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CONTENTS

DETERMINANTS OF CASH HOLDINGS IN PRIVATE FIRMS: THE CASE OF THE SLOVENIAN SMES

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ABSTRACT: *This paper examines the determinants of cash holdings in a large sample of the Slovenian small and medium sized companies in the period 2006-2013. The empirical results provide support for the transactions and precautionary motives in the cash policies of the analysed SMEs. However, we find evidence in favour of the speculative motive as well, by ascertaining that smaller, exporting and more profitable firms hold more cash. The paper also establishes that the net working capital and financial debt can be considered as cash substitutes and that keeping close relationships with banks reduces agency costs and information asymmetries and leads to lower cash levels. In addition, the ability to internally generate funds expressed as higher operating cash flow reduces the amounts of cash held. Finally, evidence shows that longer cash conversion cycles and requirements for mandatory retirement benefit contributions result in higher cash balances, while weaker empirical support is found also for the negative influence of the interest rate level on cash holdings.*

Key words: *cash holdings, liquidity, financial Crisis, SMEs, Panel data*

JEL classification: G10, G32, L25

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1 INTRODUCTION

Managing cash is an important component of a company's financing policy, especially in the case of small businesses, which are often more dependent on short-term financing sources (Peel, Wilson & Howorth, 2000; Walker & Petty, 1978). The old phrase ″cash is king″ is particularly descriptive of small and medium-sized companies, considering they face much more limited access to external financing compared to that which larger companies have access to (Mramor & Valentinčič, 2003). In addition, the recent financial crisis has put cash and its management back in the spotlight. When liquidity is scarce, efficient cash management is vital for ensuring that every spare monetary unit has been fully utilized (Nason & Patel, 2016). Even in good times, an adequate cash policy is crucial for the company as lack of liquidity may result firstly, in the company's inability to settle its liabilities as contracted or as economically efficient, secondly, in its increased costs, and, in

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the worst case, insolvency. As a result, the management of cash holdings often marks the difference between corporate failure and success. Cash holdings in general represent "cash on hand or readily available for investment in physical assets and to distribute to investors" (Gill & Shah, 2012) and it is considered a liquid asset necessary to support the day-to-day operations and the working capital needs of a company.

The purpose of this study is to investigate the determinants of cash holdings in small and medium-sized companies in Slovenia. These are the companies which employ fewer than 250 persons with an annual turnover not exceeding EUR 50 million and/or an annual balance sheet total not exceeding EUR 43 million (European Commission, 2003). We assume that companies behave prudently when it comes to liquidity and postulate that the transactions and precautionary motive prevail when deciding on the level of cash to hold. Based on the that, it is posited that small and medium-sized enterprises (SMEs) tend to lower their costs related to securing liquidity, utilize their cash substitutes at hand and accumulate cash as a buffer against difficult circumstances. The study also seeks to examine the effect of the recent financial crisis and the consequent stringent credit conditions on the cash holdings behaviour of Slovenian SMEs. All the study hypotheses rest on the specific characteristics of SMEs, which are outlined in the following paragraph. A large sample of 27,573 unique small and medium-sized firms during the period 2006-2013 for a total of 170,220 firm-year observations is used.

Small and medium-sized enterprises play a central role in the EU economy as a whole, nevertheless, they represent a sector of even greater importance for the economic development of Slovenia, which makes it a particularly interesting choice of country for the purpose of examining the characteristics of SMEs. According to the Annual Report on the European SMEs 2014/2015 (European Commission, 2015), there were 22.3 million SMEs in the non-financial business sector of the 28 European Union Member states in the year 2014, accounting for 99.8% of all enterprises in this sector, providing 67% of total employment and 58% of the sector's value added (or EUR 3.7 trillion in absolute value). As reported in the 2015 SBA Fact Sheet (European Commission, 2015), it is estimated that in Slovenia the SMEs constituted 99.8% of all non-financial business entities, accounting for circa 73% of employment and providing 63% of the value added in the local non-financial sector in 2014. According to our data analysis, cash holdings represent a significant part of the asset base of the Slovenian SMEs as they average around 18% of their net assets, which is much higher than the average 6% found in Spanish SMEs (García-Teruel & Martínez-Solano, 2008) and the average 5% found in Portuguese SMEs (Pastor and Gama, 2012).

One of the crucial differences between public and private firms is their respective ownership structure. While the ownership of private firms is in the hands of just one or a few owners, public firms' ownership is divided among thousands of shareholders. The coincidence between ownership and control in smaller firms provides managers with greater flexibility in changing the asset base and consequently the risk of the firm (Pettit & Singer, 1985). Furthermore, private businesses are usually characterized by greater informational opacity, which contrasts with the comparable, informationally

transparent publicly listed companies. This fact exacerbates the information asymmetry problems (Berger & Udell, 1998). As a result of the aforementioned characteristics, private businesses face more serious agency costs of debt (Pettit & Singer, 1985), and what is more, it makes smaller firms more susceptible to temporary economic downturns, resulting from the higher transaction costs these firms encounter and the consequently shorter maturity debt they use (Tittman & Wessels, 1988). Finally, smaller firms are challenged with more severe financing constraints, arising from their limited internal finance, the information asymmetry they bear and presumably due to the lack of collateral to support their borrowing (Whited, 1992).

Strong support is established for both the transactions and precautionary motive respectively in the cash policies of the firms studied in our sample, however, there is also evidence found on the presence of the speculative motive. More specifically, the results of our research show that smaller firms tend to hold higher levels of cash, thus mitigating the potential costs for obtaining external finance. In the same vein, we find that keeping close relationships with banks provides a buffer, leading to lower cash levels, and that in addition, cash substitutes such as net working capital and debt are indeed utilized as such. Furthermore, higher ability for generating funds internally, expressed within the research as operating cash flow generated, is negatively related to the amounts of cash held. Weak empirical support for the negative influence of the interest rate level on cash holdings is also established. The reported evidence further shows that longer cash conversion cycles and mandatory retirement benefit contributions requirements result in higher cash balances, implicating that precaution drives the cash policy in financially constrained firms. The finding that exporting and more profitable firms hold more cash implies the speculative motive, rather than the precautionary one, drives the decision to keep the cash holdings "in-house" in order to be able to take advantage of profit-making opportunities.

The results of our research make several contributions to the existing literature on cash holdings. First, our analysis establishes new and so far untested factors as determinants of cash holdings, as among others the export activities and the requirement for mandatory retirement benefit contributions. Furthermore, to our knowledge this is the first paper that addresses the effect of the recently changed interest rate climate on the cash amounts held by companies. Another important contribution of our analysis is that the research focuses on cash holdings of small and medium sized (and generally private) companies, representing a sector that has thus far received relatively little attention by researchers compared to the extensive literature available on cash policies in large companies listed on capital markets. Thus, our paper builds on the existing though limited body of knowledge devoted to a sector of great significance to the global economy. Lastly, no empirical studies regarding determinants in the field of cash holdings for small and medium-sized companies in Slovenia have been carried out so far, despite the fact they constitute the core of the country's economy.

The remainder of this paper is structured as follows. Section 2 provides the theoretical foundations and develops the empirical hypothesis, while Section 3 describes the data

set and the methodology used. In Section 4 results are discussed, in section 5 additional robustness tests are presented, while section 6 provides a conclusion to the research and its findings.

2 LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Reasons and motives for holding cash

Firms hold a certain amount of cash holdings on their balance sheets for various reasons and purposes. The two main motives for doing so are indicated in the current literature as the transactions motive and the precautionary motive respectively. The first of the two, the transactions motive, arises from the firm's need of a certain amount of cash balances necessary for covering payments related to their day-to-day business operations. Keynes (1936) defines the transactions motive as "the need of cash for the current transaction of personal and business exchanges". By securing cash for these purposes, the company avoids or reduces transaction costs associated with raising external finance. As shown by Miller and Orr (1966), higher transaction costs prompt firms to hold more liquid assets.

On the other hand, the precautionary motive for holding cash relates to a firm's intention of protecting itself against uncertain future events. To hedge against uncertainty, firms make cash reserves to meet future eventualities which would require sudden spending in times of poor cash flow. Almeida, Campello and Weisbach (2004) demonstrate the precautionary demand for cash is present in financially constrained firms which show significant propensity to save cash out of their cash flows, whereas unconstrained firms do not. Nevertheless, during the financial crisis, both constrained and unconstrained firms demonstrated a significantly increased propensity to save cash (Sun and Wang, 2015). In addition, McLean (2011) finds the precautionary motive significantly increased its presence in general among the American share issuing companies in the period between 1971 and 2008.

Another reason for holding cash lies in ensuring flexibility, in other words, it concerns the objective of exploiting unforeseen opportunities. The latter is called the speculative motive, where firms keep speculative cash on their accounts to seize profit-making opportunities in the future, typically resulting from price volatility. What is more, speculative cash balances provide the firm with the possibility to purchase assets at attractive prices at any time (Michalski, 2009). In this respect, it may appear similar to the precautionary motive for holding cash, as both these motives deal with uncertainty, however, there is an important difference. Namely, the precautionary demand for cash arises from uncertainty in the timing of payments and receipts between the current and future purchase or sale of an asset, while the speculative motive relates to the uncertainty in interest rates (Whalen, 1966; Sprenkle, 1969).

An additional motive for holding cash identified by Miller and Orr (1966) is the compensating balance requirement. Namely, firms are required to hold a certain minimum amount of cash on their current accounts, where the amount is not allowed to fall below a certain predefined level, and is used as a form of compensation to the bank instead of the company paying the bank its service charges. More specifically, compensating balances are a form of an agreement between a commercial bank and a business customer in which the bank opens a line of credit in favour of the same customer and in return demands an average minimum cash balance to be maintained in the deposit account of the business customer.

Being able to benefit from trade discounts can also be considered a reason for keeping cash on hand. It is often the case that suppliers offer their clients the option of discounts on early payment of obligations, a situation which would easily be obtainable if there was extra cash deposited in the firm's account (Ehrhardt, 2006). Kling, Paul and Gonis (2014) conclude that cash holdings improve the access to trade credit by sending a positive signal to the suppliers regarding the ability to pay back the trade credit offered.

2.2 Implications of holding cash

Holding cash has its implications, in the form of both benefits and costs. The two main benefits of having cash on hand are tightly linked to the two main motives for holding cash, i.e. the transactions and precautionary motive respectively. With regard to the former motive, it is by holding cash that the firm avoids transaction costs necessary to raise funds for making payments, it avoids the trouble of liquidating assets, issuing debt and/or equity, renegotiating existing financial contracts or cutting dividends (Opler et al., 1999; Ozkan & Ozkan, 2004). Relating to the latter of the two motives, by keeping cash in the company account, the company secures liquid assets to finance its operations or favourable investment projects in cases when other resources are limited, unavailable or too costly to acquire. In other words, cash holdings do not only reduce the possibility of financial distress and the costs associated with it, but also improve the position towards desired investment activities and minimize the costs of being dependent on external funds (Faulkender & Wang, 2006; Gill & Shah, 2012; García-Teruel & Martínez-Solano, 2008). In the light of the foregoing, benefits of cash holdings are especially emphasized in financially constrained firms, i.e. firms facing difficulties in obtaining external financing. Denis and Sibilkov (2009) state that constrained firms place higher value on cash holdings for two reasons, the first of them being (i) because cash holdings enable constrained firms to increase investment, and the second one (ii) because the marginal profitability of an investment project is higher for the constrained firms compared to the unconstrained ones.

The costs associated with holding cash include among others lower rates of return, possible tax disadvantages and agency costs of free cash flow. The most obvious cost of holding cash arises from the fact that cash generates lower return compared to other investments of the

same risk (Dittmar et al., 2003). Consequently, by holding on to its cash, the firm forgoes more productive investments and thus incurs opportunity costs of not investing in some other income earning assets (Whalen, 1966; García-Teruel & Martínez-Solano, 2008). Another view on the opportunity costs of cash provided by Almeida et al. (2004) is that greater cash holdings necessitate reductions in existing, profitable investment projects.

Tax disadvantages might occur as a result of a higher corporate tax rate compared to the personal tax rate levied on interest income. Taking that into account, investors are in a more prosperous position if they hold on to the excess cash instead of the firm (Faulkender & Wang, 2006). In a different view provided by Foley, Hartzell, Titman, and Twite (2007), the American multinationals face tax costs associated with repatriating foreign income which is why they choose to leave the cash abroad and instead accumulate foreign cash holdings in their foreign affiliates.

Holding higher levels of cash in the firm can nevertheless be a trigger for agency costs of managerial discretion due to conflict of interest between shareholders and managers. Namely, managers have the incentive to accumulate cash and channel it for purposes that might be damaging or disadvantageous to the interests of shareholders. This is emphasized especially in cases when the firm generates large free cash flows, defined as "cash flow in excess of that required to fund all projects that have positive net present values when discounted at the relevant cost of capital" (Jensen, 1986). In the presence of free cash flows in firms where ownership and control are represented by two distinct bodies, managers might be inclined to hold higher levels of cash on the account of several possible reasons, some of which may be (i) to reduce company risk, or (ii) to pursue their own personal objectives and interests, (iii) to avoid making payouts to shareholders and instead keep the cash in the company. On the contrary, the situation is different in small and medium-sized companies where management and control generally coincide, thus making conflicts among them practically non-existent or seldom (García-Teruel & Martínez-Solano, 2008; Garrod, Kosi & Valentinčič, 2008; Kosi & Valentinčič, 2013; Szczesny & Valentinčič, 2013).

2.3 Empirical studies on determinants of cash holdings

As mentioned in the previous paragraph, the majority of studies on cash holdings deals with the question of determining their factors in the setting of large publicly traded companies, while only a few papers deal with the problem of determinants of cash holdings in private firms and even fewer focus on small and medium-sized businesses (SMEs). The first to fill that void is Faulkender (2002), who studied the cash policies of small businesses and discovered that costs of financial distress and information asymmetries play a significant role in determining the cash positions of American small firms. Among the latter, higher cash balances are found with firms which expect to encounter difficulties in obtaining external funds in the future, in firms which conduct more research, as well as in higher leveraged firms, together providing evidence for the precautionary motive. The last result of the study is however contrary to the finding of Opler et al. for large public companies

(1999), suggesting important differences in the relative costs and benefits of cash balances for these two groups of companies. Furthermore, Faulkender (2002) reasserts the economies of scale in holding cash by observing that cash holdings decrease with firm size, a factor previously established for large public companies only.

In a subsequent study conducted on a sample of Spanish small and medium-sized firms, García-Teruel and Martínez-Solano (2008) show that these firms maintain a target level of cash which is higher for firms with better growth prospects and higher cash flows. In contrast, this target level is lower in times of higher interest rates, increased bank debt and higher liquidity. Interestingly, SMEs demonstrate a higher speed of adjustment towards their optimal cash levels compared to large firms. The reason might lie in the fact that SMEs are subject to greater information asymmetries and agency problems related to debt compared to larger firms, thus the costs of being further away from the optimal cash levels are higher for them as well.

Results similar to the above ones are reported and developed further by Pastor and Gama (2013) by adding the relationship with banks and debt structure as significant factors which influence the cash holdings of Portuguese SMEs. The negative impact of bank relationship on the amount of cash held suggests that maintaining close contact with banks helps lessen the information asymmetry problems regarding the use of financial debt, which is more emphasized in SMEs. Furthermore, long-term debt is associated with lower cash holdings, in this respect giving support to the transaction motive.

Orens and Reheul (2013) report that CEO demographics play an important role in structuring the liquidity policy in Belgian SMEs. Their findings suggest that CEOs who are longer tenured, older and experienced in one industry only, place more emphasis on the precautionary motive and are less concerned with the opportunity cost of cash, which is why they prefer higher cash holdings compared to shorter tenured, younger and diversely experienced CEOs.

Bigelli and Sánchez-Vidal (2012) study the factors that determine the cash holdings of Italian private firms which coincide mainly with the ones of public firms. Similar to Opler et al. (1999), they show that significantly larger cash positions are found in smaller and riskier firms, while less cash is held by firms with more net working capital, viewed as its substitute. In the same vein, lower cash levels are found in firms with a higher proportion of bank debt, as also reported by Ferreira and Vilela for large public European Monetary Union companies (2004). In addition, Bigelli and Sánchez-Vidal (2012) note that firms facing longer cash conversion cycles, lower financing deficits and lower effective tax rates hold significantly higher levels of cash.

Gao, Harford and Li (2013) conducted a large sample comparison of cash policies between public and private American firms to find that private firms hold approximately half as much cash compared to public firms, owing to the greater agency problems present in

the latter group of firms. In contrast, Hall, Mateus and Bezhentseva Mateus (2014) find the opposite situation when they compare public and private firms in Central and Eastern Europe. They find that privately held companies maintain higher levels of cash, most probably due to the precautionary motive. As private firms have limited access to capital markets, they hold on to higher cash levels as a buffer against future financial distress.

2.4 Research questions

The motives and implications for holding cash are the starting point in devising the research questions of this study. In addition, the hypothesis development rests on a number of previously established explanations on the level of cash held in companies. The following paragraphs elaborate on the firm characteristics which have already been recognised as determinants of cash holdings in previous literature, and are further complemented in the survey by introducing certain novel explanatory variables.

Firm size has been determined in a considerable amount of research as a significant factor that affects the cash level. As there are transaction costs related to raising funds from external sources, which are fixed no matter the amount borrowed, it is assumed that there are economies of scale in raising funds (Faulkender, 2002). It is therefore relatively costlier for smaller firms to obtain funds from external sources, which can be a cause for retaining more cash in their accounts. In the case of small and medium-sized companies, several other factors related to their size need to be considered, as indicated by García-Teruel and Martínez-Solano (2008). Namely, SMEs are subject to more serious information asymmetries, face more financial constraints and are more susceptible to financial distress, all of which lead to fixed costs relatively higher for smaller firms than for the large ones. As a consequence, an inverse relationship between size and cash holdings is expected, taking into account both the transactions and precautionary motives.

Another firm characteristic influencing the amount of cash holdings is the cash flow generated by the company. There are two opposing explanations regarding the effect of the cash flow magnitude on cash levels. According to the financing hierarchy model presented by Myers and Majluf (1984), firms with high cash flows will hold more cash because they prefer to fund profitable investment projects with internally generated funds rather than raising external capital due to information asymmetries. This is contrary to Kim et al. (1998), who see a negative relation between cash flow and cash holdings in the sense that cash flow presents a ready source of liquidity. Therefore, if the transaction motive prevails, we hypothesize that higher cash flows lead to lower cash levels. On the other hand, where the precautionary motive is the main cash decision driver, we hypothesize a positive relation between these two variables.

The speculative motive brings about the question on how growth opportunities influence the level of cash retained in the company's accounts. If a company foresees profitable investment projects, then it will do its best not only to avoid cash shortages, but also to

have enough resources to fund those projects when the moment to invest comes. This is even more emphasized for small firms as their access to external financing is more limited and can also be assigned to the precautionary motive. For this reason, it is expected that stronger growth opportunities result in higher cash holdings, as shown in various empirical studies (Opler et al., 1999; Ferreira & Vilela, 2004; Ozkan & Ozkan, 2004).

Leverage can be considered as an indicator of a firm's ability to generate external funds, but it can also be seen as a cash substitute. A significant negative effect on the cash holding on the United Kingdom SMEs is documented by Belghitar and Khan (2013). Since debt can serve as an alternate source of liquidity for firms with access to borrowing capacities, an inverse relation between leverage and cash holdings is assumed, giving rise to the transactions motive.

A different channel through which debt is expected to manifest its influence on the level of cash is its maturity structure. Namely, when a company uses short-term financing, it is obligated to periodically renegotiate and renew its credit terms, thus facing refinancing risk (Ferreira & Vilela, 2004). Consequently, if the majority of debt in a firm is constituted of short-term borrowing facilities, it is expected that such firm will hold on to higher cash levels in order to secure a buffer against financial distress in case the loan is not prolonged (García-Teruel & Martínez-Solano, 2008). Considering the precautionary motive, we therefore expect shorter debt maturities to result in higher cash holdings and vice versa, i.e. longer maturities to result in lower cash levels.

Petersen and Rajan (1994) report that maintaining a close relationship with financial institutions brings benefits to the borrower as it increases the availability of credit. They also find a small piece of evidence that building relationships with lenders reduces the price of credit. This might come as a result of mitigating the informational opacity and agency costs of debt by disclosing internal information, which is accumulated by lenders when relationships last longer. These findings are further corroborated by Nakajima and Sasaki (2016), who argue that bank-dependent firms accumulate cash to foster better relationships with banks. Considering these effects, it is assumed that stronger firm-bank relationships lead to lower cash levels, because they offer a certain financial buffer to the firm.

Net working capital can be considered as a cash substitute, in terms of bank lines of credit or certain non-cash liquid assets which can readily be converted to cash. In the case of small and medium-sized companies, this mostly applies to selling accounts receivable to a third party. As with all variables representing cash substitutes, a negative relation between net working capital and cash is expected, considering the transactions motive (Bigelli & Sánchez-Vidal, 2012).

Another factor that can affect the liquidity of the firm is the cash conversion cycle. This measure expresses the number of days it takes for a company to convert the resources

invested in inputs into cash. The longer the cash conversion cycle, the longer the liquid assets are tied up in operations. Taking into account the precautionary motive, we would expect that companies with longer cash conversion cycles, that is, with a weaker ability to generate cash from ongoing operations, will exhibit higher cash balances. Bigelli and Sánchez-Vidal (2012) show supporting evidence of this among Italian SMEs.

One of the novel determinants to be tested in this empirical analysis is the requirement for compulsory retirement benefit contributions. According to the Slovenian pension system, employers are obliged to pay certain prescribed amounts as mandatory benefit contributions to the Institute of Pension and Invalidity Insurance of Slovenia (Pension and Disability Insurance Act, 2012, Official Gazette of the RS, No. 96/2012 and the subsequent amendments; Social Security Contributions Act, 1996, Official Gazette of the RS, No. 5/1996 and the subsequent amendments). The literature provides evidence that legally prescribed retirement contributions have negative impact on firm liquidity, especially in the case of financially constrained firms, a characteristic common to small private companies (Phan & Hedge, 2013; Rauh, 2006). Based on the above, the requirement for mandatory pension insurance is expected to demonstrate a negative impact on cash balances. On the other hand, the literature suggests that financially constrained firms pose positive cash flow sensitivities of cash due to the precautionary motive (Almeida et al., 2004). Therefore, a positive relation between these obligations and cash levels is expected.

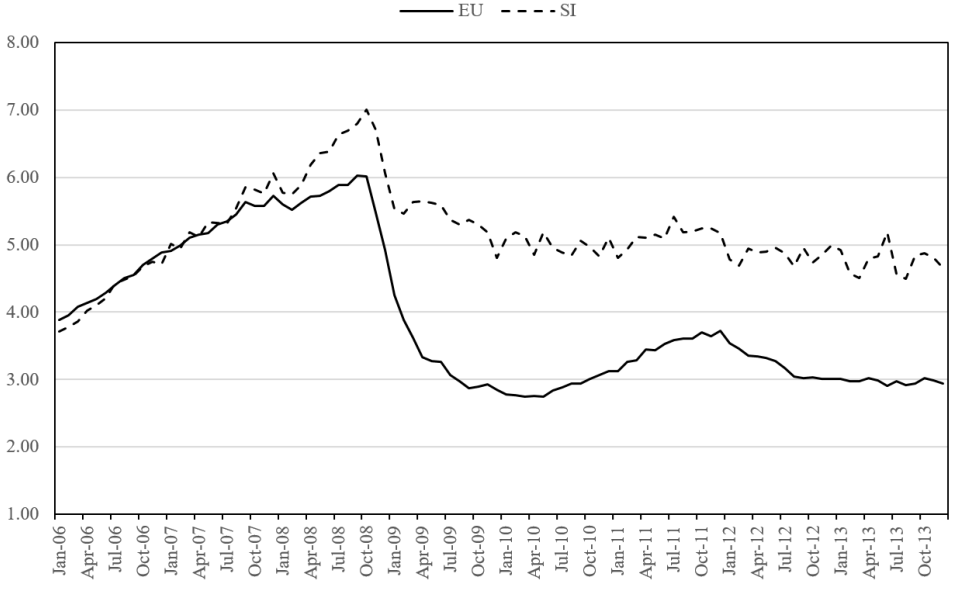
The next determinant introduced in the research is the exports volume. It has been shown that more liquid companies are more likely to export (Greenaway, Guariglia and Kneller, 2007). Looking at this relationship from the opposite side, the question arises whether a reciprocal effect of export activities on firm's liquidity exists. If the company is capable of generating cash from ongoing operations, then the need for precautionary cash accumulation is lower and we can assume a negative relation between sales generated abroad and cash holdings.

The research paper tests the relationship between cash levels and profitability, which has seldom been used in previous studies on determinants of cash holdings (e.g. Faulkender & Wang, 2006; Kling et al., 2014). There can be two channels through which a causal connection might be expected. The first causal relation is expected because profitability is considered a proxy for the operating performance of a company. In such case, it can be assumed that more profitable, that is more operationally efficient companies are more capable of internally generating cash. Therefore, it might be anticipated that higher profitability is associated with lower cash levels as the precautionary demand is lower. The second channel relates to cash being the least profitable liquid asset associated with opportunity costs, which might negatively influence a firm's profitability, making the company opt for lower levels.

The study also investigates the impact of interest rates on the amount of cash maintained in a company. The sample is constructed in a way that the years before and during the

recent financial crisis are included with the purpose to study the influence of the recent low interest rate environment. Figure 1 shows the movement of the composite cost-of-borrowing indicator which combines Monetary financial institutions' (MFIs) interest rates on all loans to corporations (European Central Bank, 2013) in the Euro zone and Slovenia in the period preceding and during the economic downturn. It is evident from Figure 1 that after the peak, reached just before the outburst of the financial crisis, the generally low level of interest rates persists throughout the sample period used in the research.

Figure 1. *Composite Cost of Borrowing Indicator in Eurozone and Slovenia over the sample period, 2006-2013*



Source: European Central Bank Statistical Data Warehouse

In such an environment, where funds from external sources are more affordable and cash deposits bring even lower earnings, it would be expected that firms reduce their cash holdings. On the other hand, the overall economic uncertainty accompanied by the reluctance of banks to grant loans might have a prevailing impact and drive companies to hold higher levels of cash as a precaution. Campello, Graham and Harvey (2010) report that financially constrained firms in the United States, Europe, and Asia were forced to reduce their cash holdings by sizeable amounts during the crisis, while the unconstrained firms' cash levels remained unaffected. Song and Lee (2012) identify a systematic change in the cash holding policies of East Asian firms, caused by the crisis of 1997-1998. They determine that the cause for the long-term increase in the demand for cash is a result of the precautionary motive in that these firms become more conservative in investing and more sensitive to cash flow risk. Sun and Wang (2015) find evidence of corporate

precautionary savings during the financial crisis. They report a decrease in cash holdings among constrained and unconstrained firms in the first year of the crisis when the sources of external finance are tightened, and an increase in holdings afterwards when the precautionary demand prevails. It is therefore unclear at this point whether an opposite or a correlated relationship between interest rates and cash holdings is to be expected.

3 METHOD

3.1 Sample and variables definition

This study uses financial data on Slovenian small and medium-sized companies (SMEs) for the years 2006-2013 from the Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES). AJPES maintains a central database, which publishes financial information on all business entities based on the territory of the Republic of Slovenia, derived from their annual reports and other corporate data, according to Article 11 of the Companies Act (Official Gazette of the RS, No. 65/2009, and the subsequent amendments) and Article 71 of the Payment Transactions Act (Official Gazette of the RS, No. 110/2006, and the subsequent amendments).

The period between the years 2006 and 2013 is primarily chosen to gauge the effects of the financial crisis on the cash policies of the Slovenian SMEs. Even though data are available for the years before 2006, they are excluded from the analysis in order to achieve consistency and comparability among the financial statements across the stated years. Slovenia revised its accounting standards which are effective as of January 1st 2006.[3]

What SMEs are is defined by the EU recommendation 2003/361. In accordance with the latter, an SME is a company that meets the following main criteria: a) has less than 250 employees; b) realizes an annual turnover of less than or equal to EUR 50 million; and c) its balance sheet assets are less than or equal to EUR 43 million. The initial sample is the set of all the Slovenian SMEs provided by AJPES.

The initial sample was refined prior to analysing the collected data by applying several criteria. First, financial firms were excluded. Then, firm-year observations with missing values or errors in the accounting data were eliminated. The variables required to be positive are assets, sales and equity. To minimize the effect of outliers, 1% of the extreme values of the variables for cash, cash flow magnitude, leverage, liquidity, cash conversion cycle, profitability and growth were dropped. This left an unbalanced panel of 27,573 unique firms with an average of 6.2 years per company, leading to an aggregate sample of 170,220 firm-year observations. The sample is made up of 24% wholesale and retail trade companies, 22% companies involved in professional, scientific and technical activities, 17%

3 See Valentinčič, Novak & Kosi (2017) for a detailed overview of the historic development of accounting standards in Slovenia, including an empirical investigation of the properties of accounting constructs.

manufacturing companies, 11% transporting companies, with the rest of the companies dispersed.

The dependent variable *CASH*, expressing the level of cash holdings, is measured as the ratio of cash to total assets minus cash, as cited in Opler et al. (1999). Following their logic, the natural logarithm of the book value of assets is used as a proxy for firm size (*SIZE*). The ability of the firm to generate cash or the cash flow magnitude (*CF*) is presented by the ratio of pretax profit plus depreciation to sales. The variable for growth (*GROW*) is approximated by the ratio of sales generated in the current year to sales from the previous year. Following García-Teruel & Martínez-Solano (2008), the variable for leverage (*LEV*) is calculated as total debt over equity. The debt maturity structure (*DEBTM*) is defined as long-term debt over total debt. The financial statements available for this research provide information on short and long-term debt maintained with banks as two separate lines within the liabilities' side of the balance sheet. Therefore, to approximate the relationship with financial institutions, the ratio of total bank debt to total debt (*BANKR*) is used in the research.

Following Bigelli and Sánchez-Vidal (2012), the variable for liquidity (*LIQ*) is calculated as net working capital less cash divided by net assets. The cash conversion cycle (*CCC*) is the sum of the average inventory conversion period and the receivables collection period less the average payment period for accounts payable.

The financial data available for this research provide information on annual pension insurance costs, however, these include payments for both mandatory and voluntary pension insurance, while our aim is to test the effect of the mandatory part of the costs, as suggested by Phan and Hedge (2013). Nevertheless, the total expenses for pension insurance are very indicative of the amounts paid as mandatory, thus the ratio of total pension insurance costs to sales is used to approximate the variable for compulsory retirement benefits (*RET*). To test the robustness of the results, an alternative variable is used and that is the number of employees, considering that the impact of compulsory pension insurance on cash holdings might be effectuated through the number of people working in a company. The variable for the number of employees (*EMP*) is derived from the average number of employees based on hours worked in the accounting period.

To capture the relationship between export activities and cash levels and test the robustness of the regression results, two alternative variables are used: one variable expressing the magnitude of exports volume, calculated as revenues generated abroad over total sales (*EXPO*), and the other alternative being a dummy variable set to one for the firm-year observations where exports occur, and the value zero otherwise (*EXPOD*). Profitability is expressed as the profit margin (*PROFM*).

Interest revenues earned on bank deposits are not separately shown in the non-operating revenue section of the income statement, while interest expense on bank loans is a separate

line. Therefore, the interest expense to debt ratio is applied as an estimate of the interest rate a company is paying on its outstanding debt (*INT*) as is stated in the existing literature (e.g. Karjalainen, 2011).

The model for investigating the relation between cash holdings and the explanatory variables is specified as follows:

$$CASH = \alpha + \beta_1 SIZE_i + \beta_2 CF_i + \beta_3 GROW_i + \beta_4 LEV_i + \beta_5 DEBTM_i + \beta_6 BANKR_i + \beta_7 LIQ_i + \beta_8 CCC_i + \beta_9 RET_i + \beta_{10} EXPO_i + \beta_{11} PROF_i + \beta_{12} INT_i + \varepsilon \quad (1)$$

where i represents the firm and α the regression constant, while β_i (i = 1,...,12) stands for the regression coefficients and ε for the error term.

4 RESULTS

4.1 Summary statistics

Table 1 illustrates some of the main characteristics of the firms included in the sample. It reveals a quite dispersed ratio of cash to assets. While on average Slovenian SMEs hold 18% of cash relative to non-cash assets, the median firm holds approximately 5% in cash. This is much higher than the average 6% and 5% found in their Spanish and Portuguese counterparties respectively (García-Teruel & Martínez-Solano, 2008; Pastor & Gama, 2012). The sample is indeed made up of small entities considering that the mean and median firms have an asset base of approximately EUR 160,000 and they employ an average of about eight people. The firms are highly leveraged, with total debt 2.43 times their equity. Bank debt represents 16% of their total debt, which is mostly short-term considering that long-term debt represents only 18% of their total external financing. Table 1 also shows that the firms in the sample are not very export oriented, with their exports volume making up only 10% of total revenues. Finally, the figures clearly show weak operating efficiency and performance of Slovenian SMEs, turning only 1.3% of revenues into profit.

Table 1: *Descriptive statistics of variables for the 2006-2013 sample (pooled)*

	Observations	Mean	25th Percentile	Median	75th Percentile	Standard Deviation
CASH	170,220	0.1806	0.0081	0.0471	0.1777	0.3580
SIZE	170,220	11.9983	10.7324	11.9271	13.1902	1.7889
CF	170,220	0.0706	0.0195	0.0563	0.1180	0.1338
GROW	170,220	1.1448	0.8590	1.0164	1.2103	0.6881
LEV	170,220	2.4327	0.3867	1.1711	2.9761	5.9372
DEBTM	170,220	0.1820	0.0000	0.0000	0.3284	0.2615
BANKR	170,220	0.1582	0.0000	0.0000	0.2729	0.2384
LIQ	170,220	0.0346	-0.1364	0.0658	0.2925	0.4534
CCC	170,220	-47.3178	-79.0131	-4.8459	54.4380	301.5106
RET	170,220	0.0171	0.0039	0.0122	0.0241	0.0199
EMP	170,220	7.6665	1.0000	2.2000	6.2000	18.1670
EXPO	170,220	0.1007	0.0000	0.0000	0.0325	0.2378
PROFM	170,220	0.0127	0.0018	0.0156	0.0514	0.1228
INT	170,220	0.1132	0.0000	0.0000	0.0408	7.1642

Note: ***CASH*** is the ratio of cash to total assets minus cash. ***SIZE*** is the natural logarithm of total assets. ***CF*** is the ratio of pretax profit plus depreciation to sales. ***GROW*** is the ratio of sales in the current year to sales from the previous year. ***LEV*** is total debt over equity. ***DEBTM*** is the ratio of long-term debt over total debt. ***BANKR*** is the ratio of total bank debt to total debt. LIQ is net working capital less cash divided by net assets. ***CCC*** is the sum of the average inventory conversion period and the receivables collection period less the average payment period for accounts payable. ***RET*** is the ratio of total pension insurance costs to sales. ***EMP*** is the average number of employees based on hours worked. ***EXPO*** is the ratio of revenues generated abroad to total sales. ***PROFM*** is net income over sales. ***INT*** is interest expense to debt ratio.

Table 2 reports bivariate Pearson's correlation coefficients of the variables. Overall, the correlations between the variable CASH and the explanatory variables show the expected relation directions, except for the variables for the cash conversion cycle, employees and profitability margin respectively. Furthermore, the correlation between CASH and EXPO is not statistically significant. The majority of bivariate correlations are not particularly high, except for the case of CF and PROFM with a correlation coefficient of 0.78.

Table 2: *Correlation matrix*

	CASH	SIZE	CF	GROW	LEV	DEBTM	BANKR	LIQ	CCC	RET	EMP	EXPO	PROFM
SIZE	-0.240**												
CF	0.010**	0.140**											
GROW	0.036**	-0.061**	0.071**										
LEV	-0.083**	0.143**	0.013**	0.052**									
DEBTM	-0.209**	0.325**	0.177**	-0.021**	0.130**								
BANKR	-0.240**	0.384**	0.078**	-0.048**	0.118**	0.463**							
LIQ	-0.160**	0.090**	0.099**	-0.054**	-0.051**	0.036**	*-0.015***						
CCC	-0.040**	0.074**	-0.092**	-0.037**	-0.024**	0.028**	*0.081***	*0.316***					
RET	0.026**	-0.121**	-0.158**	-0.087**	-0.061**	-0.043**	*-0.037***	*-0.031***	*-0.184***				
EMP	-0.103**	0.501**	-0.010**	-0.027**	0.031**	0.080**	*0.187***	*0.025***	*0.047***	*0.052***			
EXPO	-0.003	0.212**	-0.003	0.033**	0.031**	0.022**	*0.045***	*0.027***	*0.047***	*-0.060***	*0.195***		
PROFM	0.078**	0.118**	0.780**	0.128**	0.020**	0.008**	*0.026***	*0.192***	*0.007***	*-0.155***	*0.026***	*0.030***	
INT	-0.007**	0.007**	0.004	-0.002	0.007**	0.006*	*-0.006**	*0.000*	*-0.001*	*-0.005*	*-0.001*	*-0.002*	*0.002*

* Correlation is significant at the 5% level. **Correlation is significant at the 1% level. (two-tailed).

