Montenegro | 26 | 58 | 16 | 6.2 | 83 |
| Poland | 28 | 61 | 10 | 7.1 | 57 |
| Romania | 21 | 56 | 23 | 6.6 | 93 |
| Serbia | 16 | 63 | 21 | 6.2 | 125 |
| Slovakia | 21 | 60 | 19 | 6.5 | 94 |
| Slovenia | 27 | 57 | 16 | 6.8 | 72 |
| Belarus | 29 | 59 | 12 | 6.5 | 74 |
| Moldova | 25 | 62 | 13 | 6.1 | 91 |
| Russia | 21 | 57 | 22 | 7 | 79 |
| Ukraine | 21 | 53 | 26 | 6.6 | 96 |

*Source:* For a complete ranking of 155 countries in the world see Gallup (2013)

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Cracow University of Economics

On the occasion of the 90th Anniversary
of *Cracow University of Economics* foundation

90th Anniversary Cracow University of Economics

ASECU

## OPENNESS, INNOVATION, EFFICIENCY AND DEMOCRATIZATION AS PRECONDITIONS FOR ECONOMIC DEVELOPMENT

September 10-11, 2015
Cracow, POLAND

Deadline for abstracts: February 28th, 2015
Deadline for registration and payment: April 30th, 2015
Deadline for full-papers: May 15th, 2015

http://fundacjauek.krakow.pl/asecu2015
asecu2015@uek.krakow.pl

# call for papers

## General information

We welcome submissions addressing the ASECU 2015 International Confeence theme:

**Openness, Innovation, Efficiency and Democratization as Preconditions for Economic Development**

### Conference aim

The conference aims to provide a professional discussion platform for both academic and business professionals from Southern and Eastern Europe and the Black Sea Region, as well as from the neighbouring countries. The conference will address multi factor aspects of sustainable development. Openness, innovation, efficiency and democratization seem to belong to the group of the most important factors influencing catching-up processes and helping to sustain a high level of development. Hence, organizers of the conference especially expect participants to explore and examine the impact of the factors mentioned above

The conference official language is English.

## Conference Topics

**1st Session - Openness, Innovations, and Growth: Macroeconomic and Policy Issues**

Submissions: Macroeconomic Studies on Openness, Innovations and Growth (including Environmentally Sustainable Growth)

Topics:

- Export Led Growth
- Driving Factors & Effects of FDI
- FDI and Export Nexus
- Imitate or Innovate: Macroeconomic Aspects
- Openness and Knowledge Diffusion
- R&D Expenditure and Growth
- Green Innovations for Growth
- Innovative Strategies for Sustainable Development: Macroeconomic Aspects
- Globally Sustainable Development
- New Ways of Promoting Sustainable Consumption
- Long Terms Projects (e.g. Education) vs Short-Term Spending

**2nd Session - Openness, Innovations, Efficiency and Growth: Microeconomic Issues**

Submissions: Microeconomic and Business Studies on Openness, Innovations and Growth (including Environmentally Sustainable Growth)

Topics:

- Business Innovations in General
- Imitate or Innovate: Microeconomic Aspects
- Product Innovations
- Innovative Decisions Working Process
- Innovative Organizational Approaches
- Globally/ Internationally Oriented Business
- Strategies for International Business Development
- Foreign Companies and Spillovers of Innovations
- Innovative Strategies for Sustainable Development: Microeconomic Aspects
- Eco-efficiency of Transport and Logistics Operations
- New Theoretical Approaches Towards Market Interactions

**3rd Session - Democracy, Efficiency & Socially Sustainable Development**

Submissions: Studies on Democracy (and other Social and Political Institutions), Efficiency and Development

Topics:

- The Significance of Democratization of Institutions
- Democracy & Efficiency: Complementarity or Substitution
- Openness, Globalization and Limits of Democratic Policies
- The Significance of Democratization of Companies and Production
- Collective Bargaining and Decision Making at Macro and Micro Level and How to Increase its Efficiency
- Innovative Strategies for Socially Sustainable Development
- New Theoretical Approaches Towards Market Interactions: Social and Political Aspects
- Fair Trade Policies and their Results
- Corporate Social Responsibility of Business
- Social Capital and Innovation Diffusion

The conference is not restricted to the suggested themes. All participants are welcome to suggest other ideas in relation to the main theme of the conference.

