Investigating the Nexus between Energy Consumption and Financial Development: Empirical Evidence from Argentina

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ABSTRACT

This thesis investigates the relationship between energy consumption, financial development, economic growth, and urbanization in Argentina over the period 1965–2015. By analyzing the data, the research aims to provide valuable insights and recommendations for policymakers regarding the significance of financial development, economic growth, and urbanization in shaping energy consumption patterns in Argentina.

The analysis conducted in this thesis revealed no significant structural breaks throughout the examined period, indicating the stability of the relationships under investigation. This finding suggests that the dynamics between energy consumption, financial development, economic growth, and urbanization have remained relatively consistent over the years in Argentina.

One of the key findings of this thesis is the identification of a non-linear, inverted U-shaped relationship between financial development and energy consumption. This implies that as financial development increases, energy consumption initially rises, but at a certain point, further financial development leads to diminishing returns in terms of energy consumption.

This finding underscores the importance of finding an optimal level of financial development to ensure sustainable and efficient energy consumption in Argentina. Furthermore, the analysis also uncovered bidirectional causality between energy consumption and financial development. This indicates that changes in energy consumption can influence financial development, while financial development can

also impact energy consumption. Similarly, bidirectional causality was observed between energy consumption and economic growth, suggesting a mutually reinforcing relationship between these variables.

Keywords: Energy Consumption; Financial Development; ARDL; Argentina.

ÖZ

Bu tez, 1965-2015 döneminde Arjantin'de enerji tüketimi, finansal gelişme, ekonomik büyüme ve kentleşme arasındaki ilişkiyi araştırmaktadır. Çalışma, verileri analiz ederek politika yapıcılara Arjantin'deki enerji tüketim modellerini şekillendirmede finansal kalkınma, ekonomik büyüme ve kentleşmenin önemi hakkında değerli bilgiler ve öneriler sunmayı amaçlamaktadır.

Bu tezde yapılan analiz, incelenen