Note: ***CASH*** is the ratio of cash to total assets minus cash. ***SIZE*** is the natural logarithm of total assets. ***CF*** is the ratio of pretax profit plus depreciation to sales. ***GROW*** is the ratio of sales in the current year to sales from the previous year. ***DEBTM*** is the ratio of long-term debt over total debt. ***LEV*** is total debt over equity. ***BANKR*** is the ratio of total bank debt to total debt. ***LIQ*** is net working capital less cash divided by net assets. ***CCC*** is the sum of the average inventory conversion period and the receivables collection period less the average payment period for accounts payable. ***RET*** is the ratio of total pension insurance costs to sales. EMP is the average number of employees based on hours worked. ***EXPO*** is the ratio of revenues generated abroad to total sales. PROFM is net income over sales. ***INT*** is interest expense to debt ratio.

4.2 Univariate analysis

The size of a firm is an important factor that influences different aspects of the firm, from its profitability, riskiness, to access to external financing and the like, all of which are expected to have a certain level of impact on the level of cash within a firm. Based on this, a univariate analysis was performed to establish whether significant differences exist between smaller and larger SMEs. The sample is put together according to the variable *SIZE* and is ranked in size-deciles. Table 3 reports the results for the characteristics of the 1st and 10th decile firms, based on which a significant difference between these firms can be established.

Table 3: *Characteristics of smaller versus larger SMEs*

	1st decile firms by size		10th decile firms by size		Mean difference	*t*-value
	Mean	Median	Mean	Median		
CASH	0.33941	0.13930	0.06425	0.01220	0.27516	66.9***
SIZE	9.01316	9.20019	15.25310	15.09172	-6.23994	-603.1***
CF	0.03025	0.03217	0.09148	0.06860	-0.06123	-39.37***
GROW	1.25795	1.02969	1.09911	1.02964	0.15884	19.31***
LEV	0.90324	0.41552	3.40767	1.63745	-2.50443	-39.26***
DEBTM	0.04009	0.00000	0.30076	0.25256	-0.26067	-108.30***
BANKR	0.02868	0.00000	0.32693	0.29828	-0.29825	-128.24***
LIQ	-0.07101	0.08815	0.08190	0.06151	-0.15291	-24.76***
CCC	-78.10286	-22.58997	-1.26703	26.64490	-76.83583	-22.46***
RET	0.02039	0.01096	0.01275	0.00954	0.00765	32.22***
EMP	0.93912	1.00000	37.28030	22.46500	-36.34118	-116.53***
EXPO	0.04509	0.00000	0.22438	0.04359	-0.17929	-64.64***
PROFM	-0.02157	0.00744	0.02820	0.02109	-0.04977	-34.67***
INT	0.02116	0.00000	0.09058	0.03867	-0.06942	-3.82***

Note: ***CASH*** is the ratio of cash to total assets minus cash. ***SIZE*** is the natural logarithm of total assets. ***CF*** is the ratio of pretax profit plus depreciation to sales. ***GROW*** is the ratio of sales in the current year to sales from previous year. ***DEBTM*** is the ratio of long-term debt over total debt. ***LEV*** is total debt over equity. ***BANKR*** is the ratio of total bank debt to total debt. ***LIQ*** is net working capital less cash divided by net assets. ***CCC*** is the sum of the average inventory conversion period and the receivables collection period less the average payment period for accounts payable. ***RET*** is the ratio of total pension insurance costs to sales. ***EMP*** is the average number of employees based on hours worked. ***EXPO*** is the ratio of revenues generated abroad to total sales. ***EXPOD*** is a dummy variable set to one for firm-year observations where exports occur, and zero otherwise. ***PROFM*** is net income over sales. ***INT*** is interest expense to debt ratio.
*** Difference significant at 1%.

Comparing the 1st and 10th decile firms in terms of size, a significant difference between the two can be observed. As expected, the results show that smaller firms have significantly higher cash holdings. In addition, these firms pose a lower level of overall leverage and

bank debt, which confirms that their higher riskiness limits the access to external sources. Furthermore, smaller firms are less liquid, as seen from the negative net working capital and cash conversion cycle respectively, which indicates that they do not pay their suppliers until payments from their customers are settled. Based on the results in Table 3, it can be concluded that despite the fact that smaller firms show higher growth, they are nevertheless less profitable and in the end generate lower cash flows.

4.3 Regression results

The nature of the data set, that is an unbalanced panel data, determined the application of the Fama-MacBeth method (Fama & MacBeth, 1973) in order to empirically estimate the model presented in section 3.1. The Fama-MacBeth regression approach is used to remove the problem of correlated residuals across time, an issue that might otherwise be present in panel data sets. If residuals are correlated, then the standard errors of the coefficient estimates can be biased, which in turn clouds the usefulness of the regression model. And this is the reason for the application of the Fama-MacBeth procedure. The latter consists of two steps, where in the first step, a cross-sectional regression is run for each time period. In the second step, the estimates for the parameters are obtained by averaging the coefficients of each cross-sectional regression. The time-series standard errors of the average coefficients are used to draw inferences. More specifically, the standard errors are calculated as the times-series standard deviation of the regression coefficients divided by the square root of the number of years (Fama & French, 2002).

In the continuation, in Table 4 the results of the Fama-MacBeth regressions are presented, using alternative proxies for some of the variables explained in the previous section with the purpose to evaluate the robustness of the regression results. The *t*-statistics are shown in brackets, while columns 1 and 2 show the results using the proxy for the mandatory retirement benefits expressed as the ratio of pension insurance costs to sales (*RET*) combined with the two alternatives for the export variable, namely exports as their ratio to sales (*EXPO*) and the dummy variable for the firm-year observations where exports occur (*EXPOD*). Columns 3 and 4 present the results using the variable for the mandatory retirement benefits approximated by the number of employees (*EMP*) with the same combination of the export variables. The results obtained with all four regression models are consistent. All variables are significant at the 1% level, except for the variable expressing the level of interest rates (*INT*) and the growth variable (*GROW*) which is statistically insignificant.

Table 4: *Determinants of cash holdings in SMEs*

	Predicted sign	1	2	3	4
(Constant)		0.6963*** *(30.41)*	0.6916*** *(27.99)*	0.7265*** *(28.74)*	0.7274*** *(27.04)*
SIZE	-	-0.0379*** *(-17.08)*	-0.0375*** *(-15.08)*	-0.0404*** *(-16.21)*	-0.0405*** *(-14.74)*
CF	+/-	-0.2062*** *(-16.38)*	-0.2070*** *(-17.30)*	-0.2054*** *(-17.10)*	-0.2048*** *(-17.79)*
GROW	+	-0.0038 *(-1.57)*	-0.0028 *(-1.24)*	-0.0042 *(-1.69)*	-0.0032 *(-1.39)*
LEV	-	-0.0026*** *(-18.12)*	-0.0026*** *(-17.84)*	-0.0026*** *(-18.50)*	-0.0025*** *(-18.02)*
DEBTM	-	-0.0803*** *(-24.58)*	-0.0808*** *(-23.28)*	-0.0778*** *(-22.26)*	-0.0777*** *(-21.00)*
BANKR	-	-0.2169*** *(-31.36)*	-0.2183*** *(-31.04)*	-0.2169*** *(-31.78)*	-0.2184*** *(-31.36)*
LIQ	-	-0.1561*** *(-8.76)*	-0.1562*** *(-8.79)*	-0.1553*** *(-8.65)*	-0.1554*** *(-8.67)*
CCC	+	0.00004*** *(6.21)*	0.00004*** *(6.31)*	0.00004*** *(5.52)*	0.00004*** *(5.64)*
RET	+	0.1893*** *(3.90)*	0.1895*** *(4.05)*	- -	- -
EMP	+	- -	- -	0.0004*** *(7.42)*	0.0005*** *(10.16)*
EXPO	-	0.0665*** *(16.25)*	- -	0.0639*** *(15.15)*	- -
EXPOD	-	- -	*0.0149*** *(5.58)*	- -	*0.0144*** *(5.22)*
PROFM	-	0.6117*** *(16.74)*	0.6124*** *(17.35)*	0.6099*** *(16.53)*	0.6102*** *(17.05)*
INT	+/-	-0.0012 *(-2.17)*	-0.0012 *(-2.17)*	-0.0012 *(-2.17)*	-0.0012 *(-2.17)*
R2		*0.145*	*0.143*	*0.145*	*0.143*
Observations		*170,220*	*170,220*	*170,220*	*170,220*

Note: ***CASH*** is the ratio of cash to total assets minus cash. ***SIZE*** is the natural logarithm of total assets. ***CF*** is the ratio of pretax profit plus depreciation to sales. ***GROW*** is the ratio of sales in the current year to sales from the previous year. ***DEBTM*** is the ratio of long-term debt over total debt. ***LEV*** is total debt over equity. ***BANKR*** is the ratio of total bank debt to total debt. ***LIQ*** is net working capital less cash divided by net assets. ***CCC*** is the sum of the average inventory conversion period and the receivables collection period less the average payment period for accounts payable. ***RET*** is the ratio of total pension insurance costs to sales. ***EMP*** is the average number of employees based on hours worked. ***EXPO*** is the ratio of revenues generated abroad to total sales. ***EXPOD*** is a dummy variable set to one for firm-year observations where exports occur, and zero otherwise. ***PROFM*** is net income over sales. ***INT*** is interest expense to debt ratio.

***Significant at 1%.

In Table 4, not only are the coefficients statistically significant, but what is more, in most cases they are also economically significant. One exception is the variable *GROW*, as due to its statistical and economic insignificance it does not allow drawing any conclusions about the relation between growth and cash holdings. It seems that growth opportunities do not play a significant role in deciding on the level of cash to be held in the Slovenian SMEs. To gauge the economic importance of the influence of the explanatory variables on the dependent variable, the principle of Kim et al. (1998) is followed. Namely, the economic impact is evident in the percentage change over the mean value of the dependent variable, which is the result of a one-standard deviation change in the explanatory variable, while all other values are equal.

The signs of the estimated coefficients are generally in favour of the expectations outlined in the previous section, thus supporting our hypothesis that the main motives behind the cash policies of Slovenian SMEs are the transactions and precautionary ones. The notable exceptions to our expectations are the coefficients of the variables representing exporting activities and profitability, which provide support for the speculative motive. With regards to the effect of exporting activities, the coefficients for these variables suggest exporting firms are more liquid and higher sales generated abroad lead to higher cash holdings. Viewed through the logic of the precautionary demand, if the company is capable of generating cash internally, then the need for precautionary balances is lower and should therefore lead to lower cash holdings, which is however contrary to our results. The fact that exporting firms maintain more cash might better be explained by the speculative motive. Namely, the presence of a firm on foreign markets may lead to more growth or investments possibilities. In order to be able to take advantage of positive investments, which are currently unkown, the companies instead decide to maintain higher cash levels in their accounts. The same implication is provided by the positive sign of the coefficient for profitability. Particularly, the results demonstrate that more profitable firms are more capable of generating funds, maintained in their accounts, internally. More profitable or more operationally efficient firms have higher probability to reap the benefits of positive investment opportunities, and this is the reason they hold on to their funds in order to be able to take on profitable projects once they arise. The variable *PROFM* is also the one with the most important economic significance, as an increase of one standard deviation leads to an average 41.5% increase in cash.

The estimated regression coefficient of the size variable implies that firm size does in fact matter in making a decision on the level of cash holdings. The coefficient for *SIZE* in this research is negative and statistically significant. A similar result is also found by Bigelli and Sánchez-Vidal for Italian SMEs (2012), and Pastor and Gama (2012) for Portuguese SMEs. The size of the coefficient suggests a substantial economic impact, as an increase of one standard deviation of *SIZE* produces a decrease in the cash held by between -37.1% and -40.1%. This finding indicates there are economies of scale in raising funds from external sources. Given that small firms suffer from severe exposure to informational asymmetries (Berger & Udell, 1998), they do not only face more severe borrowing constraints and higher costs of external financing (Kim et al., 1998), but are also more susceptible to financial

distress (Titman & Wessels, 1988). The listed characteristics can induce higher fixed costs of holding cash, where it is these relatively higher costs that prompt smaller firms to retain more cash in their accounts for transactions and precautionary reasons.

The negative sign of the *CFLOW* coefficients supports the idea that cash flow represents a ready source of liquidity, a finding contrary to the situation in Spanish (García-Teruel & Martínez-Solano, 2008) and Portuguese SMEs (Pastor & Gama, 2012), where firms show a preference for internally generated funds where information asymmetries exist. In our case, the ability to generate funds internally lowers the need for precautionary balances, meaning the firm's cash holdings are used for current transactions.

All variables related to debt provide support for their expected influence on cash holdings. The negative sign of the variable *LEV* implies that operating and financial debt can be an alternative source of liquidity, albeit one with a relatively small economic impact, as the increase of one standard deviation decreases the level of cash by an average -8.4%. Given that leverage can be viewed as a cash substitute and as a proxy for the firm's ability to generate external finance (Belghitar & Khan, 2013), we might conclude that these external resources are used for satisfying the transactions demand for liquid assets as well. The negative sign of *DEBTM* is in line with the hypothesis that when long-term debt prevails in the debt structure of a firm, the need for securing a financial buffer is less emphasized, thus firms tend to hold lower amounts of cash, a finding consistent with García-Teruel & Martínez-Solano (2008), and Pastor & Gama (2012). Looking at the other side of the coin, short-term debt financing means higher risk, such that the company which uses short-term finance has to renegotiate and renew its credit lines, which causes uncertainty and incurs costs. Therefore, a company chooses to retain more cash holdings in order to secure a certain buffer for precautionary reasons. Our findings are consistent with Kling et al. (2014), who observe a significant decline of short-term bank finance among United Kingdom listed companies, followed by an accumulation of cash. They explain this relationship by banks denying access to short-term finance, inducing companies to hold cash as an alternative funding source. Finally, the coefficient of the variable *BANKR* provides evidence that information asymmetries are reduced by maintaining a close relationship with banks. It thus increases the company's ability to generate external funds and reduces the precautionary demand for cash. As expected, firms with a higher ratio of bank debt to total debt hold lower levels of cash, which is also the case with Portuguese and Spanish SMEs. Furthermore, the economic importance of this variable is rather high, as an increase in *BANKR* of one standard deviation brings about a reduction in cash holdings of an average -28.7%, ceteris paribus.

Liquidity is one of the determinants with the highest economic significance resulting in a 39% decrease in the level of cash for an increase of one standard deviation in the variable *LIQ*. This supports strongly the fact that other liquid assets may be used as a substitute for cash, consistent with the findings of García-Teruel & Martínez-Solano (2008), Bigelli & Sánchez-Vidal (2012,) and Pastor & Gama (2012). By having cash substitutes at disposal, the company reduces its precautionary demand for cash and maintains lower levels.

The results obtained for the cash conversion cycle are very indicative of the precautionary behaviour of the SMEs in our sample, as we find that firms with longer cash conversion periods maintain higher cash holdings. From the positive effect of the length of the cash conversion cycle on cash levels, we might conclude that companies with weaker ability to generate cash from ongoing operations decide to keep higher cash balances, in order to hedge against uncertainty when cash turnover is low. Such results were obtained also for Italian SMEs (Bigelli & Sánchez-Vidal, 2012). The economic impact of this variable is relatively small, resulting in an average 7.2% decrease in cash levels for a one standard deviation increase in *CCC*.

Turning to the proxies for the compulsory retirement benefit contributions (*RET* and *EMP*), a positive influence on cash holdings is observed, providing further support for the precautionary motive. Contrary to the previous findings that legally required retirement contributions negatively influence the liquidity of a firm, the results of this research suggest that Slovenian SMEs hold higher cash levels associated with higher pension costs. We can say that the firms in our sample act prudently and cautiously in that they accumulate cash in order to be able to meet future known obligations. Nevertheless, the economic impact of this effect is rather small. An increase of one standard deviation of the variables *RET* or *EMP* results in an increase in cash balances by 2.1% and 4.7% respectively.

Finally, limited evidence is found to support the theoretical expectation for the effect of the recently changed interest rate climate on the cash amounts held by companies. The coefficient's sign is negative, suggesting that in the period of falling interest rates, i.e. more affordable external financing and lower earnings on deposits, firms are inclined to increase their cash holdings, presumably due to precautionary reasons. This is partially in line with the finding of Sun and Wang (2015) who observe a decline in cash holdings, but only in the first year of the crisis, after which cash holdings resumed growth. The relation between interest rates and cash holdings is, however, not statistically significant and even if it were, its economic impact would be insignificant.

5 ROBUSTNESS AND ADDITIONAL TESTS

In order to evaluate the robustness of our results, additional analyses are conducted. For the sake of brevity, the tabulated regression results of many of these analyses are not presented in this paper, but are instead available directly from the authors upon request.

Our attention is first turned to the interest rate environment and its relation to cash holdings. As outlined in section 2.4, one of the objectives of this study is to analyse the impact of the changes in interest rates on the level of cash held. The effect is observed based on the average cross-sectional coefficients that span the period before, during and after the global financial crisis, which can average out their effect. Therefore, a subsample analysis is conducted by splitting the sample into different time periods, namely (i) pre-crisis period between the years 2006 and 2008, (ii) crisis period between the years 2009 and

2012, and (iii) after-crisis period in the year 2013. Pooled cross-section regression analyses for each period are performed with the same variable combinations as the original model.

Almost all regression coefficients have the same sign as the original regression model, with the exception of the coefficient for the variable *GROW*, which has a positive sign in three of the four regression models in the period before the crisis. Nevertheless, this variable is not statistically significant in this period, whereas it becomes significant at p = 0.05 in the period 2009-2012. The most noteworthy difference is the fact that the interest rate variable is not statistically significant in the periods before and after the crisis, while in the crisis period it approaches significance with an even smaller economic impact than in the original model. More precisely, an increase of one standard deviation of *INT* causes a decrease in cash holding of only -1.24% on average. The number of employees does not seem to have any effect on the small and medium-sized enterprises (SMEs) cash levels before the crisis, as this variable is statistically insignificant in the period 2006-2008. This is also the case for the third regression model in 2013, whereas the latter becomes significant at p = 0.05 level in the fourth model in 2013. Finally, as regards the export dummy variable, it proves not to be statistically significant in the 2013 regression models.

Next, the difference in cash management policies between zero bank debt companies and indebted companies is analysed in order to assess the robustness of the conclusions based on leverage related items. For that purpose, we define two subsamples based on the ratio of bank debt to total debt (variable *BANKR*), for which some descriptive statistics are presented and separate pooled cross-section regression analyses performed. As can be seen from Table 5, these two groups of companies differ mostly with regard to the amount of cash they bear and the number of employees they have. The results show that companies with zero bank debt keep 28% of their assets in cash and employ 4 people on average, while indebted companies keep on average only 5% of their assets in cash and have around 12 employees.

Table 5: *Descriptive statistics of SMEs with zero and positive bank debt*

	Zero bank debt SMEs			SMEs with bank debt				
	Mean	**Median**	**Standard Deviation**	**Mean**	**Median**	**Std. Deviation**	**Mean difference**	**t-stat.**
CASH	0.28249	0.11342	0.44260	0.05665	0.01459	0.13349	*-0.22584*	*-147.97****
SIZE	11.28473	11.17303	1.62291	12.86594	12.80840	1.58645	*1.58121*	*202.52****
CF	0.06548	0.05178	0.14495	0.07678	0.06067	0.11854	*0.01130*	*17.70****
GROW	1.17635	1.01601	0.77031	1.10653	1.01683	0.57013	*-0.06982*	*-21.46****
LEV	1.64323	0.67048	5.47078	3.39251	1.90638	6.32775	*1.74928*	*60.30****
DEBTM	0.09416	0.00000	0.21999	0.28885	0.23474	0.26803	*0.19469*	*161.50****
BANKR	0.00000	0.00000	0.00000	0.35051	0.31198	0.24193	*0.35051*	*401.55****
LIQ	0.04852	0.11747	0.54151	0.01772	0.02886	0.31384	*-0.03080*	*-14.65****
CCC	-67.01304	-13.31384	324.66207	-23.37291	4.81291	268.77488	*43.64013*	*30.34****
RET	0.01835	0.01269	0.02247	0.01555	0.01181	0.01604	*-0.00280*	*-29.92****
EMP	4.19438	1.50000	11.74231	11.88776	4.39000	23.04748	*7.69338*	*83.99****
EXPO	0.08876	0.00000	0.23393	0.11519	0.00000	0.24154	*0.02643*	*22.78****
PROFM	0.01060	0.01617	0.13697	0.01517	0.01502	0.10304	*0.00457*	*7.85****
INT	0.00603	0.00000	1.38635	0.24348	0.04615	10.55269	*0.23744*	*6.19****
Observations	93,398			76,822				

Note: Zero bank debt companies are defined as the companies with ratio of bank debt to total debt equal to zero. Positive bank debt companies are the SMEs with ratio of bank debt to total debt higher than zero. ***CASH*** is the ratio of cash to total assets minus cash. SIZE is the natural logarithm of total assets. ***CF*** is the ratio of pretax profit plus depreciation to sales. ***GROW*** is the ratio of sales in the current year to sales from the previous year. ***DEBTM*** is the ratio of long-term debt over total debt. ***LEV*** is total debt over equity. ***BANKR*** is the ratio of total bank debt to total debt. ***LIQ*** is net working capital less cash divided by net assets. ***CCC*** is the sum of the average inventory conversion period and the receivables collection period less the average payment period for accounts payable. ***RET*** is the ratio of total pension insurance costs to sales. ***EMP*** is the average number of employees based on hours worked. ***EXPO*** is the ratio of revenues generated abroad to total sales. ***EXPOD*** is a dummy variable set to one for firm-year observations where exports occur, and zero otherwise. ***PROFM*** is net income over sales. ***INT*** is interest expense to debt ratio.

*** Difference significant at 1%.

Most of the coefficients from the subsample regression analyses have the same sign as in the initial model, except for the negative sign of the variable *EMP* in zero debt *SME*s, and the positive sign of *GROW* together with the negative sign of *EXPOD* in indebted SMEs. What is interesting is that the variable *GROW* is statistically significant in both subsample analyses, however with a rather small economic impact and with an opposite

effect between the subsamples. Namely, it has a negative impact on cash holdings in zero debt SMEs, which is contrary to our expectations that future profitable investment opportunities urge companies to keep cash in their accounts to be able to fund them. Therefore, neither the precautionary nor the speculative motive are particularly strong in these companies. The situation is opposite with the SMEs that carry bank debt on their balance sheets, which show signs of precaution and possibly speculation by maintaining more cash in their accounts associated with sales growth. We also find that the variable *INT* is not statistically significant in any of the regression models. Therefore, we cannot make any inferences about the effect of the interest rate climate on cash holdings for both groups od SMEs. Furthermore, mandatory retirement benefit contributions do not seem to influence the level of cash in leveraged SMEs, as both *RET* and *EMP* variables are not statistically significant for this group of companies. On the other hand, the variable *RET* has a positive impact on the cash holdings in the SMEs with zero debt, while the higher number of employees is associated with lower cash holdings in these companies. This suggests that the number of employees might not be a good approximation of the requirements for mandatory retirement benefits. The negative impact of *RET* on cash holdings points to the precautionary motive, while the negative impact of *EMP* points to the transactions motive. Liquidity and profitability are again the determinants with the highest economic significance. Namely, an increase of one standard deviation in the variable *LIQ* or *PROFM* results in a decrease in the level of cash by 35% and an increase of 36% for the zero bank debt SMEs respectively, and in a decrease of 46% and an increase of 47% in the level of cash in the leveraged SMEs respectively.

Next, for the purpose of controlling micro companies, the sample is divided into two subsamples, one consisting of companies with zero or one employee, and the other one consisting of companies with more than one employee. The results are similar with the initial model, with minor exceptions only. The variables approximating mandatory retirement benefit contributions are statistically insignificant in three out of the four regression models for the micro companies. A possible explanation for this might be the fact that these are indeed micro companies and hence have very low expenditures related to mandatory benefit contributions. In the other group of companies, however, only the variable *EMP* is not statistically significant, which is another sign that it might not be a good approximation for mandatory retirement benefit contributions. In addition, exporting and non-exporting firms are analysed separately, nevertheless, a result similar to that of the Fama-MacBeth regressions is obtained, with just one exception and that is the negative sign of the variable for the number of employees in non-exporting firms.

Finally, industries are controlled for and a pooled cross-section regression analysis performed, using dummy variables at the two-digit industry classification code level. The Slovenian classification of economic activities is adjusted to the Statistical classification of economic activities in the European Community, abbreviated as NACE. These regressions lead to the same results as the Fama-MacBeth regressions, based on which it can be concluded that industry does not play an important role in the cash management policies of Slovenian SMEs.

6 CONCLUSION

The purpose of this study is to examine the determinants of cash holdings in small and medium-sized companies. In order to do so, a large sample of Slovenian firms is used. The panel data consist of 170,220 firm-year observations corresponding to 27,573 firms in the period between 2006 and 2013. Slovenia is a particularly interesting choice of country in which to examine the characteristics of SMEs, since they constitute the majority of all non-financial business entities in the territory of the Republic of Slovenia and provide a significant economic value.

In the research, it is observed that the cash policies of Slovenian SMEs are generally driven by the transactions and precautionary motive respectively, however, we also find evidence for the speculative motive. Our results show that smaller firms opt for higher cash holdings out of precaution and due to transaction needs, as there are economies of scale in raising funds from external sources. The precautionary demand for cash prevails in firms with longer cash conversion cycles and higher retirement benefit obligations, where higher cash balances are recorded. Firms that are facing poor cash turnover and higher expenditures tend to hold on to higher cash balances in order to secure funds for unexpected needs. In addition, when short-term debt dominates the debt structure of a firm, it causes uncertainty arising from the ability to prolong the loans. Consequently, such firms need more financial buffer and for that reason maintain higher cash balances.

On the other hand, firms that have cash substitutes at disposal, such as other liquid assets and debt, do tend to use them as such and thus keep lower cash balances in their accounts. Lower cash amounts are found in companies with higher cash flows as well. Keeping close relationship with banks reduces agency costs and information asymmetries among lenders and borrowers, which results in lower costs of external financing and better access to the latter. These companies, which are more capable of generating either internal or external funds, pose lower need for precautionary balances and use up their cash for transaction purposes. Little empirical support is found for the direct negative influence of the interest rate level on cash holdings, suggesting that the overall economic uncertainty accompanied with tightening credit conditions, might induce firms to increase their cash holdings, due to precautionary reasons.

The finding that exporting and more profitable firms hold more cash than others provides support for the speculative motive. These firms have a higher probability of taking advantage of positive growth or investment projects, so they decide to hold on to their funds in order to be able to seize profitable opportunities when they arise.

This paper contributes to the existing literature on cash holdings decisions on several grounds. First, it expands the scarce literature on the determinants of cash holdings in small and medium-sized companies, a sector of great importance for the economy in general. Second, it focuses on a large sample of Slovenian SMEs, a country where no

such research has been conducted so far. Third, it brings new evidence on the factors that influence the levels of cash by investigating so far untested determinants and by validating previous results. Lastly, it is the first paper that analyses the effect of the low interest rate environment on cash holdings of SMEs.

Even though this study makes a contribution towards better understanding of cash policies of SMEs, we acknowledge some limitations which we hope will serve as a prompt for future research. As the empirical investigation is based on a large sample of Slovenian SMEs, the study could only be generalized to firms similar to those included in our research. In order to be able to apply the findings of our research to SMEs in other countries, a comparison of their characteristics and cash policies would need to be conducted. Another possible direction for further research is that our empirical results show that SMEs hold large proportion of assets as cash. It would be interesting to examine the evolution of cash holdings in SMEs through time and the reasons thereof. Furthermore, it would be valuable to study the effect of cash holdings on SME performance, taking into account that SMEs are more financially constrained and have limited access to external finance.

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LONG-TERM AUDITOR-CLIENT RELATIONSHIPS: CONSCIOUS MISJUDGEMENTS OR UNCONSCIOUS BIASES?

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ABSTRACT: *The aim of our study is to shed light on auditors' cognitive drivers of bias inherent in long-term personal relationships with clients. We examine whether a long-term personal relationship invokes a conscious misjudgement because of a mutual long-term financial interest, or an unconscious bias invoked by affective motives and unconscious needs. The paper combines two theories, the first being the incentive based motivated reasoning (Kunda, 1990) and the second the need based motivation theory (McClelland, 1987). We analyse the problem with a two-player perfect-information sequential game within the framework of game theory, involving an accounting choice task. We find that the positive effect of a personal relationship on biased decision-making is mediated by a long-term financial interest rather than by an affective motive such as friendship. Unconscious needs are also found to influence subjects' decisions. In other words, the need for achievement and the need for power reinforce auditor independent opinion and help them resist the pressure from clients, whereas the need for affiliation is accentuated in a personal relationship and positively affects auditor bias. The study provides an original empirical investigation of the drivers of behaviour in the auditing setting, while its results indicate that both conscious financial incentives and unconscious needs influence subjects' decisions simultaneously.*

Key words: *auditing, personal relationship, financial incentives, unconscious needs, game theory*

JEL classification: M42, M48

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1 INTRODUCTION

Auditor independence is considered the most important characteristic of the audit profession due to its impact on the audit quality and confidence in financial reporting. The aim of the major reform in 2014 (Directive 2014/56/EU, Regulation No. 537/2014) is to improve statutory audits in the European Union by reinforcing auditor independence and auditor professional scepticism towards the management of an audited company. The new rules require audit reports to be more detailed and informative, and auditor work to be more closely monitored with strengthened audit committees. Most importantly, a mandatory rotation of auditors for public interest entities is introduced, requiring companies to retender their auditor every 10 years and what is more, change the auditor at least every 20 years.

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Despite the major reform, auditor independence remains a hotly debated issue by the European regulators, practitioners and the research community. The intent of the mandatory rotation of auditors is to address concerns about familiarity and self-interest threats between auditors and their clients, however, the threat of familiarity persists in the auditor-client relationship (European Commission, 2010).

Although acknowledging that the two directional goals, namely *financial incentives* and *personal relationship*, lead to biases, the so far research in auditing has downplayed the distinction between the two. In most papers, a personal relationship equals a long-term financial benefit (Hackenbrack and Nelson, 1996; Prentice, 2000; Kadous, Kennedy and Peecher, 2003; Blay, 2005; Kadous, Magro and Spilker, 2008). The first paper that simultaneously examines both incentives is the Moore, Tanlu and Bazerman (2010) study. While their experimental results do not confirm a significant effect of a personal relationship on auditor decision-making neither in the absence nor in the presence of financial incentives, the authors show that the subjects internalize their role of auditors and are unable to debias their decision in a different role (Moore et al., 2010).

Slapničar, Zaman Groff and Lončarski (2015) continue the investigation of a personal relationship by referring to a number of studies, explaining the development of affect[2] in a long-term relationship (e.g. Neuberg and Fiske, 1987; Bamber and Iyer, 2007; Nelson, 2009). Through strengthening the measurement of a personal relationship, they find significant effects of both financial incentives and the personal relationship on biased decision-making, suggesting that a personal relationship creates different bases for bias in the form of financial incentives. Furthermore, they report that the oversight risk significantly mitigates bias arising from financial incentive, whereas a personal relationship almost completely offsets this effect. Subjects in a personal relationship condition committing bias were in their study insensitive to oversight risk. The authors interpret this finding as an indication of bias that arises from affect.

Our study differs from the previous studies in that it focuses on the question whether a long-term personal relationship between an auditor and a client invokes deliberate misjudgement because of a conscious decision-making process to maximise financial interest, or unconscious bias due to affective decision-making which however does not serve exclusively to the maximisation of financial interest.

The analysis advances the incentive-based theory of motivated reasoning (Kunda, 1990) by shedding light on the controversy whether motivated reasoning is a conscious or unconscious cognitive process. According to Forgas (1995), there is little room for an affect in motivated reasoning, as it is strongly influenced by a directional goal if an affect and a financial incentive are incongruent. This is however not the case in a long-term

2 Affect is a generic term for a mood and emotion, the former indicating low intensity, enduring state without a clear cause, and the latter referring to a more intense, short lived state with a clear cause (Forgas, 1995, p. 41).

relationship between an auditor and a client, during which the two incentives become aligned.

External incentives such as financial goals and aroused affect do not entirely account for human behaviour, as another important driver of behaviour that needs to be considered is the *unconscious needs* (McClelland, 1985; Khandekar, 2012). According to the motivational needs theory, the unconscious needs permanently influence one's behaviour (McClelland, 1987). We therefore complement our analysis of incentives by the unconscious needs and look at how incentives and the needs combine in pursuing a goal. In particular, we hypothesise that the need for affiliation, i.e. the need to affiliate with people, the desire to please them, is likely to positively affect the auditor's support of the client's preferences, particularly in a long-term personal relationship with the client. The need for achievement, i.e. the need to excel in results, and the need for power, i.e. the need to have influence, power, and control over others, are on the other hand assumed to induce auditor independence in a way that the auditor resists the client's preferences.

To analyse these questions, we conducted a between-subjects randomized two-period sequential game that involves an accounting choice task. We use a two personal relationship versus non-personal relationship by one factorial design with randomly distributed covariates. Thus, a total of 190 subjects are included in the experiment, in which the selected subjects assume the roles of the auditor and the client respectively. The results of the experiment confirm that a personal relationship has a significant positive effect on the auditor's decision in favour of the client. This is evident in that in order to support the client's preferences, auditors in a personal relationship significantly more often give up on their short-term outcome to build up a long-term relationship.

The study is an original empirical investigation of the drivers of decision-making in an auditor-client setting. The results of our study contribute to the findings in prior literature by showing that in the heart of biased decision-making there lies a long-term financial benefit for both parties. We establish that unconscious bias arises from unconscious needs, rather than from the affect created in a long-term relationship, however, a personal relationship seems to accentuate the need for affiliation. The paper contributes to a body of literature investigating biases in auditor decision-making, building on the motivated reasoning and the motivational needs theory respectively. Understanding the underlying cognitive processes created by various incentives and the needs conduces importantly to the insight into the effectiveness of different regulatory measures intended to alleviate any threat in auditor independence. Such evidence can be an addition to the recent regulatory discussions on the measures against auditor dependence.

2 THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

Generally, people are prone to behaviours that offer positive incentives and are averse to behaviours associated with negative incentives (Bernstein and Nash, 2008). According to Johnstone, Sutton and Warfield (2001), auditor decisions may be trimmed down to direct and indirect incentives. The direct incentives include an actual or a potential financial benefit. The adverse influence of financial incentives on the auditor's decision-making in a long-term relationship has so far been extensively examined and the findings are largely consistent (DeAngelo, 1981; Farmer, Rittenberg and Trompeter, 1987; Mednick and Previts, 1987; Lord, 1992; Blay, 2005; Moore, Tetlock, Tanlu and Bazerman, 2006; Moore et al., 2010). The indirect incentives, on the other hand, derive from circumstances which make it difficult for the auditor to maintain objectivity. What is more, a long-term personal relationship between an auditor and a client has been found to create situations in which the auditor is hesitant to act with the professional rigor and is unwilling to impair a relationship with the client (Johnstone et al., 2001).

According to the theory of motivated reasoning (Kunda, 1990), direct and indirect incentives create directional goals that lead to cognitive biases. Whilst there is little dispute that an economic dependence has influenced the auditor's decision-making, more controversy surrounds the personal relationship. Knap and Knap (2012) suggest that exaggerated desire to please the client is not regarded as a cognitive bias, but as a common symptom of impaired auditor independence, whereas Neuberg and Fiske (1987), Moore et al. (2010) and Slapničar et al. (2015) propose that a personal relationship creates unconscious, affective bias.

Kunda (1990) and Blay (2005) suggest that information processing and making a decision invoked by a directional goal occur unconsciously. There are however two indications that bias may occur deliberately, the first one being that bias takes place only if the choices are ambiguous. In such a setting, the decision-makers are able to support the choice with seemingly objective arguments, although if the opposite directional goal is present, they may make a case for precisely reverse arguments. The second indication is the empirical finding, indicating professionals are susceptible to a high practice risk or a reputation impairment. Such a condition severely alleviates biased decision-making (Kadous et al., 2003; Blay, 2005; Kadous et al., 2008, Hope and Langli, 2010). According to Forgas (1995), motivated reasoning involves highly predetermined and directed information search patterns that serve to a pre-existing goal. This judgmental strategy is one of the least susceptible strategies to the influence of affect. In case the prevailing affective state of the decision-maker is incongruent with the goal, the affect is unlikely to influence judgements. This is however not the case when the affect is aligned with the goal.