# call for papers

## Important dates

| | | |
|---|---|---|
| **February** | **28th, 2015** | Deadline for submission of abstracts |
| **March** | **15th, 2015** | Notification for abstracts acceptance |
| **April** | **30th, 2015** | Deadline for registration and payment |
| **May** | **15th, 2015** | Deadline for submission of full-papers and application forms |
| **June** | **15th, 2015** | Notification for full-paper acceptance |
| **July** | **27th, 2015** | Announcement of the detailed conference program (at **http://fundacjauek.krakow.pl/asecu2015**) |

## Conference Committees

SCIENTIFIC Committee

- Prof. Grażyna ŚMIGIELSKA, Cracow University of Economics Poland, Chairman of the Conference Committee
- Prof. Yannis TSEKOURAS - President of ASECU, University of Macedonia, Thessaloniki
- Prof. Oleg BODYAGIN, Rostov State University of Economics
- Prof. Bozidar CEROVIĆ, University of Belgrade
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- Prof. Dumitru MATIS, "Babes Bolyai" University of Clui Napoca
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- PhD Zbigniew STAŃCZYK, Cracow University of Economics
- Prof. Bobek SUKLEV, "St Cyril and Methodius" University, Skopije
- PhD Bogdan WIERZBIŃSKI, University of Rzeszow
- Prof. Grigoris ZAROTIADIS, Aristotle University of Thessaloniki

ORGANIZING Committee

- Karolina ORZEŁ, M.Sc., Cracow University of Economics, Poland, Chairman of the Organizing Committee
- Tomasz BOBER, M.Sc., Cracow University of Economics, Poland
- Paweł KONKOL, M.Sc. - Cracow University of Economics, Poland
- Katarzyna ŚWIETLA, PhD - Cracow University of Economics, Poland

## Guidelines for Abstract Submission (All submissions are refereed)

**Submissions of abstracts** have to meet the following criteria:

- Title of the contribution written in English (type size - 14, font - Times New Roman, bold)
- The title page must include names, degree, affiliations, complete addresses (e-mail, telephone, facsimile numbers) for all authors;
- Abstracts, written in English, should be no longer than 10-18 lines (format: normal, type size - 12, font - Times New Roman, Spacing: Before: 0, After: 0, Line Spacing: 1.5, Alignment: Justified, Indentation: Left: 0, Right: 0, Special: 0).
- Abstracts should include Objectives, Data and Methods, Results, and Conclusions.
- JEL classification and up to 6 keywords should be used.

Previously published papers may not be submitted.
All accepted abstracts will be published in the Abstract Book (with an ISBN number). It will be distributed to all conference participants at the Conference. Submitted full papers will also be included in the conference proceeding CD.

For more information see example of abstract submission - EXAMPLE 1

EXAMPLE 1

### Value-Based Management – a Systemic Concept of Management

Jan Kowalski, PhD, Cracow University of Economics, Poland
Jan.kowalski@uek.krakow.pl, 27 Rakowicka St., 31-510 Cracow, Poland

Abstract

The value-based management concept assumes aware inspiring, undertaking and implementing actions focused on an increase in the value of an enterprise or another entity the functioning of which is connected with permanent strive for the multiplication of its market value. Therefore, it applies to the functioning of enterprises, strategic business units, economic projects and real estate. The concept brings a need for a comprehensive approach via creating a complex systemic structure of management focused on the multiplication of value. For this reason, the value-based management system is of key significance for the effective multiplication of the invested capital value. The article presents the assumptions, the essence and the components and mechanisms of the system functioning as the holistic approach, integrating the static representation with the dynamic (process) representation.

***Key words:*** value-based management, management system (3-6)

***JEL Classification***: G32, M10, L21 (http://www.aeaweb.org/jel/guide/jel.php)

call for papers

## Guidelines for Full-paper Submission

- Submit papers of no more than 8-10 pages (0.5 standard unit of text length (app. 20,000 characters including tables, figures, graphs and math formulas) in length including results, figures and references. It is necessary to write the extended abstract and paper according to the instructions.
- Requirements for the paper-formatting:
- Use A4 Format (297x210 mm); margins: top 25 mm; bottom 25 mm; left 25 mm; right 25 mm; Line spicing – 1.5; Between paragraphs one line space; paragraph justify. The text should be written in Word 2003 or in Word 2007 (Windows), Times New Roman, font 12; – Specific editorial requirements can be found here **EXAMPLE 2**
- The name(s) of the presenting author(s) and other co-author(s), degree, affiliation(s), complete mailing address(es), title of the papers should be provided in the Application Form;
- Electronic submissions are expected. Submissions should be in Microsoft Word format. When submitting your paper please write in the **subject** line: **ASECU conf. (*name of the leading author*)**;
- Papers with positive judgment of the referees and presented at the conference are going to be published in the conference proceedings.