In psychology, cold cognition has become increasingly acknowledged as rather the exception than the rule, and this affect is involved in almost every decision (Forgas, 1995). A long-term personal relationship may arise feelings of familiarity, what is more,

several studies report that familiarity in a long-lasting personal relationship induces the auditor's identification with the client's interest (Johnstone et al., 2001; Bamber and Iyer, 2007; Nelson, 2009; Ye, Carson and Simnett, 2011). Berscheid, Graziano, Monson and Dermer (1976) and Neuberg and Fiske (1987) show that outcome dependency influences impression formation, in other words, it increases liking somebody which may in turn lead to bias decision-making that is no longer based on utility maximisation. The fact that an incentive arising from the personal relationship with the client is congruent with the financial interest of the auditor, blurs the distinction of which incentives are at work in a long-term relationship.

If familiarity explains the choices arising from a personal relationship, this suggests that a personal relationship creates an affective (unconscious) directional goal beyond a financial incentive. If, on the other hand, the essence of a personal relationship is in the development of mutual trust that serves long-term financial interest of both parties, it may be considered a conscious motive. To investigate this question, we hypothesise:

H1: Familiarity mediates a positive effect of a personal relationship on the auditor's choice in the client's interest.

H2: Financial interest mediates a positive effect of a personal relationship on the auditor's choice in the client's interest.

The stimulus for affective reaction may come from the external world or from within the individual. Khandekar (2012) argues that individuals do not only behave in response to goals such as rewards and punishments but are also driven by their internal needs. Motivation theories differ along the line whether external stimuli or internal factors drive human behaviour. According to the most prominent need theorists, Murray, Maslow and McClelland (in Khandekar, 2012), the primacy of motivation lies with *internal* factors or needs. Needs may be innate (instinctual), learned at a very early age or acquired later over the course of life, and are relatively stable characteristics of a personality. Nevertheless, the intensity of needs changes with respect to the engagement of an individual to satisfy a certain need.

Among various need theories we draw on the McClelland's (1987) classification of needs which seems to be most relevant to decision-making context in auditing. McClelland (1987) classifies human needs as the need for achievement, the need for power and the need for affiliation respectively.

People with a high *need for achievement* have a strong desire to excel, need to take personal responsibility and show successful task results, require to attain a high standard and to overcome obstacles. They strive to accomplish something difficult, to master people and ideas (McClelland, 1987). They do this as independently as possible. Their self-regard is

increased by the successfully accomplished exercise (after Murray, in McClelland, 1987). They prefer situations in which they have personal responsibility for the outcome and as McClelland and Boyatzis (1982) explain, they have a tendency to influence others to do well. An auditor with a high need for achievement may put objectivity in reporting before his or her financial interest. Nevertheless, a high need for achievement incorporates also the urge to conduct an audit up to high standards. Thus, we propose that this need is likely to help the auditor to resist the pressure from the client.

H3: The need for achievement negatively affects the auditor's choices in the client's interest.

The *need for power* represents the need and desire to have influence, power, and control over others. High need for power is mainly expressed by the competitive behaviour and an individual's tendency to maintain or increase their validity in others. People with high need for power are not only less susceptible to others, but also have desire to influence and control others (McClelland, 1987). For these reasons, we propose that this need is likely to lead the auditor to resist the pressure from the client and not act in his or her interest, regardless of their relationship.

H4: The need for power negatively affects the auditor's choices in the client's interest.

The *need for affiliation* reflects one's tendency to seek harmonious relationships, develop and maintain close personal relationships, do things with people, that is a need to feel accepted by other people and the desire to please others (McClelland, 1987). The need for affiliation is defined as *"a concern over establishing, maintaining, or restoring a positive affective relationship with another person or a group of persons"* (Heyns, Veroff and Atkinson, 1992). People with a high need for affiliation are considered as being less assertive, more obedient, agreeable and dependent on other people (McClelland, 1987). An auditor with a high need for affiliation may set maintenance of a positive relationship with the client before objectivity in reporting. An auditor with a high need for affiliation is therefore more likely to support the client's interest.

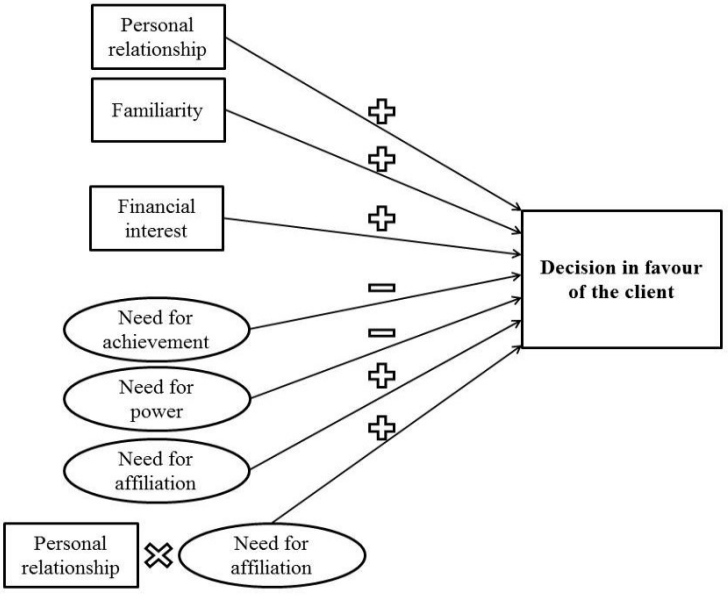
H5: The need for affiliation positively affects the auditor's choices in the client's interest.

The need for affiliation may become dominant in a relationship that embodies familiarity. Thompson (1995) shows that even the most superficial affiliation in a relationship leads to an interpretation of ambiguous information in the desirable direction of the other person in the relationship. Based on the latter, we hypothesise that a personal relationship increases the effect of the need for affiliation.

H6: The positive effect of the need for affiliation is accentuated in a personal relationship.

In Figure 1 we present a conceptual model based on the proposed hypotheses.

Figure 1: *Conceptual model*



3 EXPERIMENTAL SETTING

Participants. To analyse the proposed model, we conducted a two-period choice-task experiment with 190 senior undergraduate (26%) and graduate (74%) students of the University of Ljubljana. To assure they are familiar with the accounting choice task, we recruited the students majoring only in accounting and finance. The selected students could earn compensation in the amount between EUR 0 and EUR 10, depending on their decisions. The average total compensation amounted to EUR 5.3 (SD = 2.1, range = EUR 0-10) for a one-hour participation, which approximately represents the average hourly rate of a student worker. The students' average age is 22.6 years (SD = 2.7, range = 20-47 years), 59% of them are female, and their average work experience, including part-time student work, is 3.6 years (ranging from 0 to 26). The subjects of the study, that is the students, were then randomly assigned the roles of auditors and clients respectively, and matched in pairs. However, as our analysis focuses primarily on the decision-making of auditors, we were left with 95 observable answers.

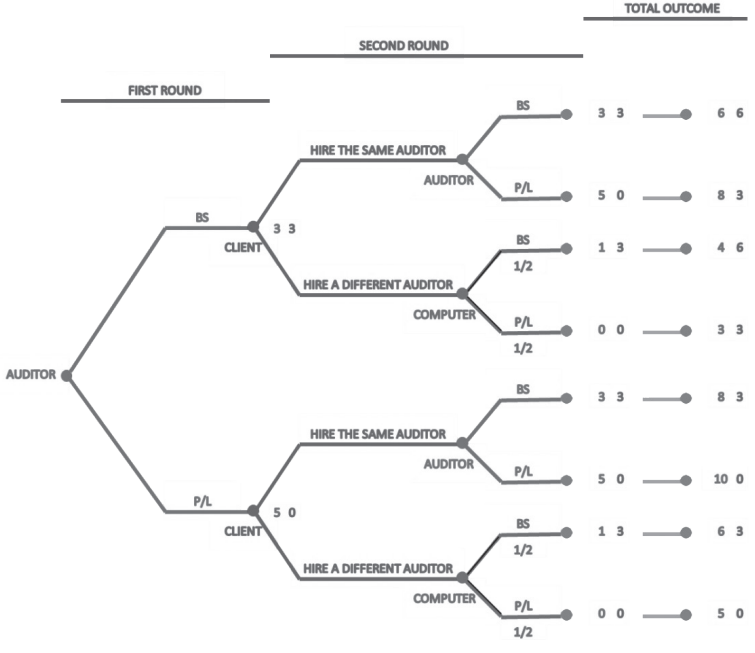
The subjects in the role of clients were given this role to create an atmosphere of a personal relationship in the client-auditor pairs in which they closely interacted. In addition, we made use of a real friendship between the participants who were given the roles of auditors

and clients as a proxy for familiarity which typically develops a the long-term auditor-client relationship. On the other hand, in a manipulated condition of a non-personal relationship where auditors were seated alone and paired with unknown clients, the clients were required to respond to the auditors' decisions after the first round of the experiment. In this way, auditors and their respective clients were able to communicate with each other though without any direct personal interaction.

Design. The experiment used in the study was designed within the framework of game theory (von Neumann and Morgenstern, 1944) as a two-player perfect information sequential game (Osborne, 2000). In game theory, this is a game with a strict order of play, in which players are aware of not only everything that happens prior to making a decision but also the financial consequences of the decision made.

In Figure 2, the design of the game and the auditors' possible decisions as well as rewards are presented using a decision tree.

Figure 2: *The decision tree*



Note: The auditor's possible decisions and the reward appear in red, the client's possible decisions and the reward appear in blue, and the random choice of the computer in the second round appears in green. Abbreviation BS denotes the auditor's choice of approving accounting of development costs of the product X as an intangible asset in the balance sheet (BS) of the client's company which is in the client's interest. Abbreviation P/L denotes the auditor's choice to approve accounting of development costs of the product X as an expense in the profit and loss account (P/L) of the client's company which is not in the client's interest but is more adequate in terms of accounting as it is based on more realistic predictions about future cash flow.

In the first round, the subjects in the role of auditors were presented with the task in which they had to approve accounting of development costs of the product X as an intangible asset in the balance sheet of the client's company or as an expense in the profit and loss account of the client's company. The clients seated with the auditors had the financial interest to persuade the auditors to support their preference for the development costs to be accounted for as intangible assets. That means the auditor needed to agree with rather optimistic predictions about the development of the product X and its future cash flows. The second alternative was based on more realistic predictions about future cash flows, requiring expensing the costs of development in the profit and loss account. Both alternatives were allowed by the International Financial Reporting Standards (IFRS), however, it was clear that the second alternative is more adequate, as in line with the theory of motivated reasoning, the decision at stake was ambiguous enough to facilitate directional goals to take place.

The auditor compensation scheme is designed in a way that enables the auditor to maximise the reward by not acting in the interest of the client. On the other hand, as the client's compensation is dependent on the company's profit, the client's compensation scheme is designed to make the client eager to convince the auditor to support their preference. In the non-personal relationship of the study, there was no communication between the auditor and the client, however, the auditor was aware that the client's reward is calculated based on the auditor's decision and what is more, that the client's decision of hiring the same auditor in the next round depends on the client's decision. Whenever the auditor chose the option not in the interest of the client, the auditor received EUR 5 as a fixed fee, while the clients earned EUR 0. Further, if the auditor opted for the alternative in favour of the client, the author earned EUR 3 and so did the client. With financial incentives attached to the choices, our intention was to model an auditor business risk of impaired independence. Paying the auditor a smaller fee for the choice compliant with the client's interests captures the reputational and legal costs of an audit failure due to lack of auditor independence.

The second round represented the following audit period and in it the clients were requested to decide whether to hire the same auditor or a different one based on the decision of the auditor from the first round. In both cases, the client's reward amounted to either EUR 3 or EUR 0. If the client decided to hire the same auditor, the reward was dependent on the subsequent choice of the auditor. However, if the client chose not to hire the same auditor in the second round, the client's outcome was determined by the random choice of the computer system, representing the choice of a new unknown auditor. The choice of the client to hire the same auditor depended on perceived probability that the auditor would select the option in the client's interest. The auditor's reward could be the same as in the first round if hired again (EUR 5 or EUR 3), but in case of a job loss the auditor's reward could only amount to EUR 1 or EUR 0 with equal probability, depending on the random number drawn by the computer.

In total, auditor could earn the most by not acting in the interest of the client (EUR 10), while total compensation of both the auditor and the client could be maximised in case of cooperation (EUR 6 + 6).

The above presented auditor-client game, was designed in Gambit software (McKelvey, McLennan and Turocy, 2013) and programmed in E-prime 2.0 software (Psychology Software Tools, Pittsburgh, PA).

Procedure. The participants in the role of the auditor were randomly assigned to two groups. In the non-personal relationship group of the study, the participating auditors and clients were seated alone without being familiar with whom they were paired with. In the personal relationship group, the auditors were seated with the clients who were either their friends or not. Following the introduction and the initial instructions on the computer, the auditors and the clients read the case and familiarised themselves with their tasks. Those that were paired discussed the decision for about 10 minutes. The auditors seated alone took their decision without any interaction with the clients. These auditors were aware that in the next period the clients could hire a different auditor. However, neither the auditors nor clients knew exactly how many more rounds there would be since the initial instructions left the participants to believe several rounds would be played. Based on the auditor's decision in the first round, the individual rewards for both the auditor and client were displayed on computer screens and experimental subjects received their rewards.

In the second round, the scenario was essentially the same as described in the paragraph above. After reading the case and their tasks, the clients had to decide to hire either the same auditor or a different one. Another negotiation round followed between the auditors and the clients in the condition of a personal relationship. After the negotiation discussion, the clients indicated their decision. On the contrary, in the non-personal group of the study, no discussions took place. In the continuation, whenever the client decided to hire the same auditor, a new negotiation followed with the auditor in the personal relationship condition. On the other hand, whenever the client decided not to hire the same auditor, the computer randomly determined the reward for both the auditor and the client.

In the end of the experimental task of the study, the involved participants completed a questionnaire on motivational factors and unconscious needs, including demographic questions.

Variable measurement. We manipulated the *personal relationship* variable in a way that the first half of the participants was assigned to a non-personal relationship group (coded by 0) and the other half of the participants to a personal relationship group (coded by 1). The former did not know who they were paired with, while the latter were seated with their counterparties.

A long-term relationship was incorporated in the study by focusing on *familiarity* that develops over time in a close personal relationship between auditors and clients. As the duration of the experiment was too short for familiarity to actually develop, we proxied the familiarity part with friendship. The latter was manipulated only in the personal relationship group in which almost half (46.8%, $N = 22$) of the auditors was randomly paired with a client they did not know (coded by 0), and the other good half (53.2%, $N = 25$) of the auditors with the clients who they were good friends with (coded by 1). In other words, in the selection process we randomly assigned students to the groups, where half of the students who were assigned to the personal relationship group was asked to select their friends from the remaining group of students. In the exit questionnaire, the students involved confirmed they are good friends with each other.

The *auditor's decision* is about supporting or not supporting the client's preference. The value 0 indicates the decision of the auditor to expense the development costs of a product in the company's profit and loss account. This option is contrary to the client's preference. The value 1 indicates the decision in favour of the client, which is approving the development costs as an intangible asset in the balance sheet.

Financial interest is measured with three proxies, a short-term reward, long-term business and the fear of losing a client and consequently financial income. The short-term reward proxy measures the importance of the first round reward for the auditor's decision, while the long-term business one expresses the desire of the auditor to maintain future business with the client. The variables are measured with the five-point Likert scale. The latter was also applied in measuring fear of losing the client, with value 1 meaning the fear is not influential at all, and 5 meaning it is highly influential.

According to McClelland (1987), there are three *unconscious needs*, that is the need for achievement, affiliation and power respectively. Initially, all three of them were measured with 27 items, firstly, to make a comprehensive screening of the needs, and secondly, to obtain unidimensional measures for the needs. The indicated items were combined and adapted from different questionnaires that report high reliability and validity (Boneva et al., 1998). Participants had to indicate their agreement with the questionnaire statements using the five-point Likert scale. Further, the items measuring the *need for achievement* were adapted and combined from the Work and Family Orientation Questionnaire developed by Spence and Helmreich (1983), and the Manifest Needs Questionnaire developed by Steers and Braunstein (1976). The two applied examples of the items representing the need for achievement are "I work very hard to continually improve my work performance" and "I prefer to do things that require a high level of skill".

The items measuring the *need for power* were adapted and combined from the Power Motivation Scale developed by Schmidt and Frieze (in Frieze and Boneva, 2001), and the Manifest Needs Questionnaire developed by Steers and Braunstein (1976). For these items, the two examples of the statements representing the need for power are "I enjoy planning

things and deciding what other people should do" and "I like to have a lot of control over the events around me".

Last, the items measuring the *need for affiliation* were adapted and combined from the Mehrabian Affiliation Tendency Questionnaire (Mehrabian and Ksionzky, 1974) again in combination with the Manifest Needs Questionnaire developed by Steers and Braunstein (1976). For these items representing the need for affiliation two examples are provided, one "I enjoy belonging to clubs, groups and other organizations" and the other "Having friends is very important to me".

To obtain a unidimensionality of the latent variables related to the unconscious needs, we performed a factor and reliability analysis in SPSS. From the initial 27 items, six of items were dropped from the analysis based on their low covariance with other measured items and low reliability of each factor. A factoring was again conducted on the 21 retained items with an orthogonal rotation. The Kaiser-Meyer-Olkin test verified the sampling adequacy for the analysis, with KMO = 0.76 ("good" according to Field, 2009), and all KMO values for individual items higher than 0.55. The Bartlett's test of sphericity $x^2(210) = 964.97$, $p < 0.001$, indicates correlations between items were sufficiently large for principal axis factoring. Three factors extracted with the Anderson-Rubin method in combination explained the 31.5% variance. The need for power and the need for achievement subscales are reported to have relatively high reliability, with Cronbach's α valued between 0.74 and 0.76. The need for affiliation, on the other hand, is less reliable with Cronbach's α = 0.63. The final list of measurement items and their respective rotated factor loadings is presented in the Appendix.

4 RESULTS

Table 1 presents descriptive statistics for the full sample and the independent *t*-test of the differences between the personal and non-personal relationship subgroup respectively. The descriptive statistics reveals interesting dynamics of behaviour. In the first round, the auditors who supported the client's preference had to give up 40% of the short-term reward in a hope to be re-appointed. When comparing the two subgroups, this expectation was significantly higher in the personal relationship where the auditors were able to communicate and negotiate face-to-face than in the non-personal relationship in which the choices were the same but with no possibility to personally influence the counterparty. Table 1 and 2 reveal that the auditors in the personal relationship significantly more frequently decided to support the client, namely in 91.5% of instances, whereas in the non-personal relationship only 58.3% of them accepted the decision in the client's interest, $t = -4.00$, $p < .001$.

In the second round, 74.7% of the clients decided to hire the same auditor again. This decision significantly differed between both subgroups: the clients rehired the same auditors in 95.7% of cases if in the personal relationship group versus 54.2% of cases

in the non-personal relationship group, t = -5.29, p < .001. 88.7% of the hired auditors were those who in the first round supported the decision in the interest of the client. In the personal relationship, the clients rehired the auditor in 97.7% of cases if the auditor opted for the client's preference in the first round. Although a rehired auditor could have maximised the outcome of the second round by not opting for the client's preference, trust in the auditor in the personal relationship setting outweighed the risk. In the non-personal relationship, on the contrary, only 75.0% of the clients rehired the auditor who in the first round supported their preference, as the trust that these auditors would support them also in the second round was lower. The rehired auditors took another decision in the second round and 73.2% of them decided in favour of the client. Overall, the final results show the frequency of the rehired auditors was significantly higher in the personal relationship group (84.4%) than in the non-personal one (53.8%), t = -2.69, p = .010.

The total auditor's outcome in both rounds was slightly higher if the auditor was co-operating with the client. It is therefore not surprising that the total auditor's outcome is higher in the personal relationship group than in the non-personal one, nevertheless, the difference is not significant, t = -.87, p = .389. In other words, not supporting the client could bring the auditor practically the same total outcome. We designed financial compensation with great care not to overwhelm the subtle influence of the affect and unconscious need respectively. The results show the total client's outcome was significantly higher in the personal relationship group as the client's outcome was heavily dependent on the co-operation with the auditor, t = -4.32, p < .001. Also, the concern to maintain long-term business and mutual trust are significantly stronger in the personal relationship group, t = -3.47, p = .001, while other variables in the model do not significantly differ between the subgroups.

Table 1: *Differences in means of variables*

Variable	**Full sample (N = 95)**		**Personal relationship (N = 47)**		**Non-personal relationship (N = 48)**	
	Mean		**Mean**		**Mean**	
	Statistics	**Std. Dev.[3]**	**Statistics**	**Std. Dev.**	**Statistics**	**Std. Dev.**
Friendship (N = 25)	.263	.443	**.532*****	.504		
Auditor's decision	.747	.437	**.915*****	.282	**.583*****	.498
Short-term reward	3.295	1.119	3.511	1.061	3.083	1.145
Long-term business	3.747	1.246	**4.170*****	.916	**3.333*****	1.389
Fear of losing a client	3.095	1.264	3.234	1.220	2.958	1.304
Need for achievement	3.671	.612	3.639	.638	3.702	.591
Need for power	3.359	.673	3.228	.696	3.487	.632
Need for affiliation	3.624	.542	3.552	.612	3.694	.460
Client's decision	.747	.437	**.957*****	.204	**.542*****	.504
Total auditor's outcome	6.253	1.458	6.383	.990	6.125	1.806
Total client's outcome	4.305	2.109	**5.170*****	1.619	**3.458*****	2.202
Auditor's decision in the second round	.732	.446	**.844****	.367	**.538****	.508

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; Significant differences appear in bold.

3 Standard Deviation

Table 2: *Auditor's decision × Client's decision × Personal relationship cross-tabulation*

Relationship				Client's decision		Total
				Against auditor	For auditor	
Non-personal	**Auditor's decision**	**Against client**	Count	15	5	20
			% within auditor's decision	75.0%	25.0%	100.0%
			% within client's decision	68.2%	19.2%	41.7%
			% of total	31.3%	10.4%	41.7%
		For client	Count	7	21	28
			% within auditor's decision	25.0%	75.0%	100.0%
			% within client's decision	31.8%	80.8%	58.3%
			% of total	14.6%	43.8%	58.3%
	Total		Count	22	26	48
			% within auditor's decision	45.8%	54.2%	100.0%
			% within client's decision	100.0%	100.0%	100.0%
			% of total	45.8%	54.2%	100.0%
Personal	**Auditor's decision**	**Against client**	Count	1	3	4
			% within auditor's decision	25.0%	75.0%	100.0%
			% within client's decision	50.0%	6.7%	8.5%
			% of total	2.1%	6.4%	8.5%
		For client	Count	1	42	43
			% within auditor's decision	2.3%	97.7%	100.0%
			% within client's decision	50.0%	93.3%	91.5%
			% of total	2.1%	89.4%	91.5%
	Total		Count	2	45	47
			% within auditor's decision	4.3%	95.7%	100.0%
			% within client's decision	100.0%	100.0%	100.0%
			% of total	4.3%	95.7%	100.0%
Total	**Auditor's decision**	**Against client**	Count	16	8	24
			% within auditor's decision	66.7%	33.3%	100.0%
			% within client's decision	66.7%	11.3%	25.3%
			% of total	16.8%	8.4%	25.3%
		For client	Count	8	63	71
			% within auditor's decision	11.3%	88.7%	100.0%
			% within client's decision	33.3%	88.7%	74.7%
			% of total	8.4%	66.3%	74.7%
	Total		Count	24	71	95
			% within auditor's decision	25.3%	74.7%	100.0%
			% within client's decision	100.0%	100.0%	100.0%
			% of total	25.3%	74.7%	100.0%

The hypothesized model was analysed with logistic regression. Logistic regression is a type of the probabilistic classification model used for predicting the outcome of a categorical dependent variable, i.e. a class label based on one or more predictor variables that are either binary or continuous. Our main dependent variable is the binary choice of the auditors, while the independent variables are either binary (personal relationship, friendship) or continuous (short and long-term financial interest, fear of losing a client and unconscious needs).

Table 3 presents the results of logistic regression and Table 4 several statistics, relating to the logistic regression models. The hypotheses are analysed in a stepwise approach to observe the effects of the included variables on the explanatory power of the personal relationship and to analyse the mediation effect. All tests of significance are two-sided, with a p value of < 0.05, thus indicating statistical significance.

We present five models. The first model explains the 21.3% (Nagelkerke R^2) variance in the auditor's choice compliant with the client's interests, correctly classifies 74.7% of the studied cases and is overall significant with $\chi^2(1) = 11.45$, $p < 0.001$. The results show a positive and significant effect of the personal relationship on the auditor's decision in favour of the client, reflecting that auditors in a personal relationship are 7.68 times more likely to decide in favour of the client's interest ($b = 2.04$, $p = .001$).

In H1, we predict that familiarity mediates a positive effect of a personal relationship. Nevertheless, the analysis shows that this is not the case. Friendship as a proxy for familiarity is not found significant and a personal relationship after the inclusion of friendship remains significant. In the third model, we include three variables, measuring financial interest as a directional goal to test H2. The results in this case prove that financial interest is the factor that explains a significant effect of the personal relationship. By having a long-term future business interest, the auditor is 8.23 times more likely to support the client's preference ($b = 2.11$, $p < .001$), and by being very afraid of losing the client and the consequent financial income, the auditor is 4.90 times more likely to inappropriately consent to the client's preferences ($b = 1.59$, $p = .020$). In other words, a long-term future interest as a conscious and deliberate incentive of the auditor mediates for the association between the personal relationship and the auditor's decision. With its inclusion in the model, the personal relationship ceases to be significant ($b = .69$, $p = .624$). A short-term reward is expectedly not found significant as the auditors needed to give up on the short-term reward for long-term future business, yet it proves to be an important control variable. The model applied not only correctly classifies 92.6% of the cases, but is also significant with $\chi^2(5) = 27.74$, $p < 0.001$, while the explanatory power is considerably increased with the inclusion of financial incentives (Nagelkerke R^2 from 23.2% to 81.1%).

In the fourth model, three more variables are added, testing the effects of the unconscious needs for achievement (H3), power (H4) and affiliation (H5). Results reveal a significant negative effect of the need for achievement ($b = -1.68$, $p = .011$) and a marginally significant

negative effect of the need for power (b = -1.50, p = .071) on the auditor's choice in the client's interest, as predicted. This confirms the prediction of H3 and H4 respectively. With the inclusion of the unconscious needs in the model, a control variable short-term reward becomes significant with a negative sign (b = -1.46, p = .021). This indicates the adequacy of our incentive scheme design, in which the auditor could earn the most by not acting in the interest of the client.

While on a stand-alone basis the effect of the need for affiliation is not found significant, the final model (Model 5) shows that personal relationship reinforces the need for affiliation to positively affect the auditor's decision-making in favour of the client as the interaction term is significant (b = 5.80, p = .026). This confirms the prediction of H6. In a logistic regression, the true main effect is only meaningful when there is no interaction, since when there is a significant interaction, the main effect cannot be unambiguously interpretable. Thus, it is normal to ignore the main effects as informative in themselves when an interaction occurs. The main effects of the personal relationship, friendship and need for affiliation in the final model are therefore left out as their results cannot be unambiguously interpretable. The Nagelkerke R^2 of the comprehensive fifth model increases to 89.0%, indicating that on one hand conscious incentives and on the other hand unconscious needs contribute to the explanation of the auditor's choices. In Figure 3, we graphically present the empirical model.

Table 3: *Results of logistic regression, predicting the auditor's decision in the client's interest*

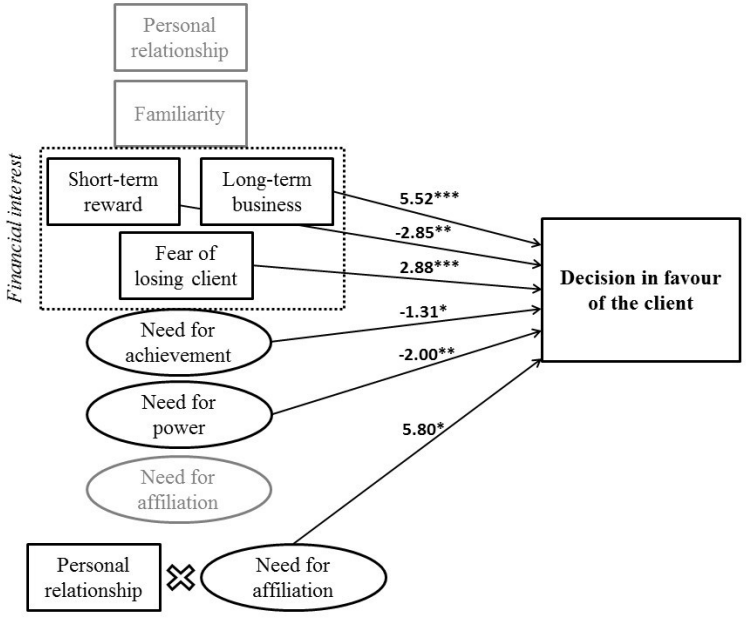
	B	(SE)	z	*p*-value	OR
Model 1					
Personal relationship	2.04	(.60)	3.38	**.001**	7.68
Intercept	.34	(.29)	1.14	.253	
Model 2					
Personal relationship	1.51	(.69)	2.19	**.029**	4.52
Friendship	1.33	(1.20)	1.11	.267	3.79
Intercept	.34	(.29)	1.14	.253	
Model 3					
Personal relationship	.69	(1.41)	.49	.624	2.00
Friendship	3.31	(2.34)	1.41	.158	27.26
Short-term reward	-.45	(.46)	-.98	.327	.64
Long-term business	2.11	(.58)	3.64	**.000**	8.23
Fear of losing a client	1.59	(.68)	2.32	**.020**	4.90
Intercept	-9.20	(3.08)	-2.99	**.003**	
Model 4					
Personal relationship	1.50	(2.12)	.71	.481	4.47
Friendship	3.46	(2.91)	1.19	.235	31.82
Short-term reward	-1.46	(.63)	-2.31	**.021**	.23
Long-term business	3.50	(.93)	3.76	**.000**	33.24
Fear of losing a client	2.21	(.79)	2.80	**.005**	9.11
Need for achievement	-1.68	(.66)	-2.55	**.011**	.19
Need for power	-1.50	(.83)	-1.81	.071	.22
Need for affiliation	-.57	(.68)	-.84	.403	.57
Intercept	-11.11	(3.04)	-3.66	**.000**	
Model 5 [Final model]					
Personal relationship	1.89	(2.02)	.93	.350	6.61
Friendship	4.33	(2.12)	2.05	.041	76.29
Short-term reward	-2.85	(1.07)	-2.65	**.008**	.06
Long-term business	5.52	(1.61)	3.42	**.001**	248.76
Fear of losing a client	2.88	(.86)	3.35	**.001**	17.86
Need for achievement	-1.31	(.64)	-2.05	**.040**	.27
Need for power	-2.00	(.78)	-2.58	**.010**	.13
Need for affiliation	-3.19	(1.43)	-2.23	**.026**	.04
Personal relationship × Need for affiliation	5.80	(2.61)	2.22	**.026**	331.21
Intercept	-13.54	(3.60)	-3.76	**.000**	

Note: Significant *p*-values appear in bold. Variables that cannot be unambiguously interpretable due to significant interaction term in the model appear in grey.

Table 4: *Statistics of the logistic regression models*

	Model 1	Model 2	Model 3	Model 4	Model 5
Number of observations	95	95	95	93	93
Number of variables	1	2	5	8	9
Wald χ2	11.45	10.64	27.74	25.15	22.50
χ2	.001	.005	.000	.002	.007
Pseudo R2	.138	.152	.704	.784	.817
Nagelkerke R2	.213	.232	.811	.868	.890

Figure 3: *The empirical model*



Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; Significant differences appear in bold. Variables that cannot be unambiguously interpretable due to significant interaction term in the model appear in grey.

5 DISCUSSION

The notion that auditor independence is affected by a long audit tenure during which the auditor's objectivity regarding a client gets impaired has been acknowledged for decades. Despite the recent regulatory measures as are audit partner rotation and public oversight, the problem seems to persist. The reason may lie in the fact that a long-term personal relationship arouses loyalty or creates an emotional bond, which may in turn cause conscious or unconscious biases (Ye et al., 2011). Other studies suggest that a personal relationship gives rise to the existence of long-term financial incentive as a directional goal that contributes to motivated reasoning and causes systematic biases (Kadous et al., 2003; Kadous et al., 2008; Blay, 2005). Nevertheless, whether these biases are conscious or unconscious is not explicitly addressed in the mentioned literature.

Our aim in this study is to shed more light on the question to what extent various incentives inherent to the personal relationship and characteristics of a decision-maker account for biases. Relying on the need theory of motivation (McClelland, 1987) and the theory of motivated reasoning (Kunda, 1990), our study extends the Moore et al. (2010) and the Slapničar et al. (2015) study respectively in trying to measure whether bias in a personal relationship is provoked by familiarity, i.e. emotional bond, by conscious self-interested maximization of long-term financial outcome, or by unconscious needs.

Our findings suggest that decision-making in favour of the client in the personal relationship is predominantly deliberate, although the decision to maximise long-term financial return is not emotionally neutral. In a personal relationship, the auditor significantly more often than in a non-personal relationship conceded to the client's preference because they more strongly trusted the clients to hire them in the next period. Interestingly, we find that familiarity, or friendship, as operationalised in our experiment, does not contribute to mutual trust and confidence in a long-term co-operation, but anyway proves to be of crucial importance when it comes to knowing how "one plays the game".

We also find that unconscious needs significantly affect the auditor's choices in a predicted way, for example the need for achievement and the need for power respectively induce auditor independence, while the need for affiliation is accentuated in a personal relationship, rending the auditor to more likely consent to the client's preferences. The results of our study allow us to infer that both conscious financial incentives and unconscious needs influence subjects' decisions simultaneously, however, it depends on the context to what extent they develop.

Understanding the drivers of the auditor's decision-making has a practical value for the development and implementation of effective regulatory measures. In a long-lasting relationship, both financial and non-financial incentives impair the auditor's independence. While financial incentive may be effectively mitigated by the oversight threat, the public oversight alone may not suffice to counteract unconscious motives. The

persisting familiarity threat lead the European Commission to propose a mandatory audit firm rotation with a rotation period of six years for the first time in 2013. In 2014, the European Parliament proposed the revised audit directive (Directive 2014/56/EU) and audit regulation (Regulation No 537/2014), requiring a 10-year mandatory audit firm rotation. Nevertheless, despite the legal changes in the field of auditing, such a long rotation period is unlikely to effectively address any of the problems, arising from familiarity issues.

Needs are relatively stable personality characteristics, and so understanding their effects on auditor independence has practical implications also for the employment of auditors in audit firms. Since a high need for achievement and a high need for power respectively result in greater auditor objectivity and, quite on the contrary, a high need for affiliation which impairs auditor objectivity, the recruitment process should give more emphasis on screening the interviewed individual's personality traits. Making auditors aware of subconscious factors that bias their decision-making in the regular ethics trainings and codes of conduct is another approach to minimize the impact of personality traits.

6 LIMITATIONS

The results of our study are to be weighed in the light of its limitation, despite the fact the experimental analysis was carefully conducted,. The first limitation of the study is in the investigation of long-term periods, where a long-term relationship was proxied with a two-round game and the uncertainty of future business, the latter applied by not informing the participants about how many rounds there would actually be. However, the subjects were left to think several rounds would be played. The long-term relationship was additionally reinforced by pairing real friends and using their friendship as a proxy for familiarity. Thus, we believe our focus on studying the long-term auditor-client relationship is valid.

The second limitation and probably our greatest may be in the fact that instead of experienced auditors students participated in the study. We tried to minimize this limitation, however with success to only some extent, by inviting only accounting and finance students who are most familiar with the audit profession and regulation. Students had on average 3.6 years of work experiences, many of them in positions of audit assistants in audit firms. Furthermore, all the included students also attended a lecture on ethics in accounting and auditing before the research experiment.

The use of undergraduate and graduate students as subjects in the laboratory experimental research is quite frequent. In the field of psychology, while studying 54 laboratory experimental research studies published in 1988 in the Journal of Applied Psychology (JAP), Organizational Behavior and Human Decision Processes, and Personnel Psychology, Dipboye (1990) found that most researches (81.5%) in their studies used students as subjects, whereas professionals, managers and technical people were used only few times (7.4%). Students have also frequently been used as subjects in the field of behavioural research in accounting (Ashton and Kramer, 1980) and financial accounting studies

(Elliott et al., 2007). While reviewing 369 experimental papers published between 1994 and 2007 in six world's best accounting journals (Accounting, Organizations and Society (AOS), The Accounting Review (AR), Contemporary Accounting Research (CAR), Journal of Accounting and Economics (JAE), and Journal of Accounting Research (JAR), Behavioral Research in Accounting (BRIA)), Chan, Landry and Troy (2011) report that slightly more than half (52.03%) of the researches used students as subjects, while others used practitioners. Regardless of the use of students as experimental subjects, these studies have made relatively significant contributions to the accounting literature. According to Mortensen, Fisher and Wines (2012), the use of advanced level accounting students as surrogates for accounting practitioners is appropriate, especially in a relatively structured decision context.

Overall, we believe the limitations of the study underestimate rather than inflate the results and that the study contributes to a deeper explanation of the adverse effect of a personal relationship on auditor independence by analysing its antecedents and the parallel influence of unconscious needs. Since the study is aimed to be interdisciplinary, in the search for novel insights it fruitfully combines auditing, finance and psychology. Its uniqueness lies in the fact that it addresses the problem of auditor independence from a different perspective.

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APPENDIX

INSTRUCTIONS FOR AUDITOR

FIRST ROUND

You are an auditor working for a reputable audit firm Auditor007. You are well aware of the importance of your professional reputation and the fact that the auditor is primarily bound to serve the public interest. You are currently auditing the accounts of a large public company Smart Firm. This is a technological company. This year the company developed a product X. The development costs of **product X** in this year amounted to EUR 2 million.

The development costs can be accounted for as either an intangible asset in the balance sheet which does not have a negative impact on earnings in the current period, or an expense in the profit and loss account which negatively affects profit. Both alternatives are allowed by the International Financial Reporting Standard (IFRS). The method according to which the company recognizes the development costs of the product in the accounts of the company depends on the management's and auditor's assessment of the likelihood that the product would be completed and successfully launched on the market.

Manager of the company Smart Firm is confident that the company is able to successfully complete the product, launch it on the market and receive considerable cash flows from sales within two years. Taking into consideration the optimistic predictions, the manager believes that the development costs of the product X should be accounted for in the **balance sheet** as an intangible asset. Under such treatment the development costs will not have a negative impact on the **company's profit**, which will amount to EUR **1 million.**

Because product X is a technologically innovative product, there are alternative forecasts based on the past experience of the company. Scepticism about the existence of the market and costumers for the product due to financial crisis and a decline in the demand for the product cast doubt on the forecasted cash flows from sales in two years. Taking into consideration the alternative forecasts, the development costs of the product X should be presented in **the profit and loss account** as an expense, however, this would have a negative impact on the company's profit which would turn into a loss of EUR **1 million**.

The company manager's reward is based on the performance of the company.

Your task is to decide how the development costs of the product X should be accounted for in the accounts.

Your outcome depends on your decisions. If you decide that the development costs of the product X should be accounted for as an asset in the balance sheet, the manager will earn EUR 3 and you will earn EUR 3. On the other hand, if you decide that the development costs of the product X should be expensed, the manager will earn EUR 0 and you will earn EUR 5.

If the manager will not be satisfied with your work, he or she can decide to hire a different auditor in the next period. In case you are rehired, you can earn EUR 3 or EUR 5, depending on your decision in the next period. If you are not hired again in the next period, your outcome will amount to either EUR 1 or EUR 0 (depending on a random number in the computer).

Please make a decision on how the development costs of the product X should be accounted for in the accounts of Smart Firm.

DISCUSS YOUR DECISION WITH THE MANAGER.

TO CONTINUE, PRESS ENTER ON THE COMPUTER KEYBOARD.

SECOND ROUND

One year has passed and if you are rehired by the manager, you have to decide again how the development costs of the product should be accounted for in the accounts. The company Smart Firm developed a **new product Y** this year. The development costs of the product Y this year is EUR 3 million.

The manager of the company is confident the company is able to successfully complete the product, launch it on the market and receive considerable cash flows from sales within two years. Taking into consideration the optimistic predictions, the manager believes the development costs of the product Y should be accounted for in the **balance sheet** as an intangible asset. Under such treatment the development costs will not have a negative impact on the **company's profit**, which will amount to **EUR 2 million**.

Because product Y is a technologically innovative product, there are alternative forecasts based on the past experience of the company. Scepticism about the existence of the market and costumers for the product due to the financial crisis and a decline in the demand for the product cast doubt on the forecasted cash flows from sales in two years. Taking into consideration the alternative forecasts, the development costs of the product y should be presented in **the profit and loss account** as an expense however, this would have a negative impact on the company's profit which would turn into a loss of EUR **1 million**.

The manager's reward is based on the performance of the company.

Your outcome depends on the manager's decision on whether you will be rehired or not.

The manager has to decide whether he/she will hire the same auditor again or hire a different one.

If the manager decides to rehire you, you can earn EUR 3 or EUR 5 and manager EUR 3 or EUR 0, depending on your decision on how the development costs of the product Y should be accounted for in the company's accounts.

However, if the manager decides to hire a different auditor, due to the loss of business you can earn only EUR 1 or EUR 0, depending on the random number selected by the computer. In this case the manager's outcome will also be randomly selected by the computer.

DISCUSS YOUR DECISION WITH THE MANAGER AND WAIT FOR HIS/HER DECISION.

TO CONTINUE PRESS ENTER ON THE COMPUTER KEYBOARD.

EXIT QUESTIONNAIRE

1. For each of the following fifteen statements indicate your level of agreement with the statements on a five-point Likert scale (1 = I completely disagree, 2 = I disagree, 3 = neutral, 4 = I agree 5 = I completely agree).

Below we present the final list of the measurement items evaluating unconscious needs and their respective rotated factor loadings.

Rotated factor loadings

	Items	Factor		
		Need for Affiliation	Need for Achievement	Need for Power
Q1	I work very hard to continually improve my work performance.	-.037	**.544**	.032
Q2	I enjoy competition. I like to win in sports and other things I do.	.091	**.467**	.233
Q3	It is important to me to be liked by other people.	.351	.013	.073
Q4	I enjoy difficult challenges. At work, I like to take on the hard jobs.	.010	**.795**	.198

Rotated factor loadings

	Items	Factor		
		Need for Affiliation	Need for Achievement	Need for Power
Q5	If I disagree with someone, I let them know it. I am not afraid of disagreement.			
Q6	When working, I often chat with fellow employees about non-work matters.	.295	-.127	.072
Q7	It annoys me when other people perform better than I do.			
Q8	It is important to me to get people to agree with my ideas.	.209	.042	**.410**
Q9	Many of my co-workers are also my friends. I enjoy spending my leisure time with them.	.383	-.140	.142
Q10	I would rather learn easy fun games than difficult thought games. (R)			
Q11	I enjoy being a manager. I like being in charge of things and people.	.192	.393	**.590**
Q12	I enjoy belonging to clubs, groups and other organizations.	**.532**	.157	.255
Q13	I prefer to do things that require a high level of skill.	-.065	**.679**	.072
Q14	I like to have a lot of control over the events around me.	-.104	.131	**.603**
Q15	Having friends is very important to me.	**.556**	-.234	.000
Q16	I work better when there is a deadline.			
Q17	I enjoy planning things and deciding what other people should do.	.002	.121	**.550**
Q18	I have very few close friends. (R)	.350	.052	-.202
Q19	I typically set realistic goals. I tend to achieve my goals.			
Q20	I dislike being the centre of attention at large gatherings. (R)	.250	.292	.200
Q21	When I am not feeling well, I would rather be with others than alone.			
Q22	It is important to me to perform better than others on task.	-.216	.375	.327
Q23	It is not necessary to hold an important position in life. (R)	.138	.333	.269
Q24	I enjoy a good movie more than a big party. (R)	**.460**	.030	-.003
Q25	Once I undertake a task, I persist.	-.122	**.579**	.058
Q26	I find satisfaction in having influence over others.	.065	.131	**.731**
Q27	I prefer independent work to cooperative effort. (R)	**.520**	.146	-.106
	Eigenvalues	1.80	4.15	2.56
	% of variance	8.57	19.75	12.33
	A	**.63**	**.76**	**.74**

Note: Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization. Factor Scores Method: Anderson-Rubin. Factor loadings over .40 appear in bold. Cronbach's α appears in bold. (R) indicates the reversed item. Rotation converged in 6 iterations. 6 items eliminated from the final analysis due to their low covariance with other measured items where the low reliability of each factor appears in grey.

2. For each of the following factors indicate how important they were for your decision by using a five-point Likert scale (1 = not important at all, 3 = somehow important, 5 = very important).

	Not important at all		Somehow important		Very important
a. Short-term reward	1	2	3	4	5
b. Long-term business relationship	1	2	3	4	5
c. Fear of losing a client	1	2	3	4	5
d. Client's reward*	1	2	3	4	5
e. Company's profit*	1	2	3	4	5
Note: *these factors were not included in further analysis.					

3. Please answer the following demographic questions.

Gender? F M

What is your age? _____

Are you an undergraduate or a graduate student? Undergraduate Graduate

What is your field of study? Accounting Finance

How many years of work experience do you have? _____

DETERMINANTS OF INFLATION IN EGYPT AND MEXICO: EMPIRICAL EVIDENCE

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ABSTRACT: *This paper empirically examines the influencing role of internal and external factors on the inflation rate for two emerging economies, Egypt and Mexico. We develop an augmented version of the monetarist model, where the model is estimated using quarterly data for Egypt for the period 1975Q1-2015Q4 and Mexico for the period 1976Q1-2015Q4. For the long-run estimation, we apply the Johansen-Juselius Maximum Likelihood estimation, as well as the Fully Modified Ordinary Least Squares methods. According to our estimation results, the price level over the long-run is affected by both internal and external factors in both countries. It is ascertained that both the monetary policy measured by supply of money and interest rate, and the fiscal policy measured by government expenditure, deficit and debt, affect the price level over the long-run in both countries. Consequently, both policies can be used to fight inflation over the long-run in these two countries. Furthermore, both the United States interest rate and price affect the price level with the same sign in both studied countries over the long-run. However, over the short-run, where it is expected that the United States price affects the price in Mexico, it in fact does not have any effect on the prices in Egypt.*

Key words: *long-run price, inflation, fiscal and monetary policies, external and internal factors*

JEL classification: E31, E41, E62

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1 INTRODUCTION

The objective of this study is to empirically investigate the impact of internal and external factors on inflation in the two emerging economies of Egypt and Mexico. The economies of these two countries share characteristics that are common to those of developing countries and this is the reason that makes their case interesting for studying how external forces affect them, especially when shocks come from the United States. Likewise, both studied countries show differences beyond the economic setting that are important to point out for the understanding of the empirical model results.

Egypt, with more than 90% of the country being desert land, relies mostly on tourism, while Mexico has oil, an in-bond industry and remittances as the primary external sources of the country's income. We consider testing our model on these two relatively different countries for the reasons of establishing how external factors influence countries that are

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geographically apart. One such example is a study on how one and the same external factor coming from the changes occurring in the United States economy is felt on one hand in Mexico, a neighbor of the United States, and on the other hand, in Egypt, a country a thousand miles away from the United States. The model used is an augmented version of the monetarist model. In a departure from the existing literature, the paper incorporates both external and internal factors, causing inflation in a country, and compares how the impact of external factors is felt in each of the studied countries. We estimate the model using quarterly data for Egypt for the period 1975Q1-2015Q4, and for Mexico for the period 1976Q1-2015Q4.

As explained and showed by Kia (2006a), inflation in small open economies is influenced by both internal and external factors. Internal factors include fiscal and monetary, as well as structural and institutional variables, while external factors include terms of trade, foreign interest rate, exchange rate, sanctions, risk-generating activities, wars, etc. Moreover, the question raised in this paper focuses on whether, besides considering other factors, a neighbor close to or far from a large country like the United States can be affected by the impact of external factors. We establish that over the long-run the price level is influenced by both internal and external factors in the analyzed countries, while over the short-run, the sources of inflation are also fiscal and monetary policies. What is more, we ascertain that both the United States interest rate and price influence the inflation rate in Mexico, however, only the United States interest rate influences the inflation in Egypt.

As seen in the next section, the existing literature for these two countries does cover the impact of most of the internal and external factors on the price but also ignores one or more factors for each country. More precisely, in most studies the influence of a large country's monetary policy and prices is not considered for the case of Egypt, in addition, foreign-financed debt management as a part of fiscal policy is also ignored. The determinants of inflation, indeed, are evaluated from different perspectives, focusing either on the external factors or the internal ones, but not on both. Also, within the existing literature, policy regime changes and some structural regime changes are ignored. As for Mexico, some studies include only internal factors while ignoring external factors and vice versa. Furthermore, some critical policy regime changes are ignored. This study fills these gaps.

The rest of the paper is organized as follows. Section 2 offers a literature review. Section 3 briefly describes Egypt and Mexico and their relationship with the United States and is followed with Section 4 on the theoretical model. Section 5 describes the data and the long-run empirical methodology and reports the results. Section 6 is devoted to the short-run dynamic models. The final section provides some concluding remarks.

2 LITERATURE REVIEW

This section focuses on the empirical evidence about internal and external factors as determinants of inflation for Egypt and Mexico. The impact of the fiscal and monetary policy respectively considered as internal factors affecting inflation rates in emerging countries, especially tourist-oriented ones like Egypt and Mexico, has not been paid enough attention in the existing literature or has shown mixed results. Moreover, when referring to external factors, the influence of a large country's monetary policy and prices was not considered for the case of Egypt. In the continuation, we show that previous empirical evidence for these two countries covers either internal (fiscal policy or monetary policy) or external factors (prices, interest rates). In other words, there is a lack of a comprehensive approach where both elements are present in the analysis.

In the case of Egypt, a few studies have found that focus on the role of fiscal policies as determinants of inflation, however, with no consideration of external or institutional factors (see Helmy, 2009; Fanizza & Soderling, 2006; and Moriyama, 2011). Other studies consider only the role of the monetary policy in the explanation of inflation (Sharaf, 2015; El Baz, 2014; Arbatli & Moriyama, 2011; Achour & Trabelsi, 2011; Helmy, 2010; and Youssef, 2007). There are also a few studies for Egypt that consider external factors as determinants of inflation, but they lack the inclusion of fiscal or monetary policies (see Hosny, 2013; Al-Shawarby & Selim, 2012; Noureldin, 2009; as well as El-Sakka & Ghali, 2005).

As can be seen from the review of the empirical evidence for Egypt, the determinants of inflation are evaluated from different perspectives, focusing on either the external factors or the internal ones, but not on both. Furthermore, there is no mention of any variable that counts for policy regime changes that also affect inflation. This study attempts to fill this gap.

In regards to Mexico, the empirical literature is divided into two groups. The first group focuses on the analysis of the determinants of inflation during the 1980s high inflationary period (Palerm, 1986; Rogers & Wang, 1995; Shelley & Wallace, 2004). The second group concentrates on monetary factors affecting the inflation rate as the economy has been able to control inflation to single digits. In this group, the focus changes from inflation uncertainty (Grier & Grier, 2006), targeting and expectations (Carrasco & Ferreiro, 2013; De Mello & Moccero, 2009; Galindo & Guerrero, 2003; Galindo & Ros, 2008), to inflation persistence (Capistrán & Ramos-Francia, 2009; Chiquiar *et al*., 2010) or the Phillips Curve (Laguna, 2007; Ramos-Francia & Torres, 2008; Rodríguez, 2012).

Furthermore, Esquivel & Razo (2003), Shelley and Wallace (2004), Cuevas (2008), Galindo & Ros (2008), Cavazos & Rivas-Aceves (2009), Chiquiar *et al.* (2010) and Durán *et al.* (2012) considered a long-run relationship between inflation and different proposed variables. Nevertheless, all the above studies focus either on internal or external determinants of

inflation, without providing a comprehensive approach where both external and internal factors are considered together as part of their proposed models.

An important consideration when analyzing inflation in Mexico is the role of external factors, in particular, how changes in the United States economy affect the inflation behavior. One example of the latter is how after the economic liberalization at the end of the 1980s inflation responded to external shocks, mainly coming from the United States, through variables as are, among others, the economic activity of the United States, and the interest rate or real exchange rate (De Mello & Moccero, 2009; Carrasco & Ferreiro, 2013; Cavazos & Rivas-Aceves, 2009).

As we can see from the existing literature, for the two analyzed countries studies focus on the fiscal view of inflation where variables such as deficit or public debt are taken into account as explanatory variables. Likewise, other analyses prefer the monetary approach to inflation where variables such as the interest rate or money supply are considered. Only few works include both fiscal and monetary policy variables, however, with no reference to external factors such as the impact of changes in the United States interest rate and the price respectively. The existing empirical evidence for both countries led us to the conclusion that there is a need for a comprehensive analysis of inflation where both internal and external factors, including the institutional changes and policy shocks, are modeled to explain the long-run determinants and the short-run dynamics of inflation. With that in mind, the contribution of this paper is to provide an empirical monetary model to study inflation for emerging economies, in our case the economies of Egypt and Mexico for the period 1975Q1-2015Q4 and 1976Q1-2015Q4 respectively. In the next section, we describe Egypt and Mexico and their relationship with the United States.

3 A SHORT GLANCE AT EGYPT AND MEXICO AND THEIR RELATIONSHIP WITH THE UNITED STATES

In order to provide a context for the model proposed in the following section, an overview of the similarities and differences between the economies of Egypt and Mexico is given in this section, with a focus on the trade relationships of both countries with the United States. In this paper, we argue that Egypt and Mexico have characteristics common to those of developing countries, which is the reason that makes their case interesting for studying on how external forces affect them, especially when shocks come from the United States. Likewise, both countries show differences beyond the economic setting that need to be pointed out for the purposes of understanding the empirical model results.

First, among the similarities, it is worth mentioning that as developing economies, Egypt and Mexico went through a period of closed economies until the 1970s, following a path of an import substitution industrialization (ISI) developing process (Villarreal, 2009). Both economies were affected by the shocks of high oil prices in 1973, however, the discovery of oil reserves in Mexico in 1976 allowed for this country to embark on external loans,

which prolonged the ISI for additional years. In the case of Egypt, with the Egypt-Israel Treaty signed in 1979, the country extended trade relations with Western economies, in particular with the United States (Weis & Wurzel, 1998). Just the same, both economies suffered from a period of high inflation during the 1980s.

To promote economic growth, market-oriented economic policies shifted their economies toward a liberalized-open economic model. In Mexico, the shift occurred at the end of the 1980s, while in Egypt the economic liberalization process started in the 1990s. Trade as a percentage of gross domestic product (GDP) has grown from 20% in Mexico during the 1970s to 60% on average for the last decade. Egypt's trade as a percentage of GDP was fluctuating from 35% during the first part of the 1970s to around 60% until 2008, and down to 35% in 2015 (World Bank Group, 2016a).

Oil is a significant component of their trade and both economies have endured the consequences of oil price fluctuations in recent years. Mexico's oil exports and related products even today still account for 10% of total exports. However, in the past, periods of high oil prices were correlated with a higher participation in total trade. In the case of Egypt, oil exports have fluctuated at around a 20% mark in the last decade and continue to be one of the main export products.

Another similarity between these two countries is tourism and remittances revenues. Mexico's tourism reached 10% of total exports in 1995, becoming one of the main sources of foreign revenues along with oil and remittances. Recently, several factors negatively affected the tourism industry, from the financial crisis of 2007-2008, the rise of drug-cartel violence in tourist areas, and the 2009 swine flu epidemic. Egypt is well known as a tourist destination for visitors around the world, in particular from Europe. Tourism generates around 10% of total employment in Egypt and represents a significant source of economic growth (Ibrahim, 2011). Revenues coming from the tourist industry however declined due to the Arab Spring uprisings early in 2011 and it has been difficult for this country to return to the previous percentages ever since (Avraham, 2015).

Global migration has contributed to the increase of remittance flows between countries. Empirical evidence shows that remittances are a significant external source for financing economic development in developing countries (Giuliano & Ruiz-Arranz, 2009). Mexico and Egypt are among the main recipient countries, after India and China. In some years, Mexico considered remittances as the second or third largest source of income, after oil and tourism. Even though remittance flows represent only 2% of the GDP, they have had an impact in the poorest areas of central and southern Mexico (Taylor *et al.*, 2008). Another characteristic of Mexico's remittances is the origin of the flows, where more than 90% of total remittances come from the United States. In Egypt, remittances were significant as a percentage of its GDP (around 8%) during the 1980s. Even though their contribution to the GDP has decreased in recent years, it is still an important source of external revenues,

averaging close to 5% of the total GDP in the last decade. In this particular case, remittance flows are coming mainly from Arab neighboring countries (World Bank Group, 2016b).

In terms of the monetary policy, the independence of the Central Bank was part of a policy to reduce uncertainties as well as to decentralize government power. BANXICO gained its independence in 1994 (Gutierrez, 2003) and Egypt's Central Bank has been operating with autonomy since 2003 (Youssef, 2007). Since their independence, both economies have followed a free-floating exchange rate system. The control of inflation was the main issue for both economies after the double-digit inflation of the 1980s. These economies followed a similar path to control inflation have conducted inflation targeting policies in recent years. Mexico's economy has been successful in controlling inflation to a 2-3% range, however with low rates of economic growth (Galindo & Ros, 2008), while with Egypt an average 10% inflation is seen in recent years due to political instability.

Second, among the differences between the two analyzed countries, we can mention Mexico's dependence on the United States market, as more than 75% of the total trade is with this country. Mexico is the second biggest market for American products, after Canada. Since the North American Free Trade Agreement (NAFTA), the intra-industry trade has increased, mainly in medium and high technology-intensive products, such as electronics and machinery equipment. Egypt has a more diversified trade composition, as the European Union is its main trade partner with 22% of total trade with this regional block. In Egypt, however, the trade pattern appears to be more inter-industrial, where exports are primary or low technological products while its imports are mostly manufacturing products.

Since the United States is Mexico's trade partner and has a strategic interest in Egypt, it is important to mention their geographical distance. Mexico has a common border with the United States, with key states being California and Texas, while Egypt is more than six thousand miles away from the United States. This distance plays a role in terms of the potential impact from the United States on their economies, where even the same event has a different impact on Mexico and on Egypt which can be explained by their geographical distance.

Religion is another significant difference between these two countries. While Mexico's population is mainly Catholic (more than 80% according to the Pew Research Center), Egypt's population is largely Muslim. In the case of Mexico, religion does not affect the economy, which is however not the case in Egypt, where the main difference is in the banking system. In the latter country, Islamic banks do not use an interest rate for loans but instead share profits and losses.

In sum, the economies of Mexico and Egypt share substantial similarities as developing economies and their differences make their comparison in dealing with inflation an interesting case to study. In the next section, we propose a theoretical model for inflation.

4 MODEL

The model used in this study is an extension of the model developed by Kia (2006a) and represents a monetary approach to inflation which is capable of incorporating both fiscal and monetary policy variables. Kia assumes the following utility function:

$$U(c_t, c_t^*, g_t, k_t, m_t, m_t^*) = (1-\alpha)^{-1} (c_t^{\alpha 1} c^*_t{}^{\alpha 2} g_t{}^{\alpha 3})^{1-\alpha} + \xi (1-\eta)^{-1}[(m_t/k_t)^{\eta 1} m^*_t{}^{\eta 2}]^{1-\eta}, \quad (1)$$

where α_1, α_2, α_3, α, η_1, η_2, η and ξ are all positive parameters, and $0.5<\alpha_i<1$, $0.5<\eta<1$. Furthermore, c_t and c^*_t are single, non storable, real domestic and foreign consumption goods, while m_t and m^*_t are the holdings of domestic real (M/p) and foreign real (M*/p*) cash balances, respectively. The variable g is the real government expenditure on goods and services, assumed to be a "good." Including government expenditure in preferences is based on the assumption that individuals benefit from government services in their consumption, for instance, clean and safe roads, foods which have been inspected, etc. provide a higher utility to consumers. The variable k_t summarizes the risk associated with holding domestic money. Consequently, it has the following function over the long-run:

$$\log (k_t) = k_0 \, defgdp_t + k_1 \, debtgdp_t + k_2 \, fdgdp_t, \quad (2)$$

where defgdp, debtgdp and fdgdp are the government deficits per GDP, the government debt outstanding per GDP and the government foreign financed debt per GDP respectively.

It is assumed government debt (bonds) pays the same interest rate as bank deposits, which is presented by R. In a risky environment, agents substitute real or interest-bearing assets for money. For example, as the government deficit per GDP increases, agents perceive higher future taxes or money supply (inflation). At the same time, the higher the outstanding government debt relative to the size of the economy is, the riskier the environment will be perceived. Individuals may hold these bonds to bridge the gap between the future labor income and expenditures, including tax expenditures. Consequently, we hypothesize constant coefficients $k_0>0$ and $k_1>0$. Furthermore, an increase in the amount of government debt held by foreign investors/governments may be considered a cause for future devaluation of the domestic currency. Consequently, demand for domestic money may fall, implying $k_2>0$.

In our research, it is assumed that Equation (2) is also subject to a short-run dynamics of the system, which is a function of a set of dummy variables included in vector DUM (explained in Section 5 for each country), and other predetermined short-run (stationary) variables that are known to individuals. These variables include the growth of money supply, real GDP, exchange rate, real government expenditure, changes in deficits per

GDP, government debt per GDP, domestic and foreign inflation rates, as well as changes in domestic and foreign interest rates.

Dummy variables (DUM) are included to capture seasonal and interventional factors that account for wars, sanctions, political and technical changes, innovations, together with policy regime changes that influence services of money. Kia (2006b) shows that the estimated long-run relationship can be biased when the appropriate policy regime changes and/or other exogenous shocks are not incorporated in the short-run dynamics of the system. As Kia mentions, DUM appears only in the short-run dynamics of the system.

Given g, defgdp, debtgdp and fdgdp, the consumer maximizes (1) subject to the following budget constraint:

$$\tau_t + y_t + (1 + \pi_t)^{-1} m_{t-1} + q_t (1 + \pi_t^*)^{-1} m^*_{t-1} + (1 + \pi_t)^{-1} (1 + R_{t-1}) d_{t-1} + q_t (1 + \pi_t^*)^{-1} (1 + R^*_{t-1}) d^*_{t-1} = c_t + q_t c_t^* + m_t + q_t m_t^* + d_t + q_t d_t^*, \quad (3)$$

where τ_t is the real value of any lump sum transfers/taxes received/paid by consumers, q_t is the real exchange rate, defined as $E_t p_t^*/p_t$, E_t is the nominal market exchange rate (domestic price of foreign currency), p_t^* and p_t are the foreign and domestic price levels of foreign (United States) and domestic goods, respectively, and π_t and π_t^* are domestic and foreign inflation rates, respectively. y_t is the current real endowment (income) received by the individual, m^*_{t-1} is the foreign real money holdings at the start of the period, d_t is the one-period real domestically-financed government debt which pays R rate of return, and d_t^* is the real foreign-issued one-period bond which pays a risk free interest rate R_t^*. It is also further assumed that d_t and d_t^* are the only two storable financial assets.

Solving the model, we get the following reduced form where money market is in equilibrium:

$$lp_t = \beta_0 + \beta_1 lMs_t + \beta_2 i_t + \beta_3 ly_t + \beta_4 lE_t + \beta_5 i^*_t + \beta_6 lp^*_t + \beta_7 lg_t + \beta_8 defgdp_t + \beta_9 debtgdp_t + \beta_{10} fdgdp_t + \beta_{11} trend, \quad (4)$$

where a l before a variable means the logarithm of that variable. Ms is the nominal money supply, i is the logarithm of (R/1+R) where R is the annual interest rate in decimal points. Similarly, i* is the logarithm of (R*/1+R*) where R* is foreign (United States) interest rate. The βs are the parameters to be estimated and have the following signs: $\beta_0>0$, $\beta_1>0$, $\beta_2>0$, $\beta_3<0$, $\beta_4=?$, $\beta_5>0$, $\beta_6=?$, $\beta_7>0$, $\beta_8>0$, $\beta_9>0$, and $\beta_{10}>0$.[3] The linear trend is also added to the equation to capture technological changes. The sign of β_{11} is an empirical verification.

3 For the sake of brevity, the derivation of Equation (4) is not reported, but is available upon request. Furthermore, like Kia (2006a) we also found $\beta_4 = \beta_6$. However, we follow his approach and do not apply this restriction in order to capture the impact of imported inflation, and also the exchange rate, a policy variable, on the inflation.

Finally, Equation (4) is a long-run relationship between the price level and its determinants and is estimated in the next section using Egypt and Mexico data.

5 DATA, LONG-RUN EMPIRICAL METHODOLOGY AND RESULTS

The model is estimated using quarterly data for Egypt for the period 1975Q1-2015Q4, and Mexico for the period 1976Q1-2015Q4. The period is chosen based on the availability of the data (see the data appendix for sources). All variables are seasonally adjusted. The Consumer Price Index (CPI) is used for both Egypt and Mexico for the domestic price p. Total US CPI, all items, 2010=1, are used for the foreign price p^*. The money supply variable is M1 and the variable i is the logarithm of (R/1+R) where R is the discount rate for Egypt and the annual deposit rate for Mexico and both rates are in decimal points. The reason for choosing this rate as a measure for the domestic interest rate is its availability in the sample period. Quarterly data on other but more relevant interest rates are available only for a very short part of the sample period.

Variables y and g are the real GDP and government expenditures on goods and services, respectively. E is the nominal market exchange rate, representing the black market rate in Egypt for part of the sample period, which is equal to the domestic currency in terms of American dollars. Foreign rate i^* is the logarithm of $(R^*/1+R^*)$ where R^* stands for the United States three-month Treasury bill rate at the annual rate, in decimal points. The series for outstanding debt is calculated for part of the sample (see the data in the appendix).

As mentioned, the short-run dynamic part of the long-run model includes vector DUM. Vector DUM for Egypt is defined as:

DUM = (*peace, price, flex, tarif, pricesub, common*). For the definition of these dummy variables see Table A1 in the Appendix.

Vector DUM for Mexico is defined as:

DUM = (*lib, flexe, dme, tarr, nafta, corto, targ, itf, braz, minr*). For the definition of these dummy variables see Table A2 in the Appendix.

The augmented Dickey-Fuller and non-parametric Phillips-Perron test are used to investigate the stationarity property of the variables. Furthermore, to allow for the possibility of breaks in intercept and slope, we also apply Zivot & Andrews (1992) and Lee & Strazicich (2001 and 2003) tests. These tests show that all the series are integrated of order one (non-stationary). They are, however, first-difference stationary. For the sake of brevity, these results are not reported but are available upon request.

The long-run estimation results of the Johansen-Juselius Maximum Likelihood estimation, as well as the Fully Modified Ordinary Least Squares (FMOLS) regression, applied as a robustness check are reported for Egypt in Table 1 and in Table 2[4] for Mexico. The FMOLS estimation was originally introduced by Phillips & Hansen (1990), nevertheless, we use its extension from Hansen (1992b). The FMOLS first estimates the cointegrating vector by least squares and then does a non-parametric correction for small-sample endogeneity.

We also use the multiple structural change test by Bai & Perron (2003). According to the results of the latter, the break for both countries is 2008Q1 which is associated with the United States crisis. We allow for this break in the long-run equation. Further, the lag length is determined to induce white noise property in the residuals. Following Hansen & Juselius (1995, p. 26), we set p = r in Equation (4) and test for autocorrelation and ARCH. LM(1) and LM(2) statistics are employed to confirm the choice of lag length. The order of cointegration (r) is determined by using Trace tests developed by Johansen & Juselius (1991).

Since we allow the short-run dynamics of the system to be affected by the dummy variables included in vector DUM, a simulation of the critical values as well as their associated *p*-values are needed for the rank test. The critical values of the test statistics are calculated based on the length of the random walk of 400 with 2500 replications and using the Bartlett correction factor; the Trace test has been corrected for the small sample error (see Johansen, 2000 and 2002). Based on the Trace test results, in the first panel of Tables 1 and 2 there are three cointegration relationships in space for both countries. According to the diagnostic test, there is no autocorrelation with the lag length of 3 for both countries as well. However, the error is not normally distributed, but as Johansen (1995a) states, a departure from normality is not very serious in cointegration tests. As ARCH estimation results show, we also have a weak heteroskedasticity, but as Rahbek *et al*. (2002) have shown, the cointegration rank tests are robust against moderate residual ARCH effects (see also Juselius, 2006).

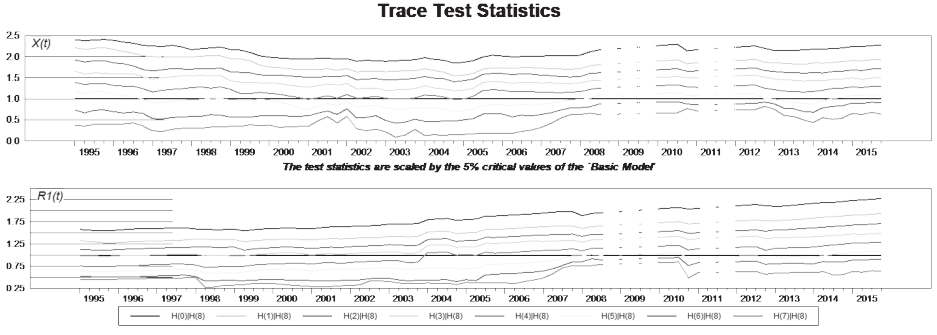
Since more than one cointegrating relationship for both countries is found, we need to identify the estimated cointegrating vectors. In this way, the estimated coefficients of cointegrating equations become economically meaningful and ensure uniqueness of all coefficients. Following Johansen & Juselius (1991) and Johansen (1995b), among many others, we can test for the existence of possible economic hypotheses among the cointegrating vectors in the system. The middle panel of Tables 1 and 2 reports the identified relationships. As the Chi-squared values indicate, restrictions are jointly accepted, the system is identified *à la* Johansen's (1995b) Theorem 3.[5] Namely, generic identification, which is related to the linear statistical model and requires the rank condition, and both empirical and economic identifications are satisfied (see Johansen & Juselius, 1994).

4 Note that the US TB rate and price index were entered as weak exogenous variables in the estimation process.

5 Note that where the system was not identified, we could never estimate the *t*-values.

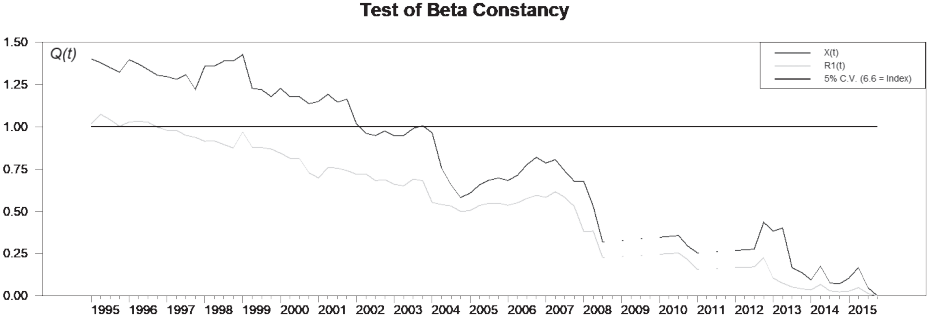
As Figures 1 to 6 show, all tests and coefficients are stable for both countries. Note that all recursive tests are normalized by the 5% critical value implying that calculated statistics that exceed unity reject the null hypothesis and suggest unstable cointegrating vectors. The curve X(t) plots the actual disequilibrium as a function of all short-run dynamics including the dummy variable, while the R1(t) curve plots the "clean" disequilibrium that corrects for short-run effects. The first 20 years were held up for the initial estimation. As these figures show, all coefficients appear stable over the long-run and the Trace tests are also stable.

Figure 1: *Trace Test Egypt Price Level**



* X(t) = the actual disequilibrium as a function of all short-run dynamics and the dummy variable.
R1(t) = the "clean" disequilibrium that corrects for short-run effects.

Figure 2: *Test of Beta Consistency Egypt**



* In R1model, we re-estimate only the long-run parameters Alfa and Beta, concentrating out the short-term dynamics by using the full sample estimate of the parameters.