EXAMPLE 2

### Title of the Contribution (Times New Roman 14 pkt)

First Author[1], Second Author[2]

**1. Introduction - Title of the section (automatically numbered)**

First paragraph of the section, lacking indentation at the beginning of the first line.

A Second and following paragraphs of the text have initial indentation of 0.5 cm. Please note the changed style. Please, note also this *emphasized* word, and other, **very important** word (just use appropriate styles).

Main body of the text:

The typescripts and manuscripts should be followed:

1. Typescripts (Programme: **Microsoft Word**, Font - Times New Roman), **format file: *.doc** or ***.docx**

[1] Corresponding author: Degree, University/Institute, department, address, e-mail.

[2] Degree, University/Institute, department, address, e-mail.

2. The manuscript should meet following requirements:
   - A4 sized paper should be used
   - Margins: left - 25 mm, right - 25 mm, Top and bottom margins 25 mm,
   - Font size: Main body text – 12 points,
   - Footnotes, references & attachments, tables – 12 points,
   - Line spacing – 1.5,
   - Spacing: Befor: 0, After: 0,
   - Alignment: Justified,
   - Indentation: Left: 0, Right: 0, Special: 0,
   - Style: Normal (not Title, Heading, Heading2,...,Body Text, etc!).
   - Leave an empty line between sections.

**Reference style** (in text)

Text: All citations in the text should refer to:

- Single author: the author's name (without initials, unless there is ambiguity) and the year of publication; e.g. (Pegrum, 2009)
- Two authors: both authors' names and the year of publication; e.g. (O'Donoghue & Clarke, 2010)
- Three or more authors: first author's name followed by 'et al.' and the year of publication. Examples: 'as demonstrated (Allan, 2000a, 2000b, 1999; Allan and Jones, 1999). Kramer et al. (2010) have recently shown .
- Journal article in print: 8 or more authors, e.g. (Sohrabi et al., 2011)
- Web page; e.g. (Australian Psychological Society, 2008)
- Web page: No author, e.g. ("Improve indigenous housing", 2007)

### 1.1 Title of the subsection (automatically numbered)

Again first paragraph without indentation.

Again second paragraph indented.

### 2. Inserting additional material

**Figures** should be centered. The title of figures should appear immediately below the figure. (Title: **Fig. 1.** Index price. (12pt)). The title of the figure should follow the figure number. Figures should not be wider than the margins of the paper. **Leave an empty line before and after each figure.** Figures will not be redrawn by the publisher. **Figures should be high- quality grayscale graphics (please, do not use colors)** vector drawings (with text converted to curves) or 300 dpi bitmaps. Size: max **12.4 cm** x **16 cm.** Under figures there should be **source** given typed in 10 points Times New Roman, Alignment: left

In case of a larger number of lines on the figure, next lines are supposed to be distinguished through symbols (flags) or other line style (e.g. broken line).


**Fig. 1.** Index price

Source: own work.

**Numbers** in all tables, as well as in the text should be written with a decimal **dot.**

**Tables** have to be centered, numbered continuously, and referenced in the text. Please, use caption format as given here. Feel free to use cross-referencing feature of your typewriting software. Tables should not be wider than the margins of the paper. Under table there should be **source** given typed in 10 points Times New Roman, Alignment: left. **Leave an empty line before and after each table.** Lines in the table should be single, standard thickness, minimum number of horizontal lines is taking out 3. There are no verticals (see the example). Numbers put in the table should be in the alignment formats, i.e. with the same number of decimal places (the maximum number of decimal places is taking out **4). Tables -10 points.**

**Table 1.** Sample table

| Column Hidings | Column Hidings | Column Hidings | Column Hidings |
|---|---|---|---|
| | | | |
| | | | |

Source: own work.

**Equations** have to be centered and right-numbered continuously inside the parenthesis (If equations are not referenced in the text, the numbering is not obligatory. Please use 12pt sized font. For writing equations, use this generator of equations

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad (1)$$

## Conclusion

This section should include the conclusions of the research project. The results of the work should be related to the already known results.