Figure 3: *Test for Constancy of the Parameters of the Identified Equations for Egypt*

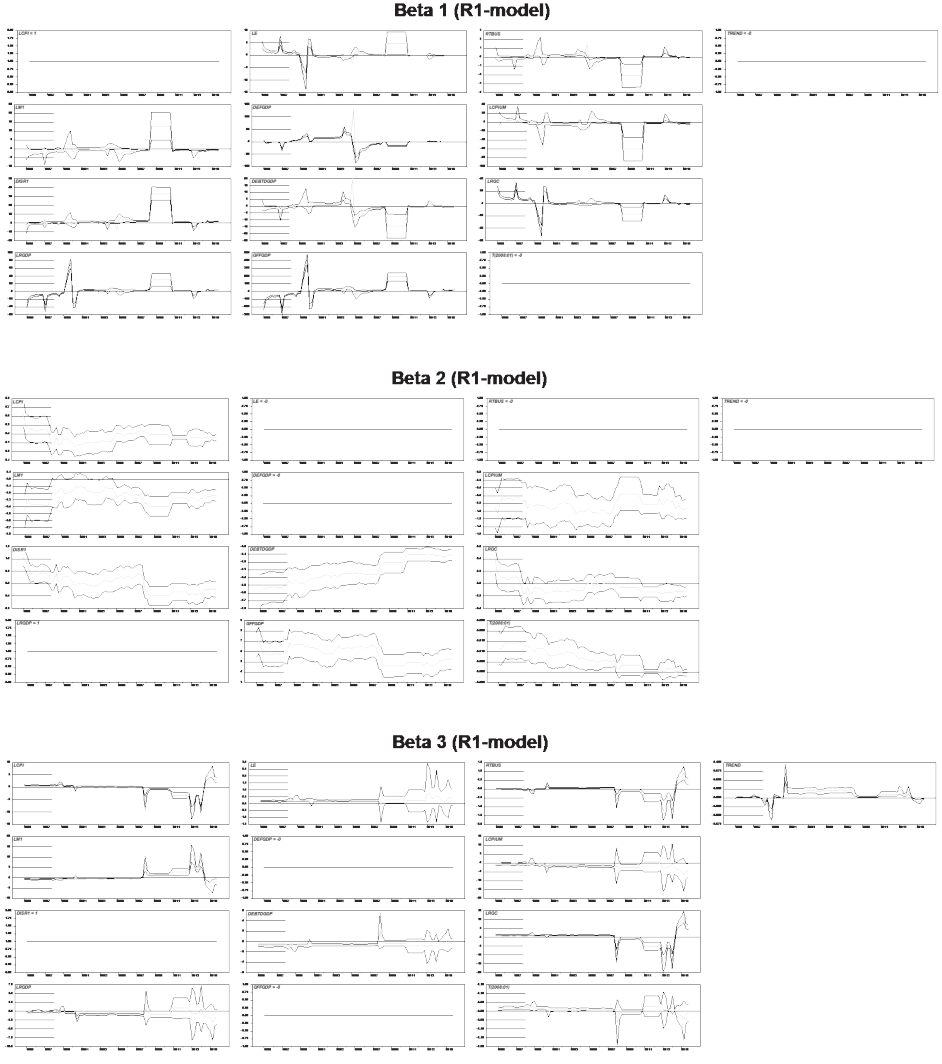
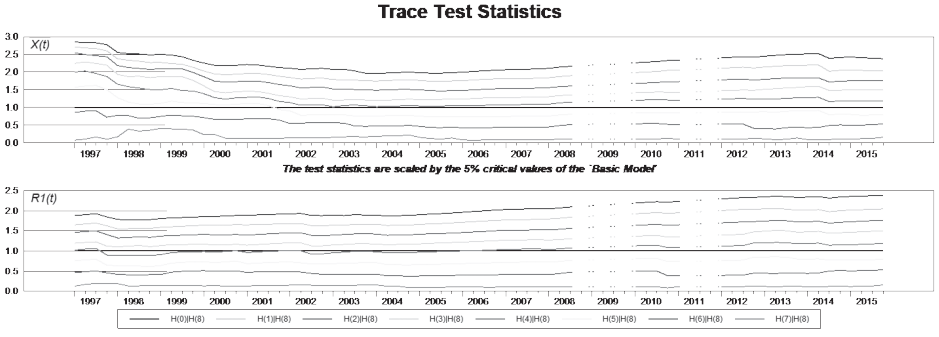
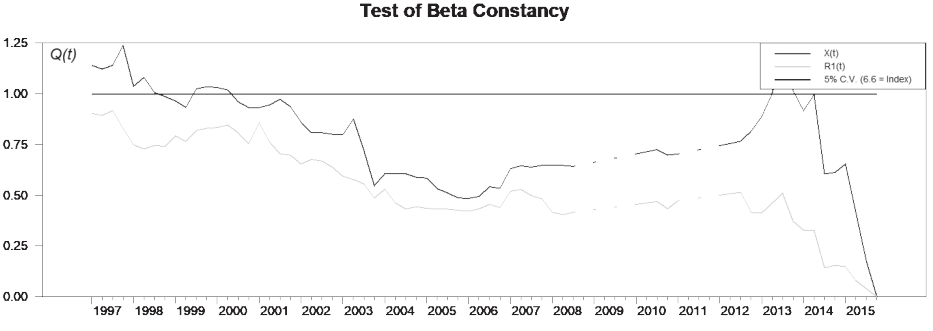


Figure 4: *Trace Test Mexico**



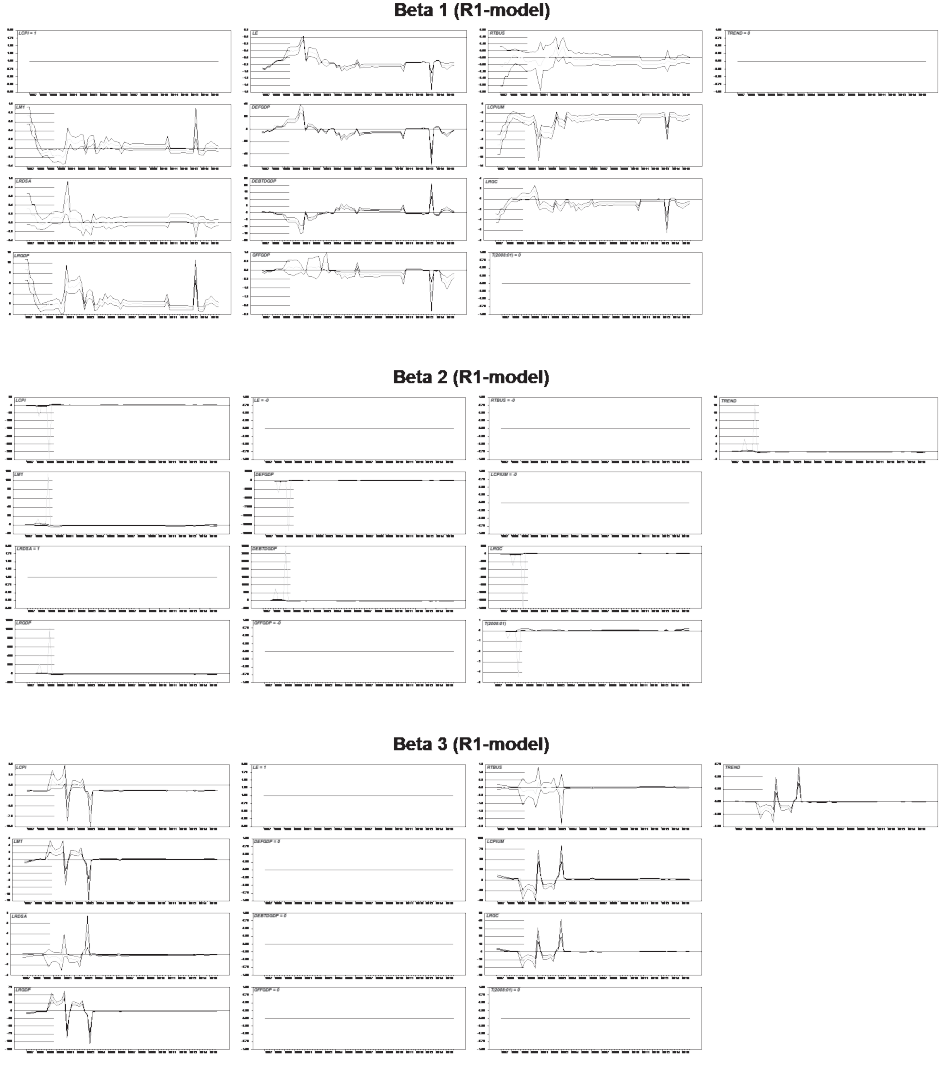
* In R1-model, we re-estimate only the long-run parameters Alfa and Beta, concentrating out the short-term dynamics by using the full sample estimate of the parameters.

Figure 5: *Test of Beta Consistency Mexico**



* In R1-model, we re-estimate only the long-run parameters Alfa and Beta, concentrating out the short-term dynamics by using the full sample estimate of the parameters.

Figure 6: *Test for Constancy of the Parameters of the Identified Equations for Mexico*



After having established that the long-run equations are stable, we analyze the identified long-run equations.

A. Long-Run Relationships in Egypt

Long-Run Price: The first row of the middle panel of Table 1 reports the long-run price equation. For the research purposes, we needed to restrict the break and trend to ensure the identified equation. As we can see from the results, all coefficients, with the exception of the coefficient of the exchange rate, are statistically significant and all, but the interest rate and foreign-financed debt, confirm our theoretical model. One possible explanation for the negative impact of the domestic interest rate on the price level is that as the interest rate goes up, demand for goods and services will fall, resulting in a lower price level. Likewise, an increase in the foreign-financed debt causes a higher demand for domestic currency (Egyptian pounds) which results in its appreciation, in other words, a lower value of the coefficient lE and consequently a lower price level. Our findings, in particular for the positive relationship between money supply and price, confirm several previous empirical studies (see Helmy, 2009; Fanniza & Soderling, 2006; Youssef, 2007; El-Sakka & Ghali, 2005; Metwally & Al Sowaidi, 2004).

Long-Run Money Supply Function: The second row of the middle panel of Table 1 may resemble the money supply function as there is a positive relationship between interest rate and money supply. Here we needed to restrict defgdp and fdgdp in order to obtain the identified equation. The sign of the price level is not what we expect, although the coefficient is statistically significant. However, the estimated coefficients of ly, lE, debtgdp, and the break are not statistically significant. On the contrary, foreign interest rate, which has a statistically significant coefficient, has a negative sign. Based on these, one would expect that as foreign interest rate goes up, money flows outside, money supply shifts up, and the interest rate goes up over the long-run. However, the estimated coefficient is negative, indicating a higher foreign interest rate results in a lower domestic interest rate. One possible explanation for this is that capital is not very mobile between the United States and Egypt. This result supports the findings of Arbatli & Moriyama (2011).

The coefficient of foreign (United States) price is statistically significant and positive. This result implies that as the foreign price goes up, there will be more demand for domestic goods, leading to a higher transaction demand for money and interest rate. Consequently, the relationship is positive. As the coefficient of lg indicates, there is no crowding out of government expenditure in Egypt. This also implies that a higher government expenditure results in a downward shift in the supply of money, which indicates that, as the size of government goes up, there will be a higher supply of money to finance the government expenditure over the long-run. This interpretation confirms both our theoretical and empirical findings that a higher government expenditure leads to a higher price level over the long-run; see Equation (4) and the first-row result. Along with this line, Helmy (2009) finds that a higher government budget deficit increases inflation using the fiscal policy of the price level theory.

Long-Run Aggregate Demand: The last row of the second panel resembles aggregate demand equation. For identification purposes, we needed to restrict lE, i*, defgdp and trend. Except for the break, all variables are statistically significant. The positive estimated coefficient of lMs indicates that as money supply goes up, there will be a lower interest rate which results in higher investment and real income. In other words, aggregated demand shifts to the right as money supply goes up. As the negative and statistically significant coefficient of i indicates, a higher interest rate decreases investment and consumption, and for that reason the real income as aggregated demand shifts to the left. Further, as the positive and statistically significant estimated coefficient of lp* indicates, a higher foreign price leads to higher demand for domestic goods, and accordingly a higher real income as aggregated demand shifts to the right. Finally, the estimated coefficient of lg indicates the multiplier effect of the government expenditure. This finding confirms the findings of Abu-Bader & Abu-Qarn (2003).

From the above result, we see both empirical and economic identifications are satisfied for Egypt. As a robust test, we see the FMOLS estimation result in the last panel of Table 1. However, since there is no restriction on any coefficient, most of the signs are not justified Maximum Likelihood results. Except for the estimated coefficients of income, debt per GDP, foreign-financed debt per GDP and the break, all coefficients are statistically significant. Among the latter, the coefficients of domestic interest rate, exchange rate, foreign price and debt per GDP confirm our theoretical model. In fact, 50% of coefficients, statistically significant or insignificant, confirm the theoretical model.

Table 1: *Long-Run Results for Egypt, Equation (4)*

H_0=r	0	1	2	3	4	5	6	7	Diagnostic tests†	*p*-value
Trace(1)	438.80	310.90	223.72	153.16	91.87	31.83	16.46	3.76	**Autocorrelation** LM(1) 0.04 LM(2)…. 0.19	**Normality** ChiSqr (20) 0.00 **ARCH** LM(1) 0.03 LM(2) 0.06
Trace 95	287.67	242.77	197.34	156.42	120.93	87.23	57.36	30.47		
***p*-value**	0.00	0.00	0.00	0.07[a]	0.62	1.00	1.00	1.00	**Lag length = 3**	

Johansen-Juselius Maximum Likelihood Results for r=3. Null: Restrictions for identification are accepted: χ^2 (4) = 5.33, *p*-value = 0.15

Normalized	lp	lMs	i	ly	lE	i*	lp*	lg	defgdp	debtgdp	fdgdp	C(2008:1)	trend
lp (***t*-stat)**	-	0.68 (4.56)	-1.78 (-7.07)	-4.04 (-28.48)	0.06 (1.60)	0.06 (5.43)	2.96 (6.13)	1.21 (7.12)	0.13 (11.66)	0.36 (2.64)	-19.72 (-9.68)	Restricted =0	Restricted =0
i (***t*-stat)**	-2.90 (-5.62)	1.79 (2.60)	-	1.53 (1.44)	-0.45 (-1.52)	-0.42 (-5.12)	4.19 (2.08)	-5.46 (-7.72)	Restricted =0	0.40 (0.82)	Restricted =0	0.10 (0.43)	0.004 (3.45)
ly (***t*-stat)**	-0.36 (-20.45)	0.24 (5.43)	-0.51 (-7.73)	-	Restricted =0	Restricted =0	0.94 (6.98)	0.12 (2.87)	Restricted =0	0.11 (2.88)	-5.19 (-9.80)	0.00 (0.30)	Restricted =0

Fully Modified Ordinary Least Squares (FMOLS) Results

lp (***t*-stat)**	**constant** 5.64 (4.89)	-0.27 (-3.20)	0.16 (2.06)	-0.11 (-0.63)	-0.10 (-3.55)	-0.03 -(3.40)	0.67 (3.32)	-0.89 (-7.65)	-0.67 (-1.98)	0.07 (1.13)	-0.84 (-0.84)	0.01 (0.26)	0.03 (13.36)

a = means we cannot reject the null of r (the number of cointegration relationships) = 3

(1) Using the Bartlett correction factor, the Trace test has been corrected for the small sample error (see Johansen, 2000 and 2002).

† LM(1) and LM(2) are the one and two-order Lagrangian Multiplier test for autocorrelation respectively (see Godfrey, 1988). The sample period is 1975Q1-2015Q4. lMs is the log of nominal money supply (M1), i and i* are the log[R/(1+R)] and log[R*/(1+R*)] respectively where R and R* are domestic and foreign interest rates in decimal points respectively, ly is the log of real GDP, lE is the log of nominal exchange rate (domestic currency per $US), lp and lp* are the log of domestic CPI and US CPI respectively. lg is the log of real government expenditures on goods and services, defgdp and debtgdp are deficits and outstanding debt per GDP respectively, and fdgdp is the amount of foreign-financed debt per GDP. C(2008:1) is a dummy variable for the break at 2008Q1 and trend is a linear time trend. The short-run dynamic part of the long-run model includes dummy variables *peace* (= 1 since 1979; zero otherwise), *price* (=1 for 1991Q2-1991Q2; zero otherwise), *flex* (=1 since 1991Q1; zero otherwise), *tarif* (a stepwise dummy = 0.25 for 1993Q2 to 1993Q4, = 0.50 for 1994Q1 to 1994Q4, = 0.75 for 1995Q1 to 1995Q4, = 1 since 1996Q1; zero, otherwise), *pricesub* (= 1 for 1994Q4-1995Q1; zero otherwise) to reflect the price subsidy of 1994-5, and *common* (=1 since 1998Q2; zero otherwise).

B. Long-Run Relationships in Mexico

Long-Run Price: The first row of the second panel in Table 2 reports the identified long-run price determination for Mexico. For identification purposes, i*, trend and the break are restricted in this equation. Overall, all variables are statistically significant. The coefficients of all variables, except debtgdp, confirm our theoretical model. A possible explanation for the negative effect of government debt per GDP on the price level over the long-run is that a higher government debt in Mexico results in a higher investment on government bonds. This in turn lowers demand for goods and services and then also the price. Again, like with Egypt, the coefficient of money supply is positive, as expected by our model, on the basis of which we conclude that lowering money supply reduces the price level over the long-run. Studies on inflation from the monetary approach include some of the variables that are considered in our empirical model (Capistrán *et al.*, 2012; De Mello & Moccero, 2009; Cuevas, 2008; Garcés, 2008; Gaytán & González, 2006; Hsing, 2003; Martínez *et al.*, 2001; Alfaro & Schwartz, 2000). The analysis of the determinants of inflation for earlier periods of Mexico's economy (Shelley & Wallace, 2004; Esquivel & Razo, 2003; Roger & Wang, 1995) also found this positive relationship.

Long-Run Aggregate Supply: The second row of the middle panel of Table 2 resembles the aggregate supply equation as there is a positive relationship between the price and real GDP. For identification purposes, lMs, lE, i*, lp* and trend needed to be restricted. The estimated coefficient of all variables is statistically significant. The estimated coefficient of the domestic interest rate is negative, implying that as the interest rate goes up, the aggregate supply curve moves down to the right along the aggregated demand, causing a fall in price. In fact, this result confirms the findings of Cermeño *et al.* (2012) and Loría & Ramírez (2011) that Mexico's central bank uses interest rate as a tool to reduce inflation.

The estimated coefficient of government expenditure, deficit, and foreign-financed debt is also negative, implying that as these three fiscal variables go up, aggregate supply shifts down, and the price falls over the long-run. One possible explanation for this is that a higher government expenditure, and consequently a higher deficit, stimulates the Mexican economy. The multiplier effect of these fiscal variables results in a shift in the aggregate supply to the right and a fall in the price over the long-run. A higher foreign-financed debt results in more availability of domestic money for production, causing aggregate supply to shift to the right and the price to fall. The estimated coefficient of government debt per GDP is positive, implying a higher government debt crowds out domestic investment which results in the left shift of the aggregate supply and a rise in the price in Mexico over the long-run.

Long-Run Aggregate Demand: The last row of the middle panel of Table 2 may resemble the aggregate demand equation, i.e. a negative relationship between price and real income. This result is confirmed in Grier & Grier (2006) and Adrangi *et al.* (1999) findings that there is an indirect negative effect of average inflation on aggregate output due to increasing

uncertainty about future inflation. For the research, we needed to restrict i, defgdp, debtgdp, fdgdp, i* and the break for identification purposes. All estimated coefficients are statistically significant. The estimated coefficient of lMs is positive, indicating that as money supply goes up, aggregate demand shifts to the right and the price goes up. We obtain the same result for the coefficient of lE which confirms Alfaro & Schwartz's (2000) findings. The coefficient of lp* is also positive, indicating a higher foreign price results in a higher demand for domestic goods and a higher price. The coefficient of lg is also positive, implying that a higher size of government leads to a higher aggregate demand and thus to a higher price level, although Sobarzo (2004) argues that Mexican government expenditures have been erratic, reducing their positive effects on the aggregate demand. As the negative estimated coefficient of trend variable shows, through time and with the improvement of technology, the price will fall.

From the above result, we see both empirical and economic identifications are satisfied for Mexico. As a robust test, we see the FMOLS estimation result in the last panel of Table 2. All coefficients, with the exception of the coefficient of i, lg and fdgdp, justify the Maximum Likelihood estimation results, nevertheless, only the estimated coefficient of the domestic interest rate is statistically significant.

Table 2: *Long-Run Results for Mexico, Equation (4)*

H_0=r	0	1	2	3	4	5	6	7	Diagnostic tests† *p*-value	
Trace(1)	449.92	328.83	226.95	153.57	94.88	44.86	19.57	NA	**Autocorrelation** LM(1) 0.07 LM(2)…. 0.09	**Normality** ChiSqr (20) 0.00
Trace 95	320.75	270.01	222.50	180.79	139.64	102.55	67.74	36.52		**ARCH** LM(1) 0.00
***p*-value**	0.00	0.00	0.00	0.38[a]	0.85	1.00	1.00	NA	**Lag length = 3**	LM(2) 0.02

Johansen-Juselius Maximum Likelihood Results for r=3. Null: Restrictions for identification are accepted: χ^2 (8) = 15.63, *p*-value = 0.05

Normalized (*t*-stat)	**lp**	**lMs**	**i**	**ly**	**lE**	**i***	**lp***	**lg**	**defgdp**	**debtgdp**	**fdgdp**	**C(2008:1)**	**trend**
lp (*t*-stat)	-	0.08 (2.40)	0.08 (2.56)	-2.04 (-7.15)	0.79 (22.74)	Restricted = 0	2.34 (12.22)	0.91 (4.38)	7.11 (8.09)	-2.06 (-5.06)	1.72 (4.27)	Restricted = 0	Restricted = 0
lp (*t*-stat)	-	Restricted = 0	-1.39 (-2.49)	14.28 (3.76)	Restricted = 0	Restricted = 0	Restricted = 0	-10.92 (-3.62)	-142.24 (-9.63)	37.33 (5.47)	-24.67 (-3.63)	-0.05 (-5.14)	Restricted = 0
lp (*t*-stat)	-	0.14 (4.44)	Restricted = 0	-0.89 (-4.74)	0.78 (24.27)	Restricted = 0	1.99 (11.63)	0.28 (2.31)	Restricted = 0	Restricted = 0	Restricted = 0	Restricted = 0	-0.01 (-8.67)

Fully Modified Ordinary Least Squares (FMOLS) Results

lp (*t*-stat)	**constant** -3.74 (-4.94)	0.35 (9.16)	-0.10 (-3.08)	-0.22 (-1.28)	0.66 (16.41)	0.03 (2.47)	1.34 (5.38)	-0.22 (-1.75)	2.69 (3.62)	-0.33 (-1.19)	-0.03 (-0.09)	-0.008 (-3.49)	0.02 (0.45)

a = means we cannot reject the null of r (the number of cointegration relationships) = 3

(1) Using the Bartlett correction factor, the Trace test has been corrected for the small sample error (see Johansen, 2000 and 2002).

† LM(1) and LM(2) are the one and two-order Lagrangian Multiplier test for autocorrelation respectively (see Godfrey, 1988).

The sample period is 1976Q1-2015Q4. lMs is the log of nominal money supply, i and i* are the log[R/(1+R)] and log[R*/(1+R*)] respectively where R and R* are domestic and foreign interest rates in decimal points respectively, ly is the log of real GDP, lE is the log of nominal exchange rate (domestic currency per $US), lp and lp* are the log of domestic CPI and US CPI respectively. lg is the log of real government expenditures on goods and services, defgdp and debtgdp are deficits and outstanding debt per GDP respectively, and fdgdp is the amount of foreign-financed debt per GDP, and trend is a linear time trend. The short-run dynamic part of the model includes *lib* (= 1 in 1973Q1-1989Q1; zero otherwise), *flexe* (= 1 for 1982Q3-1982Q4; zero otherwise), *dme* (= 1 since 1985Q4; zero otherwise), *tarr* is a stepwise dummy (= 0.5 for 1986Q2-1988Q1 and = 1 since 1988Q1; zero otherwise), *nafta* (= 1 since 1993Q1; zero otherwise), *corto* (= 1 for 1995Q1-1997Q4; zero otherwise), *targ* (= 1 since 1996Q2; zero otherwise), *itf* (= 1 since 2001Q1; zero otherwise), *braz* (= 1 since 2002Q3; zero otherwise), and *minr* (= 1 since 2004Q2; zero otherwise).

C. Comparison of Long-Run Relationships of Egypt and Mexico

In this subsection, we analyze how much price determination in the two studied countries is domestic and how much of it is external. For both countries, monetary policy measured by supply of money and interest rate, and on the other hand fiscal policy measured by government expenditure, deficit, debt, and debt management, affect the price level, as reported in the first row of the second panel in Tables 1 and 2. This leads to a conclusion that in these countries both fiscal and monetary policies can be used to fight inflation over the long-run.

As regards the external factors, although we needed to restrict the United States interest rate for Mexico, nevertheless, looking at the FMOLS result, we see both the United States interest rate and price affect the price level with the same sign in both countries. Based on this, it can be concluded that the price level over the long-run is influenced by both internal and external factors, and that being a neighbor of or far from a large country does not matter in analyzing the impact of the United States interest rate and price on the prices in these two countries. An interesting finding is that the effect of the United States interest rate and price on the price level is higher in Egypt than in Mexico (for interest rate see the FMOLS result for Mexico), despite the fact that the distance between Egypt and the United States is approximately 6,821 miles by air, while Mexico is next to the United States, explaining a significant economic interdependence between the latter two countries. For example, one unit increase in the 3-month TB rate in the United States will increase Egypt's price level by 0.06 units, and Mexico's rate by 0.03 units. At the same time, one unit increase in the United States CPI increases the CPI of Egypt by 2.96 and the CPI of Mexico by 2.34 over the long-run.

6 SHORT-RUN DYNAMIC MODELS OF INFLATION RATE

Tables 3 and 4 report the parsimonious estimation of the final error correction model (ECM) for Egypt and Mexico respectively. The models are implied by the cointegrating vectors based on Hendry's General-to-Specific approach. We allowed a lag profile of eight quarters at the original ECM and estimated the error correction models of the price, i.e. Equation (4). Following Granger (1986), we should here note that if small equilibrium errors can be ignored while reacting substantially to large ones, the error correcting equation is non-linear. Based on this finding, all possible kinds of non-linear specifications, i.e. squared, cubed and fourth powered, of the equilibrium errors with statistically significant coefficients, as well as the products of the significant equilibrium errors were incorporated in the research.

Table 3*: *Parsimonious Error Correction Model for Egypt*
Dependent Variable = Δlp

Variable	**Coefficient**	***t*-stat**	***p*-value for Hansen's (1992) stability L_i test**
constant	0.12	5.28	0.31
ECP_{t-6}	-0.02	-3.75	0.25
ΔlMs_{t-5}	0.06	2.27	0.34
ΔlE_{t-4}	0.04	3.83	0.61
Δi^*_{t-7}	-0.01	-2.42	0.23
$\Delta defgdp_{t-6}$	-0.63	-3.42	0.27
$\Delta defgdp_{t-7}$	0.47	3.13	0.95
$\Delta fdgdp_{t-1}$	-2.18	-3.43	0.18
$\Delta fdgdp_{t-2}$	1.89	2.05	0.01
Δlg_{t-5}	-0.19	-3.42	0.54
pricesub	0.05	10.55	1.00
trend	0.0004	2.95	0.22
Hansen's (1992) stability L_i test on the variance = 0.85			*p*-value = 0.01
Joint (coefficients and the error variance) Hansen's (1992) stability L_c test = 3.03			*p*-value = 0.07

* For the definition of some of the variables see footnote of Table 1. The estimation method is Newey & West's (1987) Robust Error Ordinary Least Squares.
The sample period is 1975Q1-2015Q4. Mean of the dependent variable=0.03. Δ means the first difference, ECP is the error correction term generated from the first identified long-run relationship in the cointegration space, normalized on the log of domestic price (see Table 1).Dummy variable *pricesub* is equal to one from 1994Q4 to 1995Q1 and zero otherwise. Trend is a linear time trend. $\overline{R}^2$ =0.35, σ=0.03, DW=2.04, Godfrey(6)=0.73 (significance level=0.63), White=58.16 (significance level=0.77), ARCH(5)=1.64 (significance level=0.02). Note that $\overline{R}^2$, σ and DW respectively denote the adjusted squared multiple correlation coefficient, the residual standard deviation and the Durbin Watson statistic. White is White's (1980) general test for heteroskedasticity, ARCH is the five-order Engle's (1982) test, Godfrey is the five-order Godfrey's (1978) test, L_i is Hansen's (1992) stability test for the null hypothesis that the estimated coefficient or variance of the error term is constant, and L_c is Hansen's (1992) stability test for the null hypothesis that the estimated coefficients as well as the error variance are jointly constant.

Table 4*: *Parsimonious Error Correction Model for Mexico*
Dependent Variable = Δlp

Variable	Coefficient	*t*-stat	*p*-value for Hansen's (1992) stability L_i test
constant	-0.61	-8.27	0.94
ECP_{t-1}	-0.11	-8.76	0.95
Δlp_{t-3}	0.71	7.68	0.98
Δlp_{t-5}	-0.35	-3.65	1.00
ΔlMs_{t-3}	-0.05	-2.74	0.96
Δi_{t-3}	0.02	6.66	0.85
Δly_{t-3}	1.01	4.38	0.52
ΔlE_{t-1}	0.13	5.11	0.78
Δi^*_{t-3}	-0.01	-1.97	0.00
Δlp^*_{t-5}	-1.08	-1.98	0.98
$\Delta defgdp_{t-5}$	-1.65	-2.82	0.92
$\Delta defgdp_{t-6}$	1.74	3.40	0.96
$\Delta debtgdp_{t-1}$	0.87	2.62	0.25
$\Delta fdgdp_{t-2}$	0.30	4.66	0.96
itf	0.02	2.53	0.67
nafta	-0.03	-3.81	0.81
trend	0.001	5.56	0.88
Hansen's (1992) stability L_i test on the variance = 0.91			*p*-value = 0.00
Joint (coefficients and the error variance) Hansen's (1992) stability L_c test = 3.02			*p*-value = 0.45

* For the definition of some of the variables see footnote of Table 2. The estimation method is Newey & West's (1987) Robust Error Ordinary Least Squares.
The sample period is 1976Q1-2015Q4. Mean of the dependent variable=0.055. Δ means the first difference, ECP is the error correction term generated from the first identified long-run relationship in the cointegration space, normalized on the log of domestic price (see Table 1).
Dummy variables are *itf* (=1 since 2001Q1, zero otherwise) and *nafta* (=1 since 1993Q1, zero otherwise), $\overline{R}^2$=0.85, σ=0.06, DW=1.91, Godfrey (6)=0.78 (significance level=0.59), White=142.15 (significance level=0.55), ARCH (5) =20.31 (significance level=0.00). Note that $\overline{R}^2$, σ and DW respectively denote the adjusted squared multiple correlation coefficient, the residual standard deviation and the Durbin Watson statistic. White is White's (1980) general test for heteroskedasticity, ARCH is the five-order Engle's (1982) test, Godfrey is the five-order Godfrey's (1978) test, L_i is Hansen's (1992) stability test for the null hypothesis that the estimated coefficient or variance of the error term is constant, and L_c is Hansen's (1992) stability test for the null hypothesis that the estimated coefficients as well as the error variance are jointly constant.

Assuming that due to government spending and foreign-financed debt as a percentage of GDP as well as money supply variables are exogenous over the short-run, we have five endogenous variables in the system. However, for the sake of brevity, we only report the ECM of the price level. In Tables 3 and 4, Δ denotes a first difference operator and ECS, $\overline{R}^2$, σ and DW respectively denote the squared of error correction term from the

long-run equation for the price level, the adjusted squared multiple correlation coefficient, the residual standard deviation and the Durbin Watson statistics respectively. White is White's (1980) general test for heteroskedasticity, ARCH is the five-order Engle's (1982) test, Godfrey is the five-order Godfrey's (1978) test. L_i is Hansen's (1992a) stability test for the null hypothesis that the estimated i^{th} coefficient or variance of the error term is constant, while L_c is Hansen's (1992a) stability test for the null hypothesis that the estimated coefficients, together with the error variance, are jointly constant. In addition, we include dummy variables specified in DUM for each country. According to Engle's (1982) ARCH test result, the error is heteroskedastic for both countries. Consequently, the estimation method applied is Newey & West's (1987) Robust Error Ordinary Least Squares. None of the other diagnostic checks proves significant for both countries. Based on Hansen's stability test results, all of the coefficients individually are stable, however, because the error is heteroskedastic, the variance of the estimate is not stable, making the stability test result for the joint test significant for both countries.

A. Short-Run Dynamic of Inflation Rate in Egypt

As reported in Table 3, the error correction term is significant after six lags and none of the non-linear error correction terms proves statistically significant. The estimated coefficient of the change in money supply is positive and is hence a determinant of the inflation rate in the short-run. This leads to a conclusion that a higher money supply increases inflation rate over the short-run. The coefficient of the change in the exchange rate (growth of exchange rate) is positive, implying that a fall in the value of the Egyptian pound results in a higher inflation over the short-run. Interestingly, the change in the United States rate over the short-run has a negative impact on the inflation rate in Egypt, while the growth of the United States price (United States inflation rate) does not have any impact on the inflation rate in Egypt and was for that reason dropped.

A change in deficits per GDP affects the inflation rate negatively after six quarters, while after seven quarters it raises the inflation rate. The overall coefficient, that is the sum of these coefficients, is negative, implying that the overall effect of the deficit per GDP is negative over the short-run in Egypt. Perhaps a higher deficit will be considered a higher future tax or money supply/inflation. Consequently, consumers will reduce their spending which will cause the inflation to fall. Finally, empirical evidence supports the fact the fiscal deficit reinforces the relationship between fiscal deficit and inflation (El-Sakka & Ghali, 2005).

The change in the foreign-financed debt per GDP has a negative impact on the inflation rate over the short-run as its level has a negative effect on the level of the price over the long-run. The growth of the real government expenditures affects inflation after five quarters over the short time, and the impact is negative. However, as evident from our research, over the long-run the impact of the real government expenditures increases the price level which confirms our theoretical model. Finally, the elimination of price

subsidies in late 1994 resulted in an increase in the inflation rate. The overall conclusion is that the sources of inflation over the short-run in Egypt are mostly internal. These sources include both fiscal and monetary policies, which confirm the existing empirical evidence on Egypt. However, the United States interest rate also has a negative effect on the inflation rate, but its price level, contrary to its positive long-run effect, does not have any impact on inflation rate over the short-run.

B. Short-Run Dynamic of Inflation Rate in Mexico

As reported in Table 4, the error correction term is significant after one lag, and none of the non-linear error correction terms proves statistically significant. Lagged inflation in Mexico also influences the current inflation after the third and fifth quarters with an overall positive effect, a result that confirms Ramos-Francia & Torres' (2008) findings. On the other hand, the impact of the change of money supply is significant only after three quarters and is negative. This result is contrary to what Cuevas (2008) finds in Mexico, where money shocks seem to be the leading cause of inflation in the short-run.

The change in the interest rate influences the inflation rate positively, while the growth of the real GDP affects the inflation rate positively after three quarters. The estimated coefficient of the growth in the depreciation of the domestic currency (the growth of exchange rate) is positive, implying that a reduction in the value of domestic currency results in a higher inflation rate. The changes of both foreign variables prove to have a negative impact on inflation in Mexico. Regarding the negative impact of the United States prices on Mexico, it is only over the short-run after five quarters, and not over the long-run as we would expect, that it turns positive. Moreover, the Mexican price which reflects the United States price also has an overall positive effect on the domestic price; see Table 4. The negative influence of the United States inflation on the inflation in Mexico over the short-run indicates there is no imported inflation from the United States to Mexico. However, Galindo & Ros (2008) do point out the presence of imported inflation due to the pass-through effect.

As for the fiscal variables, the change in the deficit per GDP has a negative impact on inflation after the fifth quarter, but a positive one after the sixth quarter with an overall positive effect (the summation of the coefficients). Both the government debt and its foreign-financed debt have a positive influence on inflation. The overall influence of the fiscal policy, deficit, debt and debt management on the inflation rate is positive over the short-run in Mexico. This result confirms Roger & Wang's (1995) finding on the fiscal view of inflation. Further, the dummy variable itf has a positive effect on the inflation rate in Mexico, and this is why the officially announced inflation target by the Banco de México resulted in more inflation in Mexico, while joining NAFTA on the other hand resulted in lower inflation in Mexico as the coefficient of the dummy variable nafta is negative. The overall conclusion is that the source of inflation over the short-run in Mexico is mostly internal, i.e. the fiscal policy, a result that confirms the findings of Almansour *et al.* (2015).

However, according to Blecker's (2009) finding, after the economic liberalization in the mid-80s, Mexico has since been more vulnerable to external shocks, in particular coming from the United States. Furthermore, Mackowiak (2007) finds Mexico responds more strongly to shocks coming from the United States monetary policy when compared with other emerging markets.

C. Comparison of Short-Run Relationships of Egypt and Mexico

In this subsection, it is analyzed how much price determination in the two studied countries is domestic and/or external. From the results in Tables 3 and 4, it is evident that over the short-run the sources of inflation are fiscal and monetary policies. Being far from or a neighbor of the United States is key, as both the United States interest rate and price affect Mexico's inflation rate, but only the United States interest rate influences the inflation in Egypt.

Interestingly, the magnitude effect of the impact of the United States interest rate is the same (-0.01) in both countries, with the difference that the United States interest rate influences the inflation rate in Mexico after three quarters, and in Egypt after seven quarters. In conclusion, the United States price might not have any impact on the inflation rate in Egypt, but it does have an adverse effect in Mexico.

7 CONCLUDING REMARKS

This paper examines the influence of internal and external factors on the inflation rate in Egypt and Mexico respectively, using a monetary model of inflation that incorporates both monetary and fiscal policies, as well as other internal and external factors. The model is estimated using quarterly data for Egypt for the period 1975Q1-2015Q4, and for Mexico for the period 1976Q1-2015Q4.

We find that both the monetary policy measured by the supply of money and interest rate and the fiscal policy measured by government expenditure, deficit, and debt as well as debt management, affect the price level over the long-run in both countries. Consequently, both policies can be used to fight inflation over the long-run in these countries. Furthermore, it is the United States interest rate and its price that affect the price level with the same sign in both countries over the long-run.

Therefore, it can be concluded that the price level over the long-run is affected by both internal and external factors in these countries. An interesting finding in the research is that the impact of the United States interest rate and price on the price level over the long-run is higher in Egypt than in Mexico, even though Mexico is geographically positioned next to the United States, which shows there is an economic interdependence between the two countries. However, over the short-run, distance does matter. The magnitude effect

of the impact of the United States interest rate is the same in both countries, with the difference that the United States interest rate influences the inflation rate in Mexico after three quarters, while in Egypt the inflation rate is influenced after seven quarters. We conclude that the United States price does not have any impact on the inflation rate in Egypt, but it does have a negative effect on the inflation rate in Mexico.

A higher exchange rate (lower value of domestic currency), leads to a higher price in Mexico, in both short and long-runs. Thus, a policy regime that supports a strong currency can keep inflation low in this country. An easy monetary policy in both countries results in a higher price level over the long-run, however, over the short-run, it leads to a higher inflation in Egypt, which nevertheless proves to be the opposite for Mexico.

Over the long-run, a lower interest rate turns to be an effective policy in lowering prices in Mexico, while the opposite is found for Egypt. However, while over the short-run, a change of interest rate does not have any significant effect in Egypt, a lower interest rate, as established in the research, reduces the inflation rate in Mexico.

Within the research, it is also ascertained that the fiscal policy is very effective in combatting inflation in both countries over the long-run. According to the results, an increase in real government expenditures and deficit adds to inflation over the long-run in both countries. A high debt per GDP in Egypt is inflationary, however, the opposite is true in Mexico over the long-run. Further, the foreign financing of government debt has a negative effect in Egypt, but we find the opposite effect on the price for Mexico over the long-run. Also, over the short-run, the increase of deficit and foreign financing of the debt lowers inflation in Egypt, but the opposite is true for Mexico.

From the perspective of an institutional impact, it was the removal of price subsidies in late 1994 that led to an increase of the inflation rate in Egypt. Finally, the inflation target officially announced by the Banco de México resulted in more inflation in Mexico, however, joining NAFTA resulted in lower inflation in the same country.

DATA APPENDIX

The data are seasonally adjusted and derived from the online *International Financial Statistics* (IFS), compiled by the International Monetary Fund (IMF). The data on the outstanding debt (Debt) for Egypt, which are recorded as claims on the government, were not available for the 2009Q3-2015Q4 and were for that reason constructed according to the following formulas:

$Debt_t = Debt_{t-1} + g_t$ (= total government expenditure) - T_t (= government tax revenues) - ΔMB_t (= change in monetary base)

$= Debt_{t-1} + deficits_t$ (= $g_t - T_t$) - ΔMB_t.

However, quarterly data on the outstanding government debt for Mexico are available.

The data missing for both countries were taken from the *World Development Indicator* (WDI). Also, when observations within a series were missing, they were interpolated. The data series on the GDP, government deficits and expenditures for both countries are available only yearly. Consequently, quarterly observations were interpolated, using the statistical process developed by RATS (Regression Analysis of Time Series), a procedure that keeps the final value fixed within each full period.

Information on the institutional and policy changes in Egypt was taken from *The Middle East and North Africa* (2015), and for Mexico from the annual Bank of Mexico reports (Bank of Mexico, several years). Unfortunately, no data on the government expenditure and deficit for the year 2005 for Egypt were available. To fill these gaps, we used the mean of the years 2004 and 2006 respectively. Finally, the source of the United States data is the St. Louis Federal Reserve website.

Table A1: *Definition of DUM for Egypt*

Dummy Variables	Definitions
peace	Equals 1 since 1979; zero otherwise; reflecting peace with Israel.
price	Equals 1 for 1991Q2; zero otherwise; reflecting an increase in price as a result of the tax increase from 14% to 66% in the second quarter of 1991.
flex	Equals 1 since 1991Q1; zero otherwise; reflecting the introduction of the flexible exchange rate in 1991.
tarif	*tarif* is a stepwise dummy (= 0.25 for 1993Q2 to 1993Q4, = 0.50 for 1994Q1 to 1994Q4, = 0.75 for 1995Q1 to 1995Q4, = 1 since 1996Q1; zero otherwise); reflecting the introduction of the new tariff in 1992.
pricesub	Equals 1 for 1994Q4-1995Q1; zero otherwise; reflecting the price subsidy of 1994-5.
common	Equals 1 since 1998Q2; zero otherwise; stands for joining the common market in 1998.

Table A2: *Definition of DUM for Mexico*

Dummy Variables	Definitions
lib	Equals 1 in 1973Q1-1989Q1; zero otherwise; reflecting the regulation of foreign investment.
flexe	Equals 1 for 1982Q3-1982Q4; zero otherwise; indicating the control of exchange rate.
dme	Equals 1 since 1985Q4; zero otherwise; signifying the imposition of a floating exchange rate.
tarr	*tarr* is a stepwise dummy (= 0.5 for 1986Q2-1988Q1 and = 1 since 1988Q1; zero otherwise); applied to reflect tariff reductions in both the first and second rounds in December 1987.
nafta	Equals 1 since 1994Q1; zero otherwise; reflecting the joining of the NAFTA agreement with the United States and Canada.
corto	Equals 1 for 1995Q1-1997Q4; zero otherwise; indicating the Accumulated Balances Regime.
targ	Equals 1 since 1996Q2; zero otherwise; reflecting the inflation target.
itf	Equals 1 since 2001Q1; zero otherwise; indicating the officially announced inflation target by Banco de México's adoption of the Inflation Targeting.
braz	Equals 1 since 2002Q3; zero otherwise; signifying Brazil and Mexico's trade agreement that reduced import duties on some 800 products.
minr	Equals 1 since 2004Q2; zero otherwise; reflecting the minimum interest rate announcement.

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WHERE IS AUSTRIA'S ECONOMY HEADING?

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ABSTRACT: *Austria is one of the wealthiest and most stable European Union Member States. With spectral analysis this paper attempts to forecast economic indicators of the Austrian economy up to 2030 to provide a clearer picture of its future economy. The applied spectral analysis reveals hidden periodicities in the studied country's economic data which are to be associated with cyclical behaviour or recurring processes in economic time series. The 2018-2030 period forecasts of Austria's real GDP, government budget deficit or surplus in current prices, current account balance and total population respectively are all bullish, including unemployment rate doomed to expand at an annual rate of 0.58% until 2030.*

Key words: *Austria, Gross Domestic Product, forecast, spectral analysis, Burg model*

JEL classification: C53, E37

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1 INTRODUCTION

Austria's economy is a well-developed market economy with skilled labour force and high standard of living (Index Mundi, 2018). It has developed strong ties with the European Union (EU) economies such as Germany, otherwise the economic leader of the EU block. The studied country's economy witnesses a predominant service sector, a rather developed industrial sector, and a small but highly developed agricultural sector respectively. Tourism is a strong component of Austria's economy, being one of the largest natural land reserves in central Europe. Mechanical engineering, steel construction, chemicals, luxury commodities, vehicle manufacturing, and food are the most significant industries of the country. The industrial and commercial sector respectively are characterized by a high proportion of medium-sized companies. The growth of the industrial sector requires additional imports, while in the sector of raw materials and energy production, Austria has natural resources of iron ore, non-ferrous metals, important minerals and earths. In addition, the country generates its own resources of petroleum and natural gas, and what is more, is the leader of hydroelectric power in the EU, which however needs to be constantly expanded.

Austria joined the euro area in 2002. The euro area is a monetary union of 19 of the 28 European Union member states which have adopted the euro currency as their common currency and sole legal tender. Besides Austria, the other countries belonging to the euro

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area are Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Greece, Slovenia, Cyprus, Malta, Slovakia, Estonia, Latvia, and Lithuania.

In 2018, Austria had the 7th largest real GDP among the euro area countries, with lagging behind Germany, France, Italy, Spain, Netherlands, and Belgium. The correlation of Austria's real GDP with the six top performers of the euro area is illustrated in Table 1.

Table 1: *Correlation matrix between the top 7 Real Gross Domestic Products of the euro area of Chained 2010 Euros, Seasonally Adjusted, Frequency: quarterly from 1995-01-01 to 2018-01-01 (93 pieces of data)*

	Germany	*France*	*Italy*	*Spain*	*Netherlands*	*Belgium*	*Austria*	*Euro area*
Germany	*1.00*	*0.96*	*0.54*	*0.87*	*0.95*	*0.97*	*0.97*	*0.95*
France	*0.96*	*1.00*	*0.70*	*0.96*	*0.99*	*0.99*	*1.00*	*0.99*
Italy	*0.54*	*0.70*	*1.00*	*0.83*	*0.66*	*0.65*	*0.59*	*0.75*
Spain	*0.87*	*0.96*	*0.83*	*1.00*	*0.96*	*0.95*	*0.94*	*0.98*
Netherlands	*0.95*	*0.99*	*0.66*	*0.96*	*1.00*	*0.99*	*0.99*	*0.99*
Belgium	*0.97*	*0.99*	*0.65*	*0.95*	*0.99*	*1.00*	*1.00*	*0.99*
Austria	*0.97*	*1.00*	*0.59*	*0.94*	*0.99*	*1.00*	*1.00*	*0.99*
Euro area	*0.95*	*0.99*	*0.75*	*0.98*	*0.99*	*0.99*	*0.99*	*1.00*

Source: Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org and Eurostat, https://ec.europa.eu/eurostat/data/database

Table 1 illustrates the strong relationships that Austria's economy has developed with the top six performer economies of the euro area with the exception of Italy (0.59 only). Overall, the correlation coefficient of Austria's real GDP with the euro area real GDP tops 0.99 through the 1995-2018 period (93 observations).

Based on the GDP per capita world ranking (The World Factbook, 2019), the top seven performers of the euro area rank in the following order: the Netherlands (USD 53,600 per capita 2017 estimate, 23th world ranking), Germany (USD 50,400, 27th), Austria (USD 49,900, 30th), Belgium (USD 46,600, 35th), France (USD 43,800, 41st), European Union (USD 40,900, 45th), Spain (USD 38,300, 49th), and Italy (USD 38,100, 50th).

Austria was one of the few countries in the Eurozone to emerge relatively unharmed from the 2008-2009 financial crisis (Famira-Mühlberger & Leoni, 2013) thanks to its high GDP per capita, its high employment and on the other hand relatively low unemployment. In January 2019, with 4.8% the Austrian unemployment rate was the 10th lowest rate in the euro area, with the top three lowest unemployment rate countries being the Czech Republic (2.1%), Germany (3.2%), and the Netherlands (3.6%), including the euro area recording 7.8% (Statista, 2019). After 2008, employment growth in Austria was markedly

higher than the average for the euro area and the rise in unemployment was much lower. In 2013, Austria had a higher real GDP level than before the crisis, i.e. in 2007, which was true only for about half of the euro area member countries. Over the longer term, Austria has benefited from the above-average growth attributed in part to its efficient institutions and the ability to adapt to changing conditions, and in part to the positive impact of the EU eastern enlargement, including the country's geographical location in a strong and dynamic economic region. However, compared to its neighbour Switzerland (Weyerstrass, 2015), which is not in the EU but is of similar size and geographical location, Austria has fallen behind in recent years. In fact, in 1995, Austria's GDP per capita was 14 per cent lower than that of Switzerland. By 2017, this gap had widened to 23 per cent based on the authors' computation. According to Weyerstrass, the slowdown has had both external and domestic reasons. The most important domestic demand component, i.e. private consumption, has only grown very little since 2011. Reasons for this situation have been a stubbornly high inflation rate, compared to the euro area average and to Germany, but also a rising tax burden. The Austrian income tax system is quite progressive, that is the country's nominal wage increases are to a large extent eaten up by higher taxes. In addition, the government has raised indirect taxes so as to curb the fiscal deficit. What is more, to flat its private consumption, the typical engine of economic recoveries in Austria has stuttered of late. Typically, first Austria's exports would recover, followed by companies starting to invest more. However, in the recent past and the impact still felt today, Austrian export performance has been disappointing. This has not only been caused by a lack of foreign demand but by the fact that Austrian companies have also lost ground on international markets.

This paper aims at forecasting Austria's economic indicators until 2030, using signal processing. The latter focuses on decorticating signals to capture, fathom, control, and extrapolate information nested in these signals (Rostan and Rostan, 2018a). Section 2 of the paper reviews the literature on the applied economic forecasting methods and the place of signal processing among them.

2 THEORETICAL BACKGROUND

The traditional economic forecasting methods include causal methods (regression analysis, logit, probit), time series methods (moving average, exponential smoothing, trend and seasonal decomposition, Box-Jenkins ARIMA), and qualitative methods respectively (Delphi Method, Jury of Executive Opinion, Sales Force Composite, Consumer Market Survey) (FHI, 2019). Signal processing presented in this paper to forecast Austria's economic indicators belongs to the time series methods. This type of processing is borrowed from the field of physics and focuses on the analysis, synthesis, and modification of signals. The basic assumption of this paper is that economic time series behave like signals propagating through time instead of propagating through space like physics phenomena, such as audio, video, speech, geophysical, sonar, radar, medical or musical signals (IEEE, 2019). The two reasons of using the signal processing method is firstly, the outstanding versatility of signal processing in analysing and forecasting signals, and secondly, the wave pattern

that characterized the shape of the economic indicators under examination in terms of absolute level or first difference.

The advanced economic time series forecasting methods include combination of methods such as autoregressive integrated moving average (ARIMA) and seasonal exponential smoothing (SES) techniques (Rimaitytė et al., 2017), or standard linear autoregressive (AR) models where the three most commonly used nonlinear models differ in their description of the transition between regimes (Korenok, 2011). In the threshold autoregressive (abbreviated, TAR) model, regime changes abruptly, while in the smooth threshold autoregressive (abbreviated, STAR) model, regime changes slowly. Nevertheless, in both models the regime change depends on the time index or lagged values. In the Markov-switching autoregressive (abbreviated, MAR) model, however, the regime change depends on the past values of an unobserved random variable, the state of the Markov chain, and possibly the lagged values. The proposed method of this paper is a combination of methods, the wavelet analysis which is an application of signal processing, and the Burg model which fits a p^{th} order autoregressive (AR) model to the input signal x, by minimizing (least squares) the forward and backward prediction errors while constraining the AR parameters to satisfy the Levinson-Durbin recursion.

The theories of economic cycles have been initiated by dynamic economics where economic variables are changing due to their dynamic state. Interest rates, exchange rates, volatility of asset returns, gross domestic product, government budget deficit or surplus, current account balance in current prices, levels of employment or consumer spending all propagate through time in waveforms. These waveforms represent the shape and form of the before mentioned economic signals. The modelization of economic variables based on time element, subject to uncertain, unexpected and irregular dynamics, and where fluctuations occur, has challenged econometricians and forecasters in a quest for sophisticated models able to capture and predict the evolving behaviour, frequency, rate of change, amplitude, shape and form of these economic variables through time. Many physical phenomena, such as electrical, audio or seismic signals, propagate through space in waveforms. The basic idea of this paper is to apply a model that captures dynamics in physics and use the latter in dynamic economics. The concept of dynamics derived from physics refers to a state where there is a change, as for example movement. By analysing the system of mechanics of signals, dynamics can be understood. The wavelet analysis has stirred interest for its ability to analyse changing transient physical signals (Lee and Yamamoto 1994). According to Lee and Yamamoto (1994), wavelet analysis expands functions in terms of wavelets generated in the form of translations and dilations of a fixed function called the mother wavelet, where he resulting wavelets have special scaling properties, localized in time and frequency, permitting a closer connection between the represented function and their coefficients, and ensuring a greater numerical stability in reconstruction and manipulation.

Extending the analysis to complex-behaviour economic signals, the originality of this paper is to apply the wavelet analysis to the economic variables subject to common dynamics,

such as GDP time series of the countries pertaining to the same economic zone as is the euro area. Given that in the euro area international trade and financial transactions have been much more intense during the last decades than in the past (Leon, 2016), it is expected that shocks affecting one country affect through transmission channels to some extent another country as well. Some major transmission channels have been identified, such as trade, exchange rates, final integration, including the confidence channel that may affect international business cycles (Eickmeier, 2004). Nevertheless, from a theoretical point of view, the effect of globalization on the business cycle transmission, quantified by the above channels, remains unclear. The whole issue is complicated by the fact that in an optimum currency area, such as the Eurozone where Austria is an active participant, each participating country loses its own monetary and exchange rate instruments. However, the main characteristics of the cyclical economic indicators of Austria, as are wave length, volatility and transmission mechanisms of exogenous shocks, are captured by signal processing.

The applied signal processing focuses on the analysis, synthesis, and modification of signals. In this process, wavelets mimic signals with specific properties that make them useful for signal processing, while the spectrum analysis focuses on the data analysis of these signals. From a finite record of a stationary data sequence, spectrum analysis estimates how the total power is distributed over frequency (Stoica and Moses, 2005). Such analysis may reveal the so-called *hidden periodicities* in the researched data which are to be associated with cyclic behaviour or recurring processes in the field of meteorology or astronomy for example.

The wavelet analysis is a spectrum analysis technique which uses either the Discrete Wavelet Transform (DWT) or the Continuous Wavelet Transform (CWT). Since CWT has several properties that are not tractable, such as highly redundant wavelet coefficients (Valens, 1999), an infinite number of wavelets in the wavelet transform and no analytical solutions found for most functions of the wavelet transforms, practitioners use mostly DWT. For example, to refine the wavelet-based forecasting method, Renaud et al. (2002) proposed a redundant à trous wavelet transform and a multiple resolution signal decomposition. Combining the wavelet transform and ARIMA models, Conejo et al. (2005) forecasted day-ahead electricity prices. Further, focusing on seasonalities, Schlüter and Deuschle (2010) incorporated the wavelet transform in their forecasting models with a time-varying period and intensity respectively. Merging wavelet transform with ARIMA and GARCH models, Tan et al. (2010) proposed a price forecasting method. Integrating wavelet transform to multivariate adaptive regression splines (MARS) and to vector regression (SVR called Wavelet-MARS-SVR), Kao et al. (2013) addressed the problem of a wavelet sub-series selection and this way improved the forecast accuracy. Mixing wavelet and neural network models, Ortega and Khashanah (2013) forecasted stock returns from high-frequency financial data. Capturing the cyclicality of metal prices, Kriechbaumer et al. (2014) implemented a wavelet-autoregressive integrated moving average (ARIMA) model to forecast monthly prices of metals. In order to forecast the exchange rate movement, He et al. (2014) proposed an entropy optimized wavelet-based forecasting

model. Rostan et al. (2015) appraised the financial sustainability of the Spanish pension system by means of spectrum analysis. To separate short-run noise from long-run trends, Berger (2016) transformed a financial return series into its frequency and time domain via wavelet decomposition, and assessed the relevance of each frequency to the value-at-risk (VaR) forecast. Spectrum analysis was also applied to yield curve forecasting with a robust outcome when benchmarked to the Diebold and Li (2006) model (Rostan et al., 2017). Using signal processing and the multiscale principal component analysis, Rostan and Rostan (2017) forecasted the European and Asian populations with distinctive outcomes compared with the population projections of the United Nations. Finally, Rostan and Rostan illustrated the versatility of the wavelet analysis firstly, to the forecast of financial times series (2018a), secondly, to the forecast of Spanish (2018b) and Greek economies (2018c), and thirdly, to assess the Saudi pension system sustainability (2018d).

The paper continues with Section 3 in which the methodology is presented, followed by Section 4 which gathers the results, and section 5 which concludes the paper.

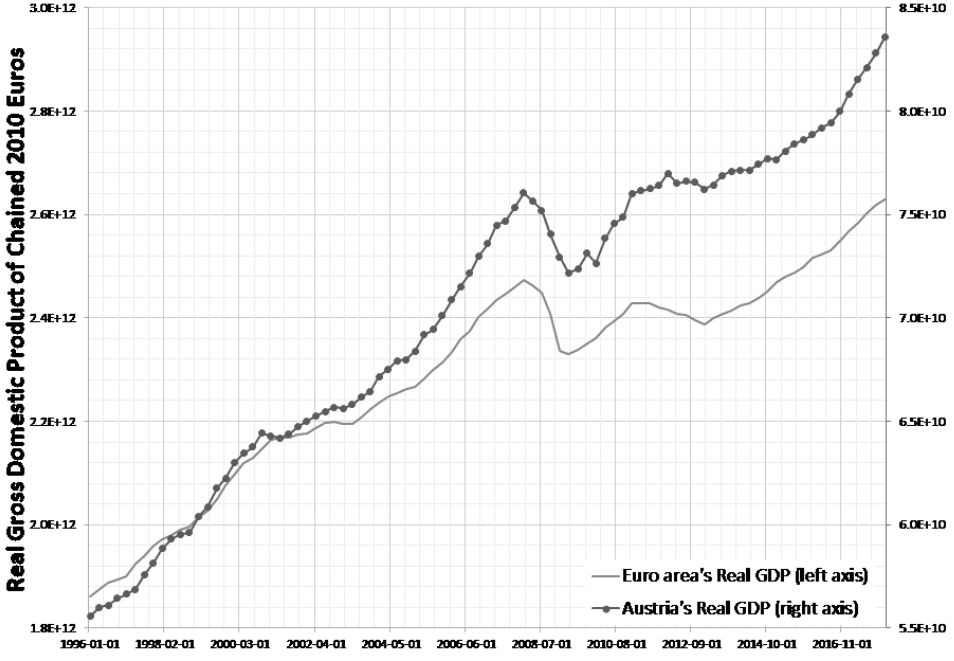
3 METHODOLOGY

The objective of the paper is to present an application of spectral analysis to the forecasts of Austria's major economic indicators to get a sense of where Austria's economy is heading by 2030. The methodology, improved with a denoising and compression step since applied to financial time series (Rostan and Rostan, 2018a), requires four steps illustrated with Austria's real Gross Domestic Product (GDP). The four steps to forecast the other economic indicators, that is the government budget deficit or surplus in current prices, current account balance, total population and unemployment rate, are identical to the four steps illustrated with GDP. Figure 1 illustrates quarterly data of Austria's real GDP of Chained 2010 Euros, seasonally adjusted, with quarterly data from 1996-01-01 to 2018-01-01 (89 pieces of data/information).

3.1 Step 1: The denoising and compression of the first-order difference of Austria's GDP time series

We compute the first-order difference of Austria's real GDP time series to transform non-stationary series into stationary series. We apply the Augmented Dickey-Fuller test to the time series before and after differentiation, where before differentiation, the time series are non-stationary, i.e. the existence of a unit root, and after differentiation, the time series is stationary, i.e. rejection of the existence of a unit root). This transformation is applied because the wavelet analysis presents a more accurate forecasting ability with stationary time series than it does with non-stationary time series. For demonstration please refer to Rostan and Rostan (2018a).

Figure 1: *Real Gross Domestic Product for Austria of Chained 2010 Euros, Seasonally Adjusted, Frequency: quarterly from 1996-01-01 to 2018-01-01 (89 data) compare to euro area real GDP*



Source: Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org and Eurostat, https://ec.europa.eu/eurostat/data/database

Applying a one-dimensional denoising and compression-oriented function using wavelets, the series are denoised. The function is borrowed from Matlab (Misiti et al., 2015) and is called 'wdencmp'. The underlying model for the noisy signal is of the form:

$$s(n) = f(n) + \sigma e(n) \qquad (1)$$

where time n is equally spaced, $e(n)$ is a Gaussian white noise $N(0,1)$, and the noise level σ is the standard deviation of $s(n)$ and is supposed to be equal to 1. The denoising objective is to suppress the noise part of the signal s and to recover f. The denoising procedure involves the following three steps:

1) Decomposition with the wavelet *sym4* and a level-2 decomposition. *Sym4* is a symlets wavelet of order 4, used as the mother wavelet for both decomposition and reconstruction. It is a nearly symmetrical wavelet, belonging to the family of *Symlets*

proposed by Daubechies (1994). We compute the wavelet decomposition of the signal *s* at level 2.

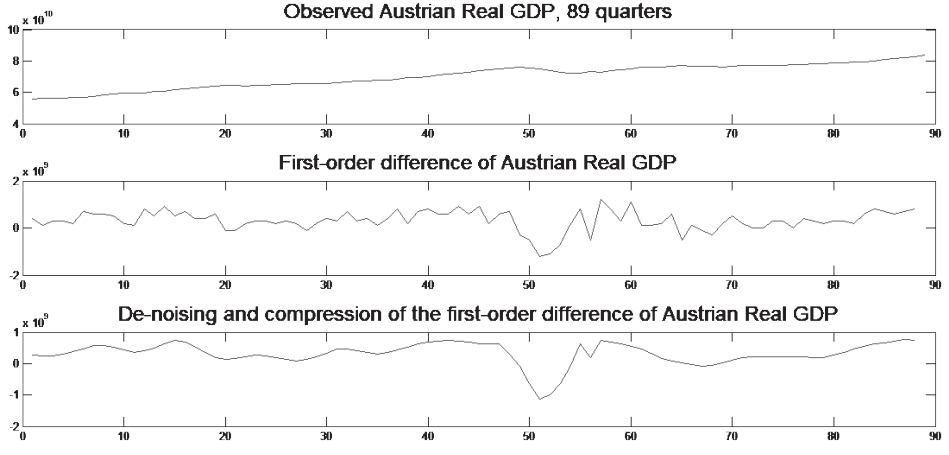
2) Detail coefficients thresholding. For each level from 1 to 2, we select a threshold and apply soft thresholding to the detail coefficients.

3) Reconstruction. We compute a wavelet reconstruction based on the original approximation coefficients of level 2 and the modified detail coefficients of levels from 1 to 2.

After denoising, the compression procedure contains three steps: 1) Decomposition. 2) Detail coefficient thresholding. For each level from 1 to 2, a threshold is selected and hard thresholding is applied to the detail coefficients. 3) Reconstruction. The difference with the denoising procedure is found in step 2. Compression is based on the concept that the regular signal component can be accurately approximated, using a small number of approximation coefficients (at a suitably selected level) and some of the detail coefficients.

Figure 2 illustrates Austria's real GDP (89 pieces of data) before differentiation (top figure), after differentiation (middle) and after denoising and compression (bottom).

Figure 2: *Observed Austria's Real GDP from 1996-01-01 to 2018-01-01 (89 pieces of data, top), First-order difference of Austria's Real GDP (middle), Denoising and Compression of the first-order difference of Austria's Real GDP (bottom)*

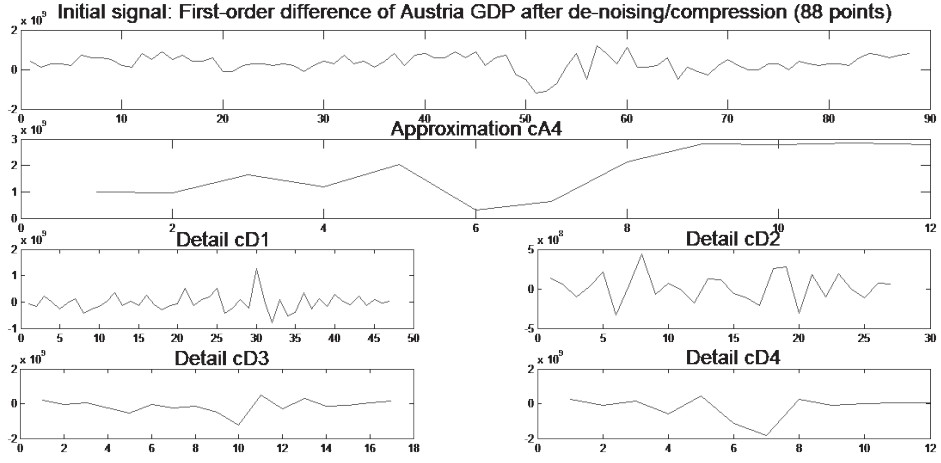


Source: Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org and Eurostat, https://ec.europa.eu/eurostat/data/database

3.2 Step 2: Wavelet Decomposition

We decompose the signal after being differentiated, denoised and compressed. The signal, i.e. the 89-quarter time series of Austria's GDP transformed at step 1, is decomposed into decomposed signals *cAs* named approximations, and *cDs* named details. The Discrete Wavelet Transform is a kind of decomposition scheme evaluated by passing the signal through lowpass and highpass filters (Corinthios, 2009), dividing the signal into a lower frequency band and an upper band. Each band is subsequently divided into a second level lower and upper bands. The process is repeated, taking the form of a binary, or a "dyadic" tree. The lower band is referred to as the approximation *cA* and the upper band as the detail *cD*. The two sequences *cA* and *cD* are downsampled. The downsampling is costly in terms of data, in other words, with a multilevel decomposition, at each one-level of decomposition the sample size is reduced by half. In fact, it is reduced by slightly more than half the length of the original signal, since the filtering process is implemented by convolving the signal with a filter. The convolution "smears" the signal, introducing several extra samples into the result. Therefore, the decomposition can proceed only until the individual details consist of a single sample. Thus, the number of levels of decomposition will be limited by the initial number of the data of the signal. The level of the decomposition of the signal is left to the appreciation of the user. In this paper, we apply a 4th-level decomposition. The choice of this level is explained at the end of the Methodology section. Figure 3 illustrates the 4th-level decomposition of the transformed Austria's real GDP, after differentiation and denoising/compression, with 88 points. It is also observed in Figure 3 that details *cDs* are small and look like high-frequency noise, whereas the approximation *cA4* contains much less noise than does the initial signal. In addition, the higher the level of decomposition, the lower the noise generated by details. For a better understanding of signal decomposition using discrete wavelet transform, refer to the methodology section of Rostan and Rostan (2018a).

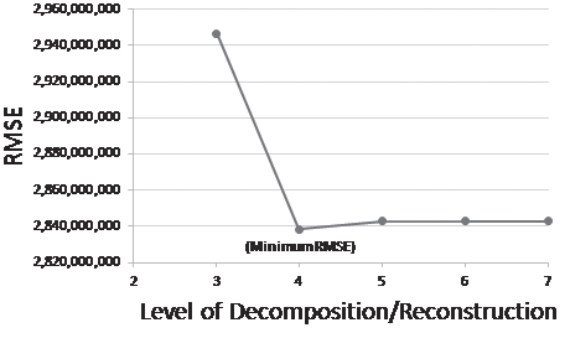
Figure 3: *4th-level decomposition of the transformed Austria's Real GDP of Chained 2010 Euros, Seasonally Adjusted (after differentiation and denoising/compression) using one-dimensional discrete wavelet analysis*



Source: Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org and Eurostat, https://ec.europa.eu/eurostat/data/database

To identify the optimal level of decomposition/reconstruction of our forecasting model, we make the level, varying from 1 to 7, where levels 1 and 2 return an error message. Figure 4 illustrates the RMSE computed on the last 52 in-sample quarters of our database (forecasts versus observed data) from 2005-04-01 to 2018-01-01 (52 quarters) of Austria's real GDP.

Figure 4: *RMSE versus level of decomposition/reconstruction*



At level-4 decomposition/reconstruction, the RMSE reaches a minimum (2.83E+09). To make the forecasts consistent between economic indicators, we apply the level-4 decomposition/reconstruction to all economic indicators, that is the government budget deficit or surplus, current account balance in current prices, unemployment rate, and total population, presented in the Results section.

3.3 Step 3: Burg extension of approximations and details

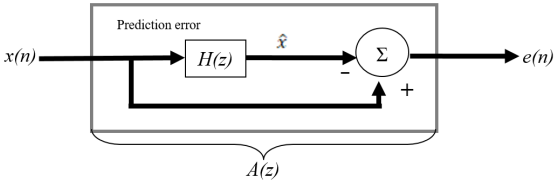
The Burg extension is applied to *cA* and *cD*, and to run the Burg extension, an autoregressive pth order from historical data is used. In this paper, we choose a p^{th} order equal to the longest available order when forecasting. For instance, in 2018-01-01, when forecasting Austria's real GDP for the subsequent quarters, the longest p^{th} order available is 84 out of the 89 collected pieces of data. Given *x* to the decomposed signal which is *cA* or *cD*, we generate a vector a of the all-pole filter coefficients that model an input data sequence using the Levinson-Durbin algorithm (Levinson 1946; Durbin 1960). We use the Burg (1975) model to fit a pth order autoregressive (AR) model to the input signal *x*, by minimizing (least squares) the forward and backward prediction errors and constraining the AR parameters to satisfy the Levinson-Durbin recursion. x is assumed to be the output of an AR system driven by white noise.

Vector *a* contains the normalized estimate of the AR system parameters, *A(z)*, in descending powers of *z*:

$$H(z) = \frac{\sqrt{e}}{A(z)} = \frac{\sqrt{e}}{1 + a_2 z^{-1} + \ldots + a_{(p+1)} z^{-p}} \tag{2}$$

Since the method characterizes the input data using an all-pole model, the correct choice of the model order *p* is important. In Figure 5, the prediction error *e(n)* can be viewed as the output of the prediction error filter *A(z)*, where *H(z)* is the optimal linear predictor, *x(n)* is the input signal, and $\hat{x}(n)$ is the predicted signal.

Figure 5: *Prediction error filter to run the Burg extension*



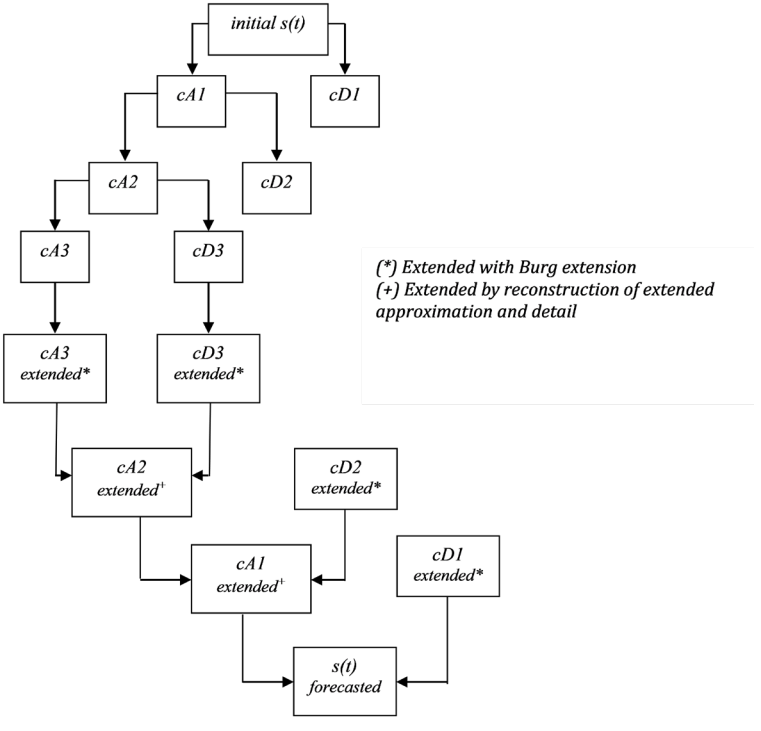
Source: Rostan and Rostan (2018a)

In the last step, the Infinite Impulse Response (IIR) filter extrapolates the index values for each forecast horizon. The IIR filters are digital filters with infinite impulse response, where unlike a finite impulse response (FIR) filter, an IIR filter provides a feedback (a recursive part of the filter) which is why it is also known as a recursive digital filter.

3.4 Step 4: Wavelet Reconstruction

After the Burg extension, the forecasted signals are recomposed, using the methodology illustrated in Figure 7. In our paper, we apply to the economic data the 4th-level decomposition/reconstruction, as explained at the end of the Methodology section. After reconstruction, the time series of the first-order difference of Austria's real GDP are transformed into Austria's real GDP absolute value. For simplification, Figure 6 illustrates a 3rd-level decomposition/reconstruction diagram.