## Acknowledgements

Supporting people and institutions (including Science Foundations) go here.

## References

References that follow have to be alphabetically sorted and should follow the introduced style (References - 12 points, Line spacing - 1.5, Justified). **All references must meet APA styles** (American Psychological Association - more information **http://www.apastyle.org/)**

1. Australian Psychological Society. (2008). *Substance abuse: Position statement*. Retrieved from http://www.psychology.org.au/publication/statements/substance/
2. Improve indigenous housing now, governments told. (2007). Retrieved from http://www.architecture.com.au/i-cms?page=10220
3. Jones, E. E., Farina, A., Hastorf, A. H., Markus, H., Miller, D. T., & Scott, R. A. (1984). *Social stigma: The psychology of marked relationships.* New York: W.H. Freeman.
4. O'Donoghue, T., & Clarke, S. (2010). *Leading learning: Process, themes and issues in international contexts.* London: Routledge.
5. Pegrum, M. (2009). *From blogs to bombs: The future of electronic technologies in education.* Crawley, W.A: UWA Publishing.
6. Sohrabi, H. R., Weinborn, M., Badcock, J., Bates, K. A., Clarnette, R., Trivedi, D., Martins, R. N. (2011). New lexicon and criteria for the diagnosis of Alzheimer's disease. *Lancet Neurology*, 10(4), 299-300.

# call for papers

The Editorial Board of **South Eastern Europe Journal of Economics (SEEJE),** the official journal of ASECU, after having the agreement of the authors, plans to publish selected conference papers following a blind refereeing process. For more information at **http://www.asecu.gr/Seeje/**

Selected conference papers may also be published in special issue of ***Scientific Annals of the "Alexandru Ioan Cuza" University of Iasi, Economic Sciences Section (SAAIC)***. More information at **http://anale.feaa.uaic.ro/anale/en**

## Contact Information

Organizing Committee
of the 11th International Conference of ASECU
Faculty of Management, Cracow University of Economics
Rakowicka 27, 31-510 Krakow
e-mail: **asecu2015@uek.krakow.pl**
Tel: **+48 12 293 7441**
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Secretariat of the Conference:

**Karolina Orzeł, M.Sc.**
Cracow University of Economics,
Faculty of Management
e-mail: orzelk@uek.krakow.pl

## Conference fee and hotel accommodation

The conference fee amounts to **123 €** per participant for all participants.

**Account:**
Fundacja Uniwersytetu Ekonomicznego w Krakowie
ul. Rakowicka 27, 31-510 Kraków, Poland
Bank Pekao SA, ul. Pijarska 1, 31-015 Kraków, Poland
IBAN: PL 38 1240 4533 1111 0010 2820 8384
SWIFT: PKOPPLPW
with a note: ASECU 2015, Name and Surname of Participant

Each participant should cover travel costs to and from Cracow, and should directly book accommodation in Cracow.

The following hotels are recommended by the Organizing Committee (list of hotels close to conference venue):

**EUROPEJSKI Hotel *** POLLERA Hotel *** CHOPIN Hotel *****

**EUROPEJSKI Hotel**
ul. Lubicz 5,
31-034 Kraków
www.he.pl

Europejski Hotel is located in central Kraków, just 10 minutes' walk from the Main Market Square and the Kraków Główny Railway Station. It offers classically appointed rooms with free Wi-Fi. The beautifully furnished, luxury rooms at the Europejski come with satellite TV and a telephone. All feature a modern bathroom with a hairdryer. One visit to the sauna is free of charge for each room type. Guests of Europejski Hotel have access to the on-site wellness centre with a sauna and a massage parlour.

**POLLERA Hotel**
ul. Szpitalna 30,
31-024 Kraków
www.pollera.com.pl

The Poller Hotel, situated in the very centre of the Old Town. From the windows of our hotel, you can see the Juliusz Słowacki Theatre, and within several minutes you can walk to the Main Market Square! Nearby the Hotel, there is also the communications centre of the city – railway and bus station. The Hotel, established in 1834, offers its guests Period, Art Nouveau interiors.

**CHOPIN Hotel**
Przy Rondzie 2,
31-547, Kraków
www.chopinhotel.com

Chopin Hotel Cracow is a charming 3-star prop erty conveniently located near the centre of Krakow. Guests of the hotel will have easy access to Botanic Garden, Central Train Station and Juliusz Slowacki Theater. Krakow Barbican, Florian's Gate and Czartoryski Museum are also not far away.

# guide for authors

The articles should be written as follows:

(1) Papers must be in English.

(2) Papers for publication (two copies) should be sent to:

Mrs. Melina Petromelidou
Editorial Secretary
South-Eastern Europe Journal of Economics
ASECU, University of Macedonia, 156, Egnatia Str., 540 06 Thessaloniki, Greece

The *Journal's* phone number is (+30) 2310891793, fax: (+30) 2310891748 e-mail:
asecu@uom.edu.gr
Submission of a paper will be held to imply that it contains original unpublished work and is not being submitted for publication elsewhere. The Editor does not accept responsibility for damage or loss of papers submitted. Upon acceptance of an article, author(s) will be asked to transfer copyright of the article to the publisher. This transfer will ensure the widest possible dissemination of information.

(3) Papers will be considered in any form, but authors of papers accepted for publication will be expected to provide a final copy conforming to the general style of the Journal as outlined in notes 4 through 13 below.

(4) Manuscripts should be 1,5 spaced, with wide margins, and printed on one side of the paper only. All pages should be numbered in sequence. Titles and subtitles should be short. References, tables, and captions for the figures should be printed on separate pages.

(5) The first page of the manuscript should contain the following information: (i) the title; (ii) the name(s) and institutional affiliation(s) of the author(s); (iii) an abstract of not more than 100 words. A footnote on the same sheet should give the name, address, and telephone and fax numbers of the corresponding author [as well as an e-mail address].

(6) The first page of the manuscript should also contain at least one classification code according to the Classification System for Journal Articles as used by the Journal of Economic Literature; in addition, up to five key words should be supplied.
The classification system used in JEL can be found at:
http://www.aeaweb.org/journals/jel_class_system.html.

(7) Acknowledgements and information on grants received can be given in a first footnote, which should not be included in the consecutive numbering of footnotes.

(8) Footnotes should be kept to a minimum and numbered consecutively throughout the text with superscript Arabic numerals.

(9) Displayed formulae should be numbered consecutively throughout the manuscript as (1), (2), etc. against the right-hand margin of the page. In cases where the derivation of formulae has been abbreviated, it is of great help to the referees if the full derivation can be presented on a separate sheet (not to be published).

(10) References to publications should be as follows: 'Smith (1992) reported that...' or 'This problem has been studied previously (e.g., Smith et al., 1969)'. The author should make sure that there is a strict one-to-one correspondence between the names and years in the text and those on the list. The list of references should appear at the end of the main text (after any appendices, but before tables and captions for figures). It should be double spaced and listed in alphabetical order by author's name. References should appear as follows:

For monographs
Sen, A., 1970, *Collective Choice and Social Welfare*, San Francisco: Holden Day.

For contributions to collective works
Kornai, J., 1991, Stabilization and Economic Transition in Hungary: The Next Two Years, in J. de Melo and A. Sapir (eds.), *Trade Theory and Economic Reform: North, South and East*, Oxford: Basil Blackwell, 307-326.

For periodicals
Magdalinos, M., 1990, "The Classical Principles of Testing Using Instrumental Variables Estimates", *Journal of Econometrics,* 44, 241-279.

Note that journal titles should not be abbreviated.

(11) Illustrations will be reproduced photographically from originals supplied by the author; they will not be redrawn by the publisher. Please provide all illustrations in quadruplicate (one high-contrast original and three photocopies). Care should be taken that lettering and symbols are of a comparable size. The illustrations should not be inserted in the text, and should be marked on the back with figure number, title of paper, and author's name. All graphs and diagrams should be referred to as figures, and should be numbered consecutively in the text in Arabic numerals. Illustration for papers submitted as electronic manuscripts should be in traditional form.

12) Tables should be numbered consecutively in the text in Arabic numerals and printed on separate sheets.

13) Accepted papers should be submitted in electronic form in a storage media (i.e. CD, DVD, USB, etc.) with accompanying manuscript. Electronic manuscripts have the advantage that there is no need for re-setting of text, thereby avoiding the possibility of introducing errors and resulting in reliable and fast delivery of proofs. The preferred format is either .doc or .docx. Make absolutely sure that the file on the disk and the printout are identical.

(14) Page proofs will be sent to the corresponding author. Proofs should be corrected carefully; the responsibility for detecting errors lies with the author. Corrections should be restricted to instances in which the proof is at variance with the manuscript. There are neither submission fees nor page charges.