Figure 6: *Diagram of a 3rd-level wavelet decomposition/reconstruction tree to forecast the initial signal s(t)*

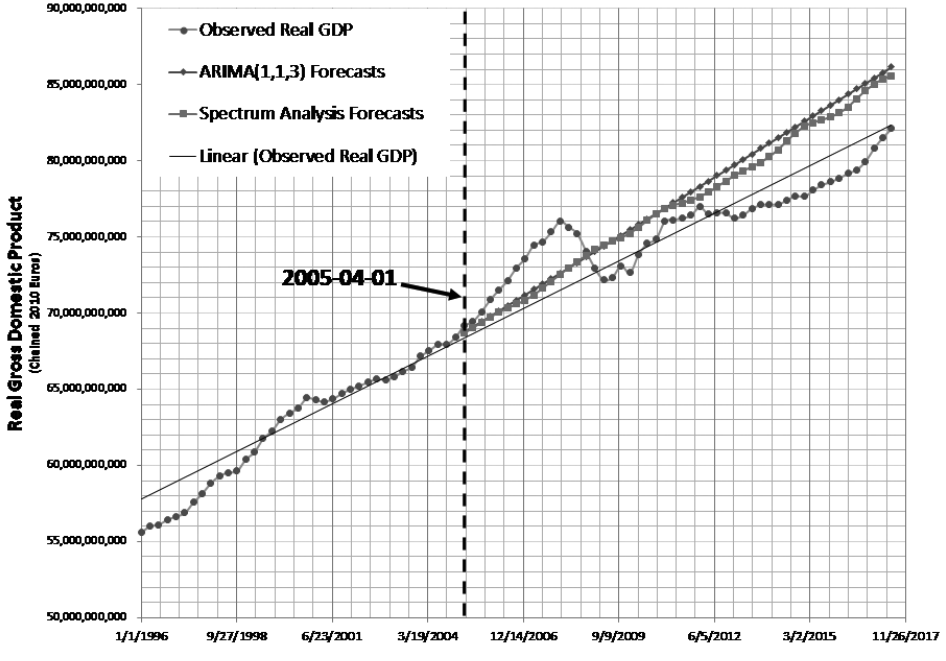


Source: own elaboration

3.5 Assessing the forecasting ability of spectrum analysis (SA)

An additional exercise within the research is to assess the forecasting ability of SA, which is done by measuring the forecasting error over the last 52 in-sample quarters of Austria's real GDP time series from 2005-04-01 to 2018-01-01. We benchmark the SA to the ARIMA(1,1,1) forecasting model (Box and Jenkins, 1976; Baillie and Bollerslev, 1992; Box et al., 1994), applied to the absolute level of GDP, i.e. no denoising and no decomposition of the time series. In addition, the Root Mean Error Square criteria (forecasts versus historical data) are applied to compute the error of forecasting. The SA beats the ARIMA(1,1,1) model with the RMSE of 2.83E+09 versus 3.21.E+09 with ARIMA over 52 quarters. The reason for using the 52 in-sample quarters data is to match our forecasting period which extends over 52 quarters from 2018-04-01 until 2031-01-01. Figure 7 illustrates the real GDP in-sample forecasts with the two models.

Figure 7: *Austria's Real GDP forecasts from 2005-04-01 to 2018-01-01 (52 quarters), ARIMA(1,1,1) versus Spectrum Analysis (4th level of decomposition/reconstruction, pth order = 33)*

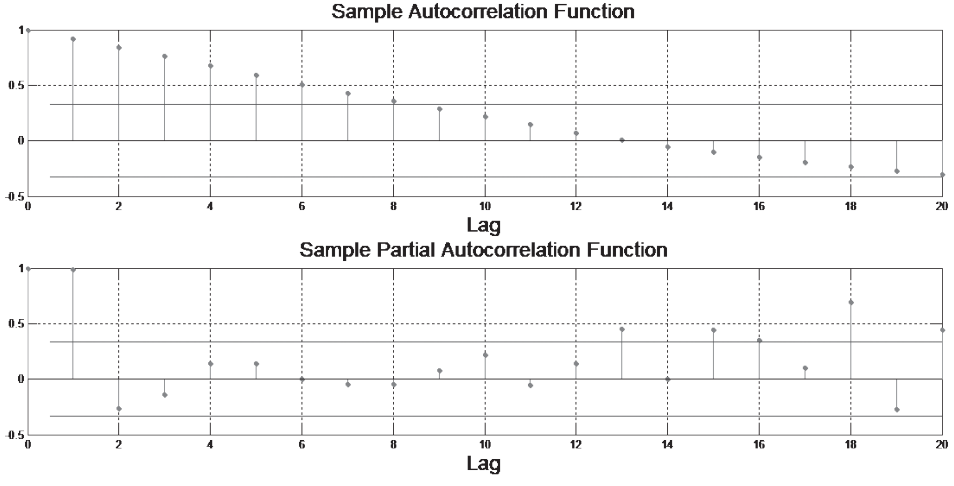


Source: Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org and Eurostat, https://ec.europa.eu/eurostat/data/database

We choose the ARIMA(1,1,1) model since it best fits the data of the Austria's real GDP time series. We identify the ARMA lags $p = 1$ and $q = 3$ with the Bayesian information criterion (BIC) to the real GDP time series (37 data). For this purpose, we estimate several models with different p and q values. For each estimated model, we compute the loglikelihood objective function value. Then, we input the loglikelihood value to compute the BIC measure of fit which penalizes for complexity. The methodology involving the ARIMA model is implemented in Matlab using the econometrics toolbox.

In Figure 8, we plot the sample autocorrelation function and the partial autocorrelation function respectively of Austria's real GDP time series, illustrated in Figure 1 from 1996-01-01 to 2005-01-01 (37 pieces of data). The sample ACF decays slowly, which is consistent with the ARMA model. We obtain a rough idea of the ARMA lags by looking at the PACF. It appears that not more than one AR or MA terms are required.

Figure 8: *sample autocorrelation function (ACF) and partial autocorrelation function (PACF) of the historical Austria's Real GDP time series from 1996-01-01 to 2005-04-01 (37 pieces of data)*



Source: Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org and Eurostat, https://ec.europa.eu/eurostat/data/database

To formally identify the ARMA lags, several models are fitted with different lag choices, making the degree of differencing, i.e. the "I" of ARIMA, varying from 0 to 3. We fit all combinations of ARMA(p,q) for p = 1,...,3 and q = 1,...,3, that is a total of 9 models per degree of differencing, when possible. The loglikelihood objective function and the number of coefficients are stored for each fitted model. We then calculate the BIC for each fitted model, by means of which the following four output BIC matrices are obtained, i.e. for no differencing, the first, second, and third order differencing respectively. In the four

output BIC matrices presented below, the rows correspond to the AR degree (p) and the columns to the MA degree (q). The optimal value in the BIC matrices is the smallest BIC value, where the smallest value (1.0e+03*1.5429) is obtained with the first order differencing:

		q	
1.0e+03 *	1.5429	1.5522	1.5570
p	1.5582	1.5524	1.5701
	1.5565	1.5628	1.5628

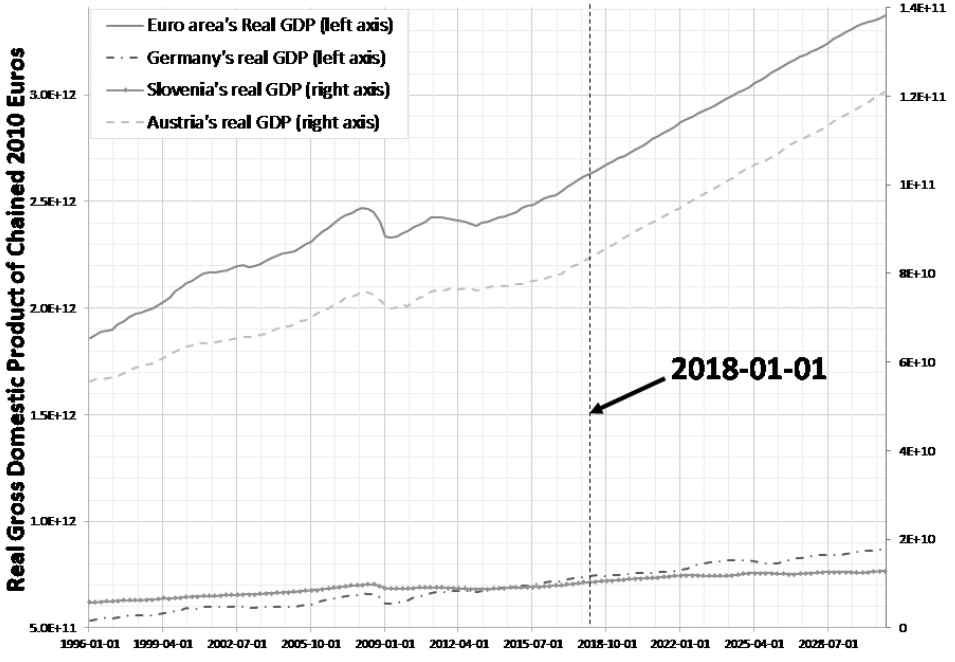
Selected model: ARIMA(p,d,q) = ARIMA(1,1,1).

4 RESULTS

The objective of the paper is to illustrate an application of the wavelet analysis to the forecast of the Austria's real GDP. In Figure 9, we illustrate 54-quarter forecasts from 2018-04-01 to 2031-01-01. The data on the left-hand side up to the vertical dot line represent Austria's real GDP quarterly data observed from 1996-01-01 to 2018-01-01 (89 pieces of data). For the decomposition/reconstruction part of the wavelet analysis, we use the 4th level, as mentioned in the Methodology section of the paper.

4.1 Forecasting Austria's Real GDP of Chained 2010 Euros, Seasonally Adjusted

Figure 9: *Observed (1996-01-01 to 2018-01-01) and Forecasted (2018-04-01 to 2031-01-01) Austria's Real GDP of Chained 2010 Euros, Seasonally Adjusted, Frequency: quarterly; on the right-hand side of the vertical dot line, 52-quarter forecasts with spectrum analysis (4th-level decomposition/reconstruction, pth order = 84)*



Source of historical data: Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org, and Eurostat, https://ec.europa.eu/eurostat/data/database.

The sharp increase of Austria's GDP between 2018 and 2030 is benchmarked to the euro area, Germany, and Slovenia respectively. From Figure 9, the spectral analysis forecasts an expansion of Austria's, Germany's, Slovenia's, but also the euro area's economies with their respective real GDPs increasing steadily and reaching historical highs on 2031-01-01, 120,989,880,000 of Chained 2010 Euros in Austria, 3,375,212,900,000 in the euro area, 866,136,980,000 of Chained 2010 Euros in Germany, and 12,830,498,000 of Chained 2010 Euros in Slovenia. These forecasts represent an annual growth rate of +2.89% between 2018 and 2030 (13 years) of Austria's real GDP, beating the estimated annual growth rates in the euro area (+1.94%), in Germany (+1.19%), and in Slovenia (+1.68%). These estimates are benchmarked to the 2018-2030 OECD (2019) annual growth rates projections expected to be +1.48% in Austria, +1.38% in the euro area (EA16), +1.21% in Germany, and +1.26%

in Slovenia. The OECD projections are less optimistic than the spectral projections for Austria, the euro area and Slovenia respectively, but are almost equal for Germany.

According to the Austrian Ministry of Finance (2018), in a sensitivity scenarios analysis and an optimistic outlook, the G20-countries will implement their growth strategies, the Western Balkan countries will pursue a clear EU-accession strategy and Austria will gain market shares in global trade and tourism, and private investment will accelerate.

With spectral forecasts, Austria's real GDP projection pictures a positive growth of the Austrian economy, however, additional economic indicators should be forecasted to confirm the trend. The 4-step methodology is applied to the following economic indicators:

- Government budget deficit or surplus (revenues minus expenses expressed in absolute level and in percentage of GDP).
- Current account balance in current prices.
- Unemployment rate.
- Total population.

4.2 Forecasting Austria's Government budget deficit or surplus in million euros (Revenues minus Expenses), Current account balance in billion United States dollars, Unemployment rate in percent and Total Population in thousands

Figure 10:

Figure 10a: Government budget in million EUR

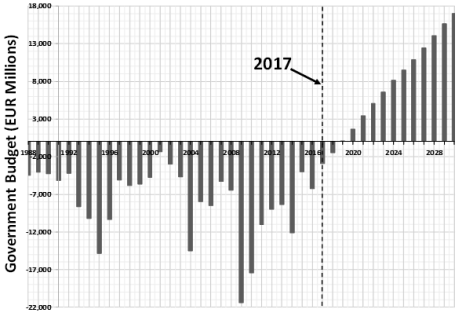


Figure 10b: Current account balance in billion USD

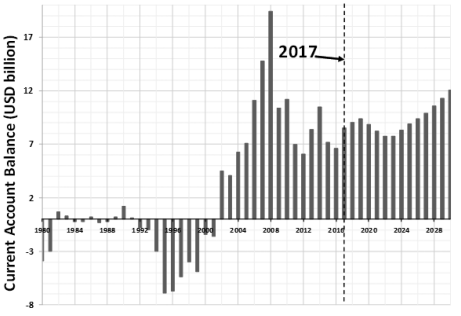


Figure 10c: Unemployment rate in percent

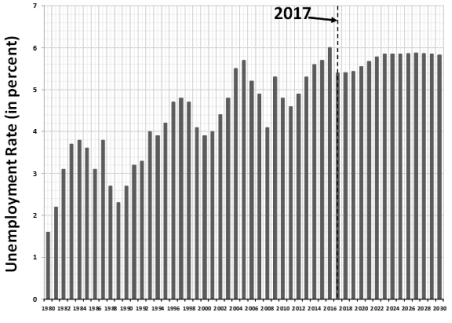
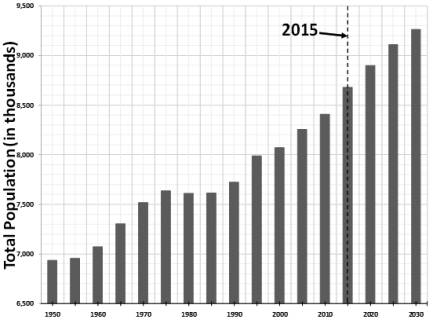


Figure 10d: Total Population in thousands



- *Government budget deficit or surplus in million euros (Revenues minus Expenses):* Observed (1988 to 2017) and Forecasted (2018 to 2030) Austria's government budget in million euros. Forecasts with spectral analysis (4th-level decomposition/reconstruction, p^{th} order = 27). Source of historical data: https://countryeconomy.com/deficit/austria.
- *Current account balance in billion United States dollars:* Observed (1980 to 2017) and Forecasted (2018 to 2030) Austria's current account balance in billion United States dollars. Forecasts with spectral analysis (4th-level decomposition/reconstruction, p^{th} order = 34). Source of historical data: https://knoema.com/atlas/Austria/Current-account-balance.
- *Unemployment rate:* Observed (1980 to 2017) and Forecasted (2018 to 2030) Austria's unemployment rate. Forecasts with spectral analysis (4th-level decomposition/reconstruction, p^{th} order = 34). Source of historical data: https://knoema.com/atlas/Austria/Unemployment-rate.
- *Total Population:* Observed (1950 to 2015) and Forecasted (2020 to 2030) Austria's total population. Forecasts with spectral analysis (4th-level decomposition/reconstruction, p^{th} order = 12). Source of historical data: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, DVD Edition.

Source: Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org and Eurostat, https://ec.europa.eu/eurostat/data/database

The applied spectrum analysis is well-designed to forecast trends embedded in the historical data of Austria, especially the reverting trend observed with the government budget deficit starting in 2010 in Figure 10a. Figure 10a illustrates a positive trend of the government budget deficit after 2009 that should reassure the Austrian policy makers with a budget that will become a surplus of EUR +17,037 million by 2030, from EUR -2,925 million in 2017. Over the 2018-2030 period, the government budget surplus will average EUR +7,934 million according to the spectral analysis forecasts, which is well above the historical average of EUR -7,716 million. This optimistic spectral forecast has to be contrasted with the qualitative analysis of Srdoc (2017). According to Srdoc, Austria's government budget deficit compares well with other euro area countries, but the country has been exposed to numerous external risks, such as unpredictable weak demand for its exported products. Austrian banks have been exposed to Central and Eastern Europe, and the Hypo Alpe Adria bank collapse is an example of how Austrian banks may be impacted. Nevertheless, in 2009, the bank of Hypo Alpe Adria was nationalised by the Austrian government. The Carinthia state holding and Grazer Wechselseitige Versicherung sold their stakes to the Austrian government for EUR 1 each. To avoid bankruptcy, the Austrian taxpayers had to cover a loss between EUR 13 billion and EUR 19 billion of outstanding loans. In addition, the country has been exposed to political and economic uncertainties caused by the European sovereign debt crisis, the current refugee crisis, and the ongoing clashes between Russia and Ukraine (Bonenberger, 2017). According to the Austrian Ministry of Finance (2018), in an optimistic sensitivity analysis of the government budget where the world economy lacked economic tensions while existing political tensions relaxed, the public debt ratio would markedly decline below 60% of GDP already by 2021, and a significant leeway for further tax reductions would emerge for public households. The flip side of the sensitivity analysis is a pessimistic scenario where economic tensions will work themselves through the world economy and Europe, for instance through the ongoing US-China trade war where Europe could be the big loser. Political tensions will build up thanks to for instance an unorderly Brexit whose probability of occurrence has jumped with the election of Boris Johnson, a Brexit hardliner, as Prime Minister of the United Kingdom in July 2019. This political turmoil is expected to reduce world trade and push prices of raw materials up. Corrections in asset markets will reduce consumer confidence and enterprises will hold back their investments. Nevertheless, despite the predicted weak demand, according to the analysis, the public debt ratio would decline rather modestly and public deficits would stay below -2%.

Current account balance is the sum of net exports of goods, services, net income, and net current transfers. Figure 10b illustrates the observed and forecasted Austrian current account balance. In the wave of the 2008-2009 crisis, the Austrian current account balance was badly hurt, as after reaching an all-time high of USD 19.1 billion in 2008, it plunged by more than 50% on average in the subsequent years until 2017. Thereafter, the Austrian current account balance projection is optimistic, with a transitional rally until 2019 that will lose steam up to 2023, then reverse steadily during the 2024-2030 period to reach USD 12.1 billion by 2030.

The OECD harmonized unemployment rate provides the number of unemployed persons as a percentage of the labour force, represented by the total number of people employed plus unemployed. As illustrated with Figure 10c, the historical trend of Austria's unemployment rate is positive and such will be the forecasted rate. In 2017, Austria's unemployment rate dropped by 10% to 5.4%, from 6% in 2016. Austria's 5.4% unemployment rate, while low compared to the other euro area members, flirts with its highest levels since the end of World War II, driven by an increased number of refugees and European migrants entering the labour market. For the subsequent years following the 2017 drop, the unemployment rate projection is unfortunately expected to regain momentum by 2027, topping 5.88%, then steadily decrease, thereafter reaching 5.82% in 2030, which represents an annual growth rate of 0.58% compared with 2017.

Figure 10d illustrates the steady growth of the Austrian population until 2030 to reach 9,260,707 people in 2030, which represents an annual growth of 0.43% over the 2015-2030 period. In 2016, the GDP-composition estimates by end use were represented by household consumption (52.6%), government consumption (20.1%), investment in fixed capital (23%), investment in inventories (0.8%), exports of goods and services (52.1%), and imports of goods and services (-48.6%, CIA World Factbook 2017). Nevertheless, one obvious driver of Austria's real GDP growth in the upcoming years - spectrum analysis forecasts a 2.89% annual growth - will be the Austrian population expansion since household consumption represents more than 50% of Austria's GDP.

5 DISCUSSION AND CONCLUSION

Spectral analysis (SA) is applied to the forecasts of major economic indicators of the Austrian economy up to 2030 to provide a clearer picture of the country's future economy. SA reveals hidden periodicities in data which are to be associated with the cyclical behaviour or recurring processes in economic time series. SA aims at decorticating economic data by unveiling simplified time series after decomposition, extrapolating information nested in these simplified series and rebuilding the forecasted time series. The context of the Austrian economy is pretty optimistic, as economic growth has been relatively strong in recent years in terms of real GDP, approaching 1.55% in 2015, rising to 2.50% in 2016, and jumping to 3.37% in 2017. This growth acceleration has been captured by spectral analysis, projecting a 2.89% annual growth for Austrian real GDP until 2030. Additional indicators of Austria's economy have been forecasted and all indicators, except the unemployment rate, converge to the fact that Austria's economic growth will 'lift all boats', in other words, Austria's government budget will become a surplus to EUR +17,037 million by , from –EUR 2,925 million in 2017. According to the SA forecasts, over the 2018-2030 period, the government budget surplus will average EUR +7,934 million, which is well above the historical average of EUR -7,716 million. In addition, with the applied AS the Austrian current account balance projection is bullish, experiencing a transitional rally until 2019 that will lose steam until 2023, then reverse steadily during the 2024-2030 period to reach USD 12.1 billion by 2030. The Austrian population will expand over the 2015-2030 period at an annual growth rate of 0.43%. What is more, one driver of Austria's real GDP growth

in the coming years will be the Austrian population growth since household consumption represents more than 50% of Austria's GDP. However, unemployment rate will be the lager, as with 5.4% unemployment rate in 2017, it flirts with its highest levels since the end of World War II, driven by an increased number of refugees and European migrants entering the labour market. The unemployment rate projection will unfortunately regain momentum reaching 5.82% in 2030, which represents an annual growth rate of 0.58% compared with 2017. A wealthy country as Austria is with a healthy and growing economy will continue to attract tourists, migrants and EU workers. The increasing supply of workers will unavoidably pressure up the unemployment rate. The Kurz government elected in December 2017 had made immigration control a top priority, planning to reverse the unemployment rate uptrend (Schumacher, 2017). However, Sebastian Kurz, a conservative who formed a coalition between his People's Party (ÖVP) and the far-right Freedom Party (FPÖ), was eventually ousted by Austrian lawmakers in a no-confidence vote in May 2019, following a bribery scandal involving the leader of FPÖ. Austria's president appointed an interim government led by Vice-Chancellor Hartwig Löger (BBC, 2019), and it point to Austria entering a new period of political uncertainty that should mitigate the positive outlook of economic indicators forecasted with the spectral analysis.

In conclusion, Austria's economy has accelerated over the past two years (2.50% in 2016 and 3.37% in 2017), surpassing the euro area (2.05% and 2.42% respectively). This trend has been captured by applying spectral analysis over the next 13 years between 2018 and 2030 when Austria's real GDP annual growth rate should reach 2.89% versus 1.94% for the euro area. With a predominant service sector, a rather developed industrial sector, a small, but highly developed agricultural sector, and a strong tourism sector respectively, Austria's economy should outperform the economies of most of its partners of the euro area, taking for examples the biggest and one of the smallest economies, Germany (+1.19%) and Slovenia (+1.68%). The 2018-2030 OECD annual growth rates projections are expected to be +1.48% in Austria, +1.38% in the euro area (EA16), +1.21% in Germany, and +1.26% in Slovenia. The OECD projections are less optimistic than the spectral projections for Austria, the euro area, and Slovenia respectively, but are almost equal for Germany. In addition, the 2018-2030 period forecasts of Austria's government budget deficit or surplus in current prices, current account balance and total population are all bullish, including unemployment rate doomed to expand at an annual rate of 0.58% between 2018 and 2030. However, these spectral projections should be mitigated by a negative political outlook, following three recent events that should have a crucial impact on Austria's economy in the future, namely 1) Austria's government collapse in May 2019, 2) the Brexit deal that is to be negotiated by the new Prime Minister of the United Kingdom, Boris Johnson, a Brexit hardliner, elected in July 2019, and 3) the ongoing US-China trade war, started in January 2018 by the United States president Trump, where Europe could be the biggest loser. Many European companies will indeed suffer because they both produce and sell goods in the two largest economies in the world, the US and China. For example, tariffs that China imposed on US-made autos hit German carmaker BMW since the later produces cars in the US and export them to China (South China Morning Post, 2018).

Additional studies, focusing on the main economic partners of Austria and incorporating in the forecasting model the comovements of their economies with Austria's economy using for instance the Multiscale principal component analysis, should refine our findings.

6 COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of potential conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent: Informed consent was not necessary for this study.

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Analysis of Horizontal Price Transmission: The Case of Mexico–United States Dry Bean Trade

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ABSTRACT: *Dry bean is the leading source of plant-based proteins in Mexico, yet the country's self-sufficiency shows an eroding tendency after the enforcement of NAFTA. During this period, the United States became Mexico's principal supplier of dry beans. The purpose of this paper is to analyse the price transmission for black and pinto dry beans in Mexico in the period between 2012 and 2019. The research results however reveal only a very limited relationship between the analysed prices in the two countries. It is established that price dynamics are predominantly governed by domestic market interactions rather than those transmitted across the border, hence the erosion of Mexico's self-sufficiency in dry bean cannot be entirely attributed to the trade liberalization..*

Key words: *horizontal price transmission, dry bean, United States–Mexico agricultural trade, vector auto-regression model*

JEL classification: E31; Q17

DOI: 10.15458/ebr98

1 BACKGROUND

Dry bean plays a significant role in Mexico's economy since it is the leading source of low-cost plant-based proteins, particularly important for the considerable part of the country's population stricken by poverty and often still affected by undernourishment (Figure 1). Furthermore, it is also one of the main annual crops measured by the share of the cultivated agricultural land, however, most of the production takes place under rain-fed conditions and with low levels of productivity. Nonetheless, for many households in Mexico, dry bean is an important source of income and a determinant of welfare (Sangerman Jarquín et al., 2010). It is important to point out that, even though the growth of the per capita consumption of dry bean has slowed down during the last decades among Mexicans, data show that for households of the lower socioeconomic strata and those living in smaller communities, dry bean tends to account for a considerable share of their global spending on food (INEGI, 2019).

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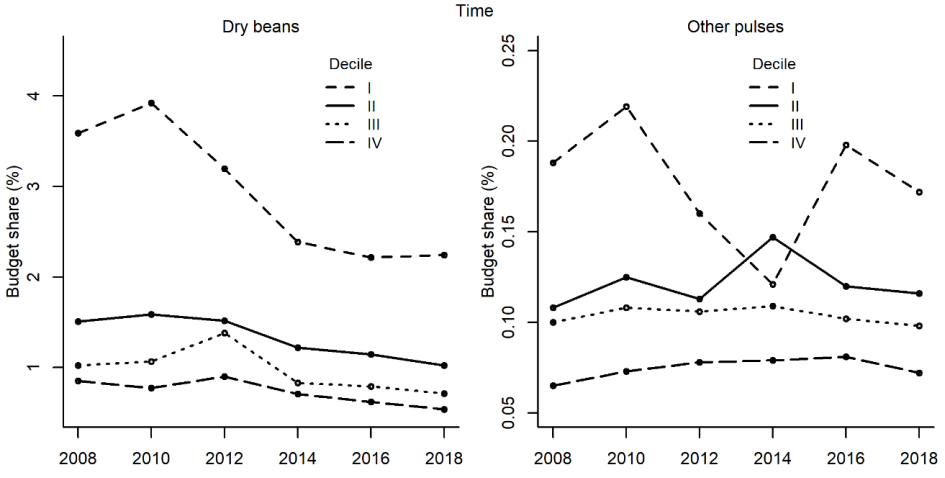
Figure 1: *Average budget share for dry bean and other pulses (chickpeas, lentils, lima beans, and peas) for households of the lower income deciles (expenditure as a percentage of current quarterly income), 2008-2018*

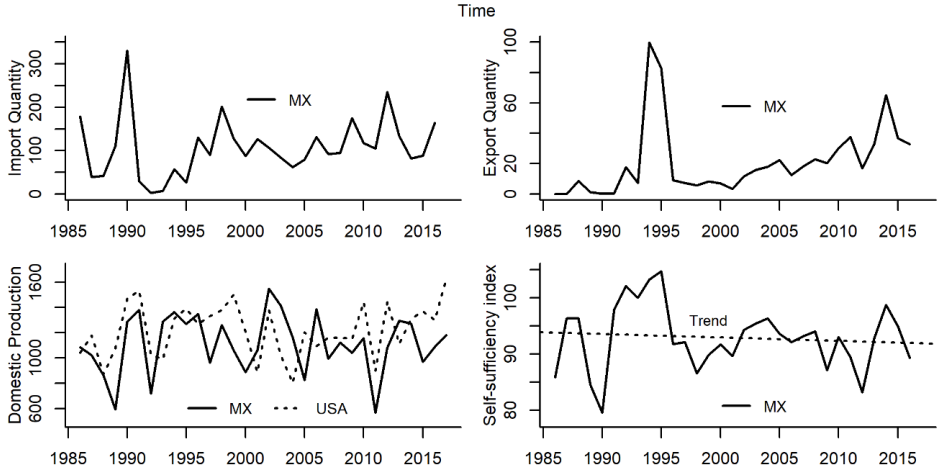


Source: own elaboration with data from INEGI 2019

Mexico still produces about 50 different varieties of beans which can be divided into four major groups. Black beans account for slightly less than a half of total Mexican bean consumption, Pinto beans represents one third and the remaining share is covered by pink and yellow varieties. Production is spatially concentrated and three regions are responsible for about 80% of the country's dry bean production, much whereof takes place under semi-arid conditions (Vallejo Díaz, 2010). On an aggregate level, Mexico's dry bean production has shown a notable variation in the last decade, but the overall trend has been relatively flat.

According to the FAOSTAT data (FAO, 2019), in 2017 the quantities produced were 1.18 million tonnes, which is slightly above the ten year's average (1.10 million tonnes). Despite the relatively high production quantities in the last years, these are insufficient to cover the apparent national consumption of this commodity which is slightly increasing. Therefore, demand was met by increasing imports and consequently Mexico's self-sufficiency index for dry beans measured as the ratio of domestic production to apparent national consumption depicts a slightly eroding tendency (Figure 2).

Figure 2: *Mexico's domestic production of dry beans, imports, exports, and self-sufficiency index (1986-2017), quantities in thousand metric tonnes. FAO, 2019*



Source: Own elaboration.

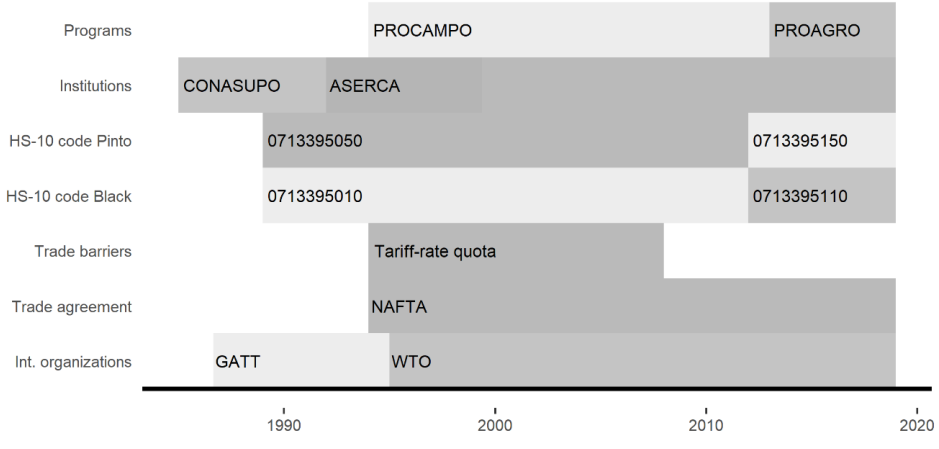
Mexico is a major participant in international agricultural trade and the United States (U.S.) is the country's largest agricultural trading partner, accounting for almost 90% of exports and 70% of imports of agro-food categories. The U.S. is also the principal foreign supplier of dry beans to Mexico as it has imported on average around 130 thousand tonnes of the commodity in the last decade. Since its share is more than 95%, the U.S. traditionally accounts for almost all of Mexico's dry beans imports. The figure Import Quantity reveals the total imported quantities of dry beans were generally fluctuating, nevertheless, with a slightly upward trend (Figure 2). The last available data for 2016 are 164 thousand tonnes, which is notably above the ten-year average. Pinto and black beans from the U.S. represented on average 46.16% of Mexican imports of dry beans during the 2012-2018 period (FAO, 2019).

Beans are one of the four agricultural commodities commonly known as sensitive products in Mexico, and consequently there is a long history of government protection and intervention on this market (Yunez-Naude, 2003). On the contrary, economic liberalism has been the framework for Mexico's general economic and agricultural policies during the last decades. The debt crisis of 1982 marked the end of the import substitution model for the country and ushered it into an era of exposure to international competition, as well as the liberalization of production and labour markets (Martínez, 2007). Thus, Mexico joined the General Agreement on Tariffs and Trade (GATT) in 1985 and then NAFTA[3] in 1994 (OECD, 2006). Mexico's agricultural sector was not a part of the liberalisation process, and prior to the agricultural policy reform in 1990 the government heavily

3 North American Free Trade Agreement.

regulated the prices and marketed the output of beans. Consequently, international trade became insignificant and substantial policy induced distortions were present. Mexico continued the expensive policy system of market intervention with tariffs, import quotas and guaranteed or concerted agricultural commodity prices until the trade liberalisation under NAFTA, therefore maintaining its domestic bean prices above world prices (*producer price support*). Moreover, the system of consumer subsidies[4] for beans provided a considerable consumer price support (Baffes & Gardner, 2003). The trade policy for the dry bean sector, however, changed substantially with the inception of the NAFTA. The agreement included the tariff phase-out schedule which combined tariff-free quotas with declining tariff rates for over-quota imports for the four sensitive agricultural products, namely, maize, dry beans, milk and sugar. All the import barriers insulating the Mexican agricultural sector against trade with the U.S. and Canada were phased out in 2008. A common Most-Favoured-Nation tariff of 125.1% is applied by Mexico to imports of dry bean from third countries, though, as already mentioned, these imports are not significant in most of the years (OECD, 2006).

Figure 3: *Policy structure for the black and pinto beans sector in Mexico (1980-2018)*



Source: Own elaboration.

4 Until 1999, the system of consumer subsidies was run by a parastatal organization "Compañía Nacional de Subsistencias Populares" (CONASUPO), which was in charge of the activities related to food security for beans, maize, feed products and milk powder.

The Mexican government also directed income transfers to producers of basic crops by means of institutions and programs such as ASERCA (1991), PROCAMPO (1993), and Alianza para el Campo (1995). The PROCAMPO program was expanded and then renamed to PROAGRO in 2012. These programs included agricultural diesel and energy subsidies, commodity storage support, investment support throughout the production process, marketing services and diversification support for uncompetitive bean farmers (Yunez-Naude & Barceinas Paredes, 2004). The development of the policy structure for Mexico's black and pinto beans sector is presented in Figure 3.

The implications of the market liberalisation under NAFTA have been addressed in numerous studies. In the case of the agricultural sector, Yunez-Naude & Barceinas Paredes (2004) pointed to the following expected outcomes from the treaty, namely, 1) domestic prices would fulfil the Law of One Price (or LOP; in this case, they would mirror the U.S. prices), 2) prices of imported commodities would manifest reductions, and 3) exposure to international competition would increase productivity and/or reduce the domestic supply of importable commodities. Moreover, the dry bean sector alone has been the subject of several papers and reports. The study of García Salazar et al. (2006) evaluates the effects of import tariff reduction and the exchange rate changes by an inter-temporal and spatial equilibrium model. Following the same approach, Borja Bravo & García Salazar (2008) assess policy scenarios aimed at the reduction of imports. Ayala Garay et al. (2008) analyse the competitiveness and profitability of the sector in Mexico and the U.S., while Sangerman Jarquín et al. (2010) focus on the evolution of dry bean production in Mexico and the consequences of the trade agreement. Further, Zahniser et al. (2010) provide a comprehensive report of the dry bean sectors of Mexico and the U.S. Although some of the above-mentioned contributions include brief comments related to the expected implications of the trade liberalisation on prices of agricultural commodities, they focus mainly on the competitiveness of the Mexican producers.

There is nevertheless no comprehensive and focused study which analyses the evolution of prices and how the international prices of dry beans are transmitted to the Mexican market. Thus, a decade of an entire exposition of the Mexico's dry bean market to the international dynamics calls for a detailed assessment of the issue, using recent data and contemporary time series econometrics methods. Considering the foregoing, the authors aim at analysing the horizontal price transmission of the world prices (*namely the U.S. export prices*) to the Mexican market of Pinto and Black beans exclusively. Therefore, the central objective of the paper is to evaluate the level of integration in the markets mentioned above, providing a detailed insight into the dynamics of prices of the two most relevant varieties of dry beans using the vector auto-regression models (VAR). Understanding the price co-movements across the markets is often a central focus when one tries to evaluate the level of market integration and market efficiency. For that reason, the horizontal price transmission analysis attracts notable academic attention and the paper tries to expand the available methodological and empirical applications. Contributions from less developed countries that rely heavily on food imports, from the post-communist economies interested in the functioning of the re-established market mechanism and from those subject to economic

policy reforms geared towards the liberalization of their domestic markets, keep growing. The rationale driving this interest is that an appropriate level of price transmission may predict efficient arbitrage and serve as a measure of market efficiency.

The presented analysis also corresponds with another important trade agreement to be implemented, namely the United States–Mexico–Canada Agreement (USMCA) which has been signed but not yet ratified[5]. The issue of the sensitivity of the dry bean market and the corresponding prices has often been mentioned by the Mexico's policy makers and reported by the media. The results might therefore help to achieve more effective agricultural policy governance and to support the actual implementation of the USMCA.

The remainder of the paper is organized as follows. After starting with the "Methodological approach" section which presents the methodology with the arguments for the selection of the models, the "Data" section in the continuation provides a description of the data used, whereas the empirical results are presented in the "Results and discussion" section. Finally, the remarks and policy recommendations are included in the section "Conclusions".

2 METHODOLOGICAL APPROACH

Two horizontally related markets are expected to have a virtually same price, recognizing that the actual differences might be due to factors such as transaction costs (implied by the arbitrage), market power, economies of scale, and product differentiation, among others (Abidoye & Labuschagne, 2014). Conventionally, when analysing the horizontal price transmission, the law of one price constitutes the fundamental elements of the underlying theoretical framework. This law states that in the case of international trade where there are no hindrances for the movement of commodities and the transport costs are assumed to be zero, the spatial arbitrage condition and spatial market efficiency ensure the prices of homogeneous commodities traded in different countries are equated when expressed in the same currency (Ardeni, 1989).

A modified version of the LOP with transport costs would be:

$$P_t^d = er_t P_t^f + C_t^{fd} \tag{1}$$

where P_t^d is the domestic price, P_t^f is the foreign price, C_t^{fd} are the transaction costs of spatial arbitrage from f to d, while er_t is the exchange rate in time t. If a relationship such as (1) holds at each t, the international and domestic markets are said to be integrated (Rapsomanikis et al., 2003).

5 As of September 2019.

In the paper at hand, four variants of price transmissions are ascertained. The first two are the horizontal cross-commodity transmissions based on the argument that the commodities involved are imperfect substitutes, and the systematic differences in the prices analysed render the homogeneity assumption not tenable, i.e. the imported dry beans tend to be more expensive than the domestic alternatives. What is more, there is evidence of bidirectional trade found in the U.S. and Mexico dry bean market during the period of the study. The second two price transmissions are comprised of the two stages of a cross-border supply chain and hence cannot be regarded as purely horizontal. Although the homogeneity assumption was disregarded in the case of the horizontal price transmission, the prices involved may still co-move to some extent, however the transmission will be imperfect (Minot, 2011).

Thus, one long run representation for the cross-commodity price transmission is given by:

$$p_t^d = \alpha + \beta p_t^w + \varepsilon_t; \; with: \; p_t^w = ln\,(P_t^w) = ln\,(er_t\, P_t^f) \tag{2}$$

where p_t^d is the natural log of P_t^d (i.e. domestic price), p_t^w is the world price (or benchmark price, but in this study the prices of beans imported from the U.S.), and α represents the shifters contributing to the price differentials which are assumed to be a constant proportion of the prices. In the case of cross-commodity price transmission, β is expected to be close to 1 under perfect substitutability (Listorti & Esposti, 2012). Finally, if p_t^d and p_t^w are non-stationary series, i.e. their order of integration is 1 or I(1), and if equation (2) holds in the long run, then ε_t represents stationary deviations [I(0)] from the equilibrium value at each time. In that case, the two prices are said to be co-integrated. It is observed that spatial arbitrage activities do not occur immediately but involve time delays. Moreover, the nature of the data prompts the use of time series methods, the rationale being that shocks affecting regional trade could be persistent (Fackler & Goodwin, 2001).

Following the use of the dynamic regression models, Rapsomanikis et al. (2003) argue for the evaluation of the notional components of the transmission between prices such as 1) asymmetry, 2) co-movement and completeness, 3) dynamics and speed, as an approach to ascertain the extent of the studied price transmissions. To ascertain the dynamic relationships between the prices, this analysis follows a version of the price transmission testing framework advanced by Rapsomanikis et al. (2003), which entails the use of time series techniques.

The first step within the framework of this research is to analyse the degree of integration of the time series involved in the analysis. The series must be organized in pairs, i.e. the first one is the price causing the shock and the second one the price out of which a response is expected. Three alternatives emerge from the results, namely, 1) when the degrees of integration are different, then it is said that the series are not co-integrated, 2) when the degrees are 0 [I(0)], then it is possible to estimate a Vector Auto-regressive (VAR) model in levels, and 3) when the degrees are 1 [I(1)], then a test on the null hypothesis of co-

integration must be performed. Here, two possible results emerge, either a) acceptance or b) rejection. In the first case, the suggestion is to estimate a VAR in first differences, while in the second case it is to estimate a Vector Error Correction Model (VECM) (Rosa et al., 2014). In each of the three alternatives, it is advised to perform the Granger-causality tests (Rapsomanikis et al., 2003). The degree of integration of the series in the research was ascertained using the Augmented Dickey-Fuller test (ADF) (Dickey & Fuller, 1979), which examines the null hypothesis of I(1) versus the alternative of I(0). The question of the Granger-causality between the variables was addressed using the Toda & Yamamoto (TY) (1995) approach. The Granger-causality test is used to ascertain whether the past values of one variable help in explaining the current values of another variable in conjunction with the past values of the second variable. The TY approach comes in handy when the order of integration of the variables is not the same and may be performed independently of the co-integration test. Within the research, the co-integration test was performed with the Engle & Granger (EG) (1987) procedure. Co-integration occurs when two or more I(1) series are trending together or co-moving so that they reveal a long run equilibrium relationship. The production levels of dry bean in Mexico and the U.S. have been comparable during the last decades and are positively correlated in the 1986-2017 period (Pearson's correlation coefficient = 0.36, test value > 5% critical value). Finally, since the two markets under the study are expected to be integrated, Mexico might represent a large buyer to the U.S. during shortage periods, which raises the question of endogeneity. To mitigate the issue, VAR models were set up with the prices under study whenever co-integration was not found.

3 DATA

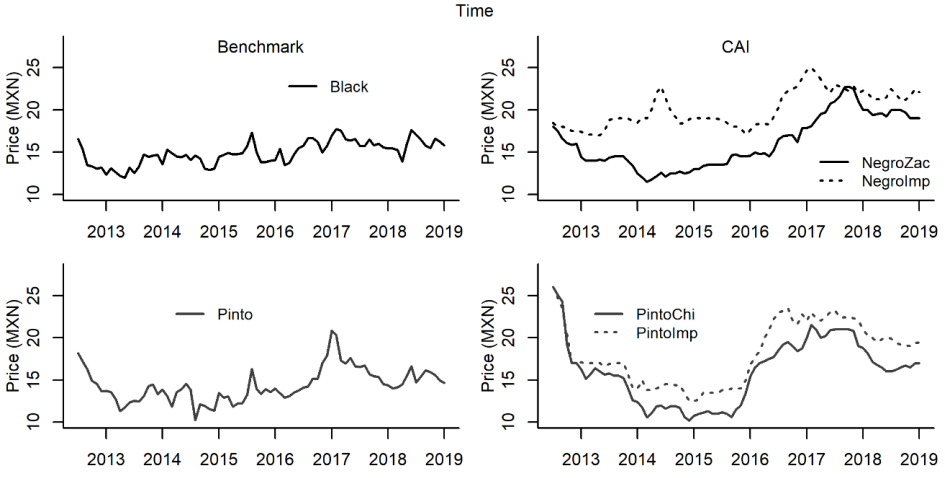
The required data for the analysis were extracted from the official Mexican national sources (e.g. SNIIM) and the United States Department of Agriculture (USDA) database. The analysis was carried out using nine monthly series, ranging from July 2012 through January 2019 (Table 1).

Table 1: *Variable description, units of measure and source (monthly series)*

Variable	Description	Units	Source
NegroZac	Frequent average price for bola Zacatecas black bean, at CAI	MXN/Kg	Sistema Nacional de Información e Integración de Mercados (SNIIM)
PintoChi	Frequent average price for Chihuahua pinto bean, at CAI	MXN/Kg	Sistema Nacional de Información e Integración de Mercados (SNIIM)
NegroIm	Frequent average price for black bean, traded as 'imported' at CAI	MXN/Kg	Sistema Nacional de Información e Integración de Mercados (SNIIM)
PintoIm	Frequent average price for pinto bean, traded as 'imported' at CAI		Sistema Nacional de Información e Integración de Mercados (SNIIM)
B-5110	Price of black beans obtained as the ratio of value to quantity of imports from the U.S., code: 0713395110	USD/Kg	Global Agricultural Trade System (GATS), FAS-USDA
B-5150	Price of pinto beans obtained as the ratio of value to quantity of imports from the U.S., code: 0713395150	USD/Kg	Global Agricultural Trade System (GATS), FAS-USDA
Er	Average exchange rate	MXN/USD	OECD Statistics
Black	Benchmark price for black beans (obtained as B-5110*Er)	MXN/Kg	Own elaboration
Pinto	Benchmark price for pinto beans (obtained as B-51-50*Er)	MXN/Kg	Own elaboration

In choosing the time frame, the availability of continuous observations was considered. Among the series, there are two domestic prices for dry bean, namely, 1) black bola Zacatecas (NegroZac) and 2) pinto Chihuahua (PintoChi) traded at the Central de Abasto de Iztapalapa (CAI), which is Mexico City's biggest wholesale market. Other series are 3) benchmark price for black beans imported by Mexico under the code 0713395110 (Black), 4) benchmark price for pinto beans imported by Mexico under the code 713395150 (Pinto), 5) price of black bean traded under the label 'imported' at CAI (NegroIm), and 6) price of pinto bean traded under the label 'imported' at CAI (PintoIm) (Figure 4).

Figure 4: *Benchmark prices and prices for black bean and pinto bean traded at CAI*



Source: Own elaboration

It is worth mentioning that although prices in the U.S. for the beans considered in this study (i.e. foreign price) displayed a downward trend in the period analysed, when expressed in the Mexican currency (i.e. world price or benchmark) this tendency was reversed due to the depreciation of the Peso against the U.S. dollar. The prices of the domestic alternatives, on the other hand, dropped manifestly during the years from 2013 to 2015, accompanying the above-average harvests in the years from 2012 to 2014. Under a complete exchange rate pass through (ERPT), a change in the farm price measured in a domestic currency will be fully transmitted to the retail price measured in a foreign currency (see reviews by Menon, 1995; Goldberg & Knetter, 1997).

4 RESULTS AND DISCUSSION

The proper use of the terms *integration* and *efficiency* in the context of international agricultural markets has been pointed out in the existing literature (Barrett, 2001). Based on the latter, an early result is that the Mexico and the United States market for black and pinto dry beans has been integrated during the period under study, as evidenced by the continuous and unhindered trade (USDA - FAS, 2019). In the following sections, the results regarding research efficiency are reported, with all procedures carried out using the log transformation of the prices involved in the analysis.

4.1 Unit root test

The ADF tests the null hypothesis of a unit root presence or that the series is I(1), i.e. H_0: $\delta = 0$ against the one-sided alternative H_1: $\delta < 0$ in the equation:

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \theta_1 \Delta Y_{t-1} + ... + \theta_p \Delta Y_{t-p} + u_t \quad (3)$$

where t represents the trend and α is the intercept. Three specifications were evaluated, including the 1) model with time trend and intercept (Trend), 2) model with intercept only (Drift), and 3) model with none of the above (None). The results for the series in levels are displayed in Table 2.

Table 2: *ADF test results for the series in levels*

Variable	Type test	Lag (p)	δ	Test value	CV* 10%	CV 5%	CV 1%
NegroZac	None	1	0.0002	0.1687	-1.61	-1.95	-2.60
NegroIm	None	2	0.0005	0.4604	-1.61	-1.95	-2.60
Black	None	6	0.0019	0.8095	-1.61	-1.95	-2.60
PintoChi	None	3	0.0002	0.1013	-1.61	-1.95	-2.60
PintoIm	None	1	-0.0007	-0.4467	-1.61	-1.95	-2.60
Pinto	None	0	-0.0015	-0.4576	-1.61	-1.95	-2.60
NegroZac	Drift	1	-0.0168	-0.8430	-2.58	-2.89	-3.51
NegroIm	Drift	2	-0.0519	-1.7015	-2.58	-2.89	-3.51
Black	Drift	6	-0.1862	-2.3541	-2.58	-2.89	-3.51
PintoChi	Drift	3	-0.0293	-1.4971	-2.58	-2.89	-3.51
PintoIm	Drift	1	-0.0441	-1.9191	-2.58	-2.89	-3.51
Pinto	Drift	0	-0.1855	-2.9808	-2.58	-2.89	-3.51
NegroZac	Trend	1	-0.0795	-2.8132	-3.15	-3.45	-4.04
NegroIm	Trend	1	-0.1246	-2.9401	-3.15	-3.45	-4.04
Black	Trend	6	-0.5392	-3.5236	-3.15	-3.45	-4.04
PintoChi	Trend	3	-0.0398	-1.7842	-3.15	-3.45	-4.04
PintoIm	Trend	1	-0.0760	-2.9625	-3.15	-3.45	-4.04
Pinto	Trend	0	-0.2537	-3.7725	-3.15	-3.45	-4.04

**CV = Critical Value*

The lag lengths were chosen based on the Akaike Information Criterion (AIC). The null hypothesis was rejected (test value > 5% critical value) in the case of the Pinto series, under the Drift and Trend specifications. From this result, we conclude there is not any co-integration between Pinto and PintoChi, nor is there any between Pinto and PintoIm.

The remaining series involved in the analysis have the same order of integration, namely I(1). On the other hand, the first differences of the series are all stationary (Table 3).

Table 3: *ADF test results for the first differences of the series*

Variable	Type test	Lag (p)	δ	Test value	CV* 10%	CV 5%	CV 1%
ΔNegroZac	None	0	-0.7353	-6.6726	-1.61	-1.95	-2.60
ΔNegroIm	None	1	-0.6903	-5.6535	-1.61	-1.95	-2.60
ΔBlack	None	5	-1.6259	-4.1121	-1.61	-1.95	-2.60
ΔPintoChi	None	2	-0.4670	-4.2872	-1.61	-1.95	-2.60
ΔPintoIm	None	0	-0.5548	-5.4483	-1.61	-1.95	-2.60
ΔPinto	None	1	-1.2557	-7.4028	-1.61	-1.95	-2.60
ΔNegroZac	Drift	0	-0.7358	-6.6341	-2.58	-2.89	-3.51
ΔNegroIm	Drift	1	-0.6965	-5.6492	-2.58	-2.89	-3.51
ΔBlack	Drift	5	-1.6709	-4.1834	-2.58	-2.89	-3.51
ΔPintoChi	Drift	2	-0.4637	-4.1914	-2.58	-2.89	-3.51
ΔPintoIm	Drift	0	-0.5575	-5.4233	-2.58	-2.89	-3.51
ΔPinto	Drift	1	-1.2570	-7.3576	-2.58	-2.89	-3.51
ΔNegroZac	Trend	0	-0.7671	-6.7868	-3.15	-3.45	-4.04
ΔNegroIm	Trend	1	-0.6963	-5.6095	-3.15	-3.45	-4.04
ΔBlack	Trend	5	-1.6541	-4.1219	-3.15	-3.45	-4.04
ΔPintoChi	Trend	2	-0.4692	-3.9743	-3.15	-3.45	-4.04
ΔPintoIm	Trend	0	-0.5841	-5.5372	-3.15	-3.45	-4.04
ΔPinto	Trend	1	-1.2713	-7.3505	-3.15	-3.45	-4.04

**CV = Critical Value*

4.2 Granger-causality test

The test was performed following the TY approach which is useful even when the series do not have the same order of integration, and what is more, is independent of the co-integration test. Thus, six systems of VAR equations with an intercept (α) and a time trend (tt) were set up, using the variables in Table 1, in a pair-wise fashion: NegroZac-Black, NegroIm-Black, PintoChi-Pinto, PintoIm-Pinto, and NegroZac-PintoChi.

Each system was specified as follows:

$$Y_t = \alpha_1 + tt_1 + \theta_1 Y_{t-1} + \ldots + \theta_p Y_{t-p} + \gamma_1 X_{t-1} + \gamma_p X_{t-p} + u_t$$
$$X_t = \alpha_2 + tt_2 + \varphi_1 X_{t-1} + \ldots + \varphi_p X_{t-p} + \lambda_1 X_{t-1} + \lambda_p X_{t-p} + u_t \quad (4).$$

Table 4: *Lag lengths at which the VAR systems produced non-correlated residuals*

VAR equation	Chi-square	Df	P. value	Lag length (p)
NegroZac-Black	45.942	44	0.392	1
NegroIm-Black	35.220	40	0.685	2
NegroIm-NegroZac	32.787	40	0.784	2
PintoChi-Pinto	23.995	32	0.845	4
PintoIm-Pinto	34.697	40	0.707	2
PintoIm-PintoChi	36.211	40	0.642	2
NegroZac-PintoChi	35.567	40	0.670	2

The lag lengths (p) of the systems were determined by the AIC criterion. When necessary, more lags were added to each system up to the point where the residuals were no longer serially correlated, and all the roots of the characteristic polynomial lied within the unitary circle. Table 4 presents the final lag lengths of each system based on the results of the Portmanteau test applied for serially correlated errors, where 12 lags were used for the Portmanteau statistics.

Since the maximum order of integration of the variables in each pair was 1, a lag was added to each system (i.e. p + 1) according to the TY approach. Afterwards, the systems were re-estimated, followed by testing the null hypothesis H_0: $\gamma_1 = \gamma_2 = \ldots = \gamma_p = 0$ on the first p lags of the re-estimated systems against H_1: $\gamma_1 \neq \gamma_2 \neq \ldots \neq \gamma_p \neq 0$. This is equivalent to testing whether X Granger-causes Y. Likewise, testing the null H_0: $\lambda_1 = \lambda_2 = \ldots = \lambda_p = 0$ against H_1: $\lambda_1 \neq \lambda_2 \neq \ldots \neq \lambda_p \neq 0$ is equivalent to testing whether Y Granger-causes X.

Table 5: *Granger-causality test results of pair-wise VAR systems (with constant and trend)*

VAR equation (Y-X)	Null: X does not Granger-cause Y			Null: Y does not Granger-cause X		
	Chi-square	Df	p. value	Chi-square	DF	p. value
NegroZac-Black	0.193	1	0.661	0.001	1	0.974
NegroIm-Black	0.229	2	0.892	7.449	2	0.024
NegroIm-NegroZac	0.292	2	0.864	0.375	2	0.829
PintoChi_Pinto	0.995	4	0.911	2.280	4	0.684
PintoIm-Pinto	2.802	2	0.246	0.631	2	0.729
PintoIm-PintoChi	19.428	2	0.000	3.218	2	0.200
NegroZac-PintoChi	0.278	2	0.870	1.486	2	0.476

Table 5 displays the acceptance of two alternative hypotheses for the Granger-causality test, namely, that the price of NegroIm Granger-Causes Black and that the price of PintoChi Granger-Causes PintoIm with p. value < 0.05 and p. value < 0.01, respectively. In this case, the rejection of the null indicates that the price of Black can be better predicted using the past values of Black and NegroIm than using the past values of Black alone.

4.3 Co-integration test

The co-integration tests were carried out using the EG approach. Thus, p_t^d was regressed on p_t^w and the residuals saved as ε_t. Then, we regressed $\Delta\varepsilon_t$ on ε_{t-1} in an equation as is (3), with drift. Lags of the dependent variable were added when necessary, according to the AIC. The results reveal co-integration is present when the coefficient of ε_{t-1} is statistically significant.

Table 6: *Co-integration test results*

Equation	Type test	Lag (p)	δ	Test value	CV* 10%	CV 5%	CV 1%
NegroZac-Black	Drift	6	-0.1193	-2.0555	-3.04	-3.34	-3.90
NegroZac-PintoChi	Drift	0	-0.0559	-1.6132	-3.04	-3.34	-3.90
NegroIm-Black	Drift	0	-0.2963	-3.9162	-3.04	-3.34	-3.90
PintoChi-PintoIm	Drift	1	-0.2515	-3.4657	-3.04	-3.34	-3.90

**CV = Critical Value. Values taken from Davidson & MacKinnon (1993).*

The results of the EG test are shown in Table 6. There are two co-integrating relationships in the systems analysed, namely, between NegroIm and Black (which we take as being the same commodity in two stages of its marketing chain), and between PintoChi-PintoIm with p. value < 0.01 and p. value < 0.05, respectively. For the two other two systems, the conclusion is the prices are not co-moving in the long run, therefore leaving their dynamics limited to short-run responses.

4.4 VEC and VAR models

In the case of the systems where co-integration was found, the price transmission was ascertained by means of an equation as is:

$$\Delta \boldsymbol{p}_t = \boldsymbol{\mu} + \boldsymbol{\Pi p}_{t-1} + \boldsymbol{\Gamma}_1 \Delta \boldsymbol{p}_{t-1} + \ldots + \boldsymbol{\Gamma}_p \Delta \boldsymbol{p}_{t-p} + \boldsymbol{\varepsilon}_t \quad (5).$$

Table 7: *VECM estimates for the systems NegroIm-Black and PintoIm-PintoChi (Maximum likelihood)*

Response	Variable	Estimate	Std. Error	Test value	p. value	AIC
NegroIm	ECT_{t-1}	0.0206	0.0211	0.9742	0.3333	-994.6014
	Intercept	0.1262	0.1278	0.9874	0.3268	
	$NegroIm_{t-1}$	0.4773	0.1192	4.0039	0.0002***	
	$Black_{t-1}$	0.0770	0.0664	1.1591	0.2503	
	$NegroIm_{t-2}$	-0.2406	0.1205	-1.9966	0.0498**	
	$Black_{t-2}$	0.0826	0.0618	1.3371	0.1855	
Black	ECT_{t-1}	0.1644	0.0376	4.3726	0.0000***	
	Intercept	0.9955	0.2275	4.3753	0.0000***	
	$NegroIm_{t-1}$	0.2433	0.2122	1.1467	0.2554	
	$Black_{t-1}$	0.1305	0.1182	1.1037	0.2735	
	$NegroIm_{t-2}$	0.1348	0.2145	0.6283	0.5319	
	$Black_{t-2}$	-0.0388	0.1100	-0.3525	0.7255	
	Variable		NegroIm	Black	Trend	
	Co-integrating vector		1.0000	-3.4624	0.0075	
Response	Variable	Estimate	Std. Error	Test value	p. value	AIC
PintoIm	ECT_{t-1}	-0.2740	0.1254	-2.1842	0.0323**	-996.7971
	Intercept	0.1836	0.0843	2.177	0.0329**	
	$PintoIm_{t-1}$	0.2391	0.1566	1.527	0.1313	
	$PintoChi_{t-1}$	0.3793	0.1228	3.0898	0.0029***	
	$PintoIm_{t-2}$	0.2042	0.1483	1.3768	0.173	
	$PintoChi_{t-2}$	-0.2623	0.1338	-1.9604	0.0539*	
PintoChi	ECT_{t-1}	0.1289	0.1613	0.7991	0.4269	
	Intercept	-0.0891	0.1085	-0.8215	0.4142	
	$PintoIm_{t-1}$	-0.0582	0.2014	-0.289	0.7734	
	$PintoChi_{t-1}$	0.5940	0.1579	3.7618	0.0003***	
	$PintoIm_{t-2}$	0.2826	0.1907	1.4818	0.1429	
	$PintoChi_{t-2}$	-0.3095	0.1721	-1.7984	0.0764*	
	Variable		PintoIm	PintoChi	Trend	
	Co-integrating vector		1.0000	-0.7856	-0.0014	

** $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$*

Equation (5) is a long run specification of the VECM formed with the $\boldsymbol{p}_t$ vector of the prices (2x1) in each system and $\boldsymbol{\Gamma}_i$ as matrices (2x2) of the short-run responses to shocks. The lag-length specification of the models was selected using the AIC, the estimates of which are displayed in Table 7. The coefficient ECT is called an adjustment coefficient and

it indicates that in the system NegroIm-Black, Black does error correct and will return to equilibrium after 1/0.1644 ~ 6 steps, *ceteris paribus*.

In the case of the systems where no co-integration relationship was found, their short run dynamics were ascertained through bivariate VAR models. Such models were set up with the variables in first differences, as Rapsomanikis et al. (2003) suggest. The lag length was selected using the AIC, moreover, differences in logs were applied to approximate percent changes when multiplied by 100. The results of the VAR models are reported in Table 8.

Table 8: *VAR estimates for the systems NegroZac-NegroIm, NegroZac-PintoChi and NegroZac-Black (Ordinary Least Squares)*

Response	Variable	Estimate	Std. Error	Test value	p. value	R-Squared
ΔNegroZac	$\Delta NegroZac_{t-1}$	0.2478	0.1141	2.1716	0.0330**	0.0751
	$\Delta NegroIm_{t-1}$	0.0767	0.1262	0.6077	0.5452	
ΔNegroIm	$\Delta NegroZac_{t-1}$	-0.0162	0.0972	-0.1668	0.8679	0.1801
	$\Delta NegroIm_{t-1}$	0.4275	0.1076	3.9738	0.0002***	
ΔNegroZac	$\Delta NegroZac_{t-1}$	0.2132	0.1220	1.7471	0.0847*	0.0825
	$\Delta PintoChi_{t-1}$	0.0744	0.0755	0.9849	0.3279	
ΔPintoChi	$\Delta NegroZac_{t-1}$	0.3297	0.1765	1.868	0.0657*	0.2658
	$\Delta PintoChi_{t-1}$	0.3924	0.1092	3.5925	0.0006***	
ΔNegroZac	$\Delta NegroZac_{t-1}$	0.1896	0.1137	1.6681	0.0996*	0.1328
	$\Delta Black_{t-1}$	0.0426	0.0634	0.6722	0.5036	
	$\Delta NegroZac_{t-2}$	0.0927	0.1127	0.8229	0.4133	
	$\Delta Black_{t-2}$	0.1287	0.0628	2.0473	0.0443**	
ΔBlack	$\Delta NegroZac_{t-1}$	-0.0782	0.2015	-0.3882	0.6990	0.0543
	$\Delta Black_{t-1}$	-0.0762	0.1123	-0.6790	0.4993	
	$\Delta NegroZac_{t-2}$	0.1055	0.1997	0.5281	0.5991	
	$\Delta Black_{t-2}$	-0.2032	0.1114	-1.8246	0.0722*	

** $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$*

The short-run dynamics of the prices analysed in the VAR models indicate that in two cases a statistically significant transmission was found, namely, in the systems NegroZac-PintoChi and NegroZac-Black with p. value < 0.1 and p. value < 0.05, respectively. Based on the acquired results, the final interpretation is that when the price of Black changes by 1% with respect to the previous month, the price of NegroZac responds with a 0.13% change relative to the previous month, however, with the response taking place with a two-month delay.

5 CONCLUSIONS

This contribution is aimed at examining the co-movement of the prices of the Pinto and Black dry bean in Mexico and the United States during the post-NAFTA period. The key research question of this study is whether there is a possibility of co-integration between the benchmark international price for pinto beans and the corresponding commodities traded at CAI entirely dismissed based on the results of the unit root tests. It was therefore confirmed that the price dynamics in the analysed markets are governed by domestic conditions rather than those transmitted across the border. Furthermore, the results of the VECM indicate there is no short run transmission from Black to NegroIm (which are regarded as the same commodity), nevertheless, the two share a common trend in the long run. Whereas the results from the VAR model indicate there is a statistically significant short run transmission from Black to NegroZac, they however do not share a common trend. The Granger-causality tests point out that the past values in the price of NegroIm are helpful when explaining the future values of Black beans. Among the domestic prices, the past values of PintoChi are of use when explaining the future prices of PintoIm. The former result indicates that the information regarding the prices of black dry beans traded at CAI might be used to influence the prices in the exporting markets, sourcing the United States.

Dry bean remains a sensitive product in Mexico, sharing in the political discourse and the academic interest. Regarding the latter, what this analysis suggests is that, although an aggregated self-sufficiency measure reflects an eroding tendency for Mexico in the case of dry beans, pinto beans imports dropped during the period under study, whereas black bean imports remained relatively flat. On the other hand, the presence of the bidirectional trade indicates that the beans imported from the United States behave as differentiated commodities which fetch higher prices at CAI. Therefore, with imports consumers in Mexico City gain access to substitute goods, keeping the cheaper domestic alternatives. From the consumer's point of view, price spikes are to be expected from the variables governing domestic supply and from the factors causing the actual differences between the prices compared, rather than from imports from the United States.

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E/B/R

POVZETKI V SLOVENSKEM JEZIKU

Determinants of Cash Holdings in Private firms: The Case of the Slovenian SMEs

Determinante Gotovinskega Salda v Zasebnih Podjetjih: Primer Slovenskih Majhnih in Srednje Velikih Podjetij

Marija Angelovska, Aljoša Valentinčič

Članek razišče determinante gotovinskega salda na podlagi obsežnega vzorca slovenskih majhnih in srednje velikih podjetij v obdobju od 2006 do 2013. Empirični rezultati podprejo tako transakcijski kot tudi previdnostni motiv v denarnih politikah majhnih in srednje velikih podjetij. Vendar pa najdemo tudi dokaze, ki govorijo v prid spekulativnega motiva, in sicer na podlagi ugotovitve, da imajo manjša, izvozna in bolj dobičkonosna podjetja več denarnih sredstev. Raziskava prav tako dokaže, da se obratni kapital in finančni dolg lahko upoštevata kot denarni nadomestki, ter da ohranjanje tesnih stikov z bankami zniža agencijske stroške in asimetrijo informacij, ki vodijo do nižjih ravni denarnih sredstev. Poleg tega sposobnost internega ustvarjanja sredstev, izražena v obliki višjih denarnih tokov, zniža znesek sredstev v gotovini. Nazadnje, dokazi pokažejo, da se daljši cikli pretvorbe gotovine in zahteve glede obveznih prispevkov za pokojnino odražajo v višjih stanjih denarnih sredstev, medtem ko je tudi pri negativnem vplivu stopnje obrestne mere na gotovinski saldo vidna šibka empirična podpora.

Ključne besede: *gotovinski saldo, likvidnost, finančna kriza, majhna in srednja podjetja, panelni podatki*

Long-Term Auditor-Client Relationships: Conscious Misjudgements or Unconscious Biases?

Ali Pride v Dolgoročnih Odnosih med Revizorjem in Stranko do Zavedno Napačnih Presoj ali Nezavednih Pristranskosti?

Mina Ličen

Cilj naše študije je osvetliti kognitivne motive revizorjeve pristranskosti v dolgoročni osebnih odnosih s stranko. Raziskujemo, ali dolgoročen osebni odnos privede do zavedno napačne presoje zaradi skupnega dolgoročnega finančnega interesa ali nezavedne pristranskosti, ki jo izzovejo motivi naklonjenosti in nezavedne potrebe. Študija povezuje dve teoriji: teorijo motiviranega utemeljevanja (Kunda, 1990), ki temelji na spodbudah, in motivacijsko teorijo nezavednih potreb (McClelland, 1987). Problem analiziramo z zaporedno igro dveh igralcev s popolnimi informacijami v okviru teorije iger, pri čemer se izvaja naloga računovodskega odločanja. Ugotovili smo, da pozitiven učinek osebnega odnosa na pristransko odločanje izhaja iz dolgoročnega finančnega interesa in ne iz motivov naklonjenosti, kot je prijateljstvo. Prav tako smo zaznali vpliv nezavednih potreb na posameznikove odločitve. Potreba po dosežkih in potreba po moči torej podpirata revizorjevo neodvisno mnenje in pomagata pri odporu na pritisk stranke, pri čemer je potreba po pripadnosti v osebnem odnosu poudarjena in pozitivno vpliva na pristranskost revizorja. Študija je izvirna empirična raziskava motivov ravnanja v postopku revizije, ki je pokazala, da zavedne finančne spodbude in nezavedne potrebe vplivajo na posameznikove odločitve hkrati.

Ključne besede: *revizija, osebni odnosi, finančne spodbude, nezavedne potrebe, teorija iger*

Determinants of Inflation in Egypt and Mexico: Empirical Evidence

Determinante Inflacije v Egiptu in Mehiki: Empirični Dokazi

Amir Kia, Maritza Sotomayor

Članek pred vami empirično razišče vplivno vlogo notranjih in zunanjih dejavnikov na stopnjo inflacije v dveh gospodarstvih v vzponu, in sicer v Egiptu in Mehiki. V okviru raziskave razvijemo razširjeno različico monetarističnega modela. Slednji model je ovrednoten s pomočjo četrtletnih podatkov, ki za Egipt zajemajo obdobje od prvega četrtletja 1975 do četrtega četrtletja 2015, in za Mehiko obdobje od prvega četrtletja 1976 do četrtega četrtletja 2015. Za pridobitev dolgoročne ocene uporabimo metodo največje verjetnosti avtorjev Johansena in Juseliusa, kakor tudi v celoti spremenjene običajne metode najmanjših kvadratkov. Skladno z rezultati naše ocene, v obeh državah na raven cene dolgoročno vplivajo tako notranji kot zunanji dejavniki. Ugotovili smo, da tako denarna politika, merjena z zalogo denarja in obrestno mero, kot tudi fiskalna politika, merjena z državnimi izdatki, deficiti in dolgovi, dolgoročno vplivata na raven cene v obeh državah. Iz tega razloga se lahko v obeh državah dolgoročno uporabi obe politiki v boju proti inflaciji. Poleg tega ameriška obrestna mera in cena na dolgi rok vplivata na raven cene z enakim znakom v obeh raziskanih državah. Gledano na kratki rok pričakujemo, da ameriške cene vplivajo na cene v Mehiki, vendar se izkaže, da slednje nimajo nobenega vpliva na cene v Egiptu.

Ključne besede: *dolgoročna cena, inflacija, fiskalna in denarne politika, zunanji in notranji dejavniki*

Where is Austria's Economy Heading?

Kam Vodi Gospodarstvo Avstrije?

Pierre Rostan, Alexandra Rostan

Avstrija predstavlja eno najbogatejših in najbolj stabilnih držav med državami članicami Evropske unije. Znanstveni članek skozi spektralno analizo poskuša napovedati ekonomske kazalnike avstrijskega gospodarstva vse do leta 2030, tako da poda podrobnejši vpogled v prihodnje gospodarstvo te države. Spektralna analiza razkrije skrite periodičnosti v gospodarskih podatkih, ki jih je potrebno povezati/povezovati s cikličnim vedenjem/ravnanjem ali ponavljajočimi se procesi v ekonomskih časovnih vrstah. Napovedi za obdobje 2018-2030 glede realnega bruto domačega proizvoda, javnofinančnega primanjkljaja ali presežka v tekočih cenah, saldo tekočega računa in celotnega prebivalstva so vse optimistične, vključno s stopnjo brezposelnosti, ki je do leta 2030 obsojena na letno porast v višini 0,58%.

Ključne besede: *Avstrija, BDP, spektralna analiza, model Burg*

Analysis of Horizontal Price Transmission: The Case of Mexico–United States Dry Bean Trade

Analiza Horizontalne Cenovne Transmisije: Primer Trgovine s Fižolom v Zrnju med Mehiko in ZDA

Antonio Aguilar-Lopez, Aleš Kuhar

Fižol je najpomembnejši vir rastlinskih beljakovin v Mehiki, vendar pa samooskrba v državi po uveljavitvi sporazuma NAFTA pada. V tem obdobju so ZDA postale glavni dobavitelj fižola v zrnju za Mehiški trg. V prispevku je prikazana analiza cenovne transmisije za črni in pinto fižol v zrnju na mehiškem trgu v obdobju med 2012 in 2019. Rezultati raziskave kažejo zelo omejeno povezanost analiziranih cen teh dobrin med državama. Ugotovljeno je, da dinamiko cen večinoma določajo dejavniki na domačem trgu, ne pa dejavniki tujega trga, zato poslabšanja mehiške samooskrbe s fižolom v zrnju ne moremo v celoti pripisati liberalizaciji mednarodne trgovine.

Ključne besede: *horizontalna cenovna transmisija, fižol v zrnju, ZDA, Mehika, kmetijska trgovina, vektroski avtoregresijski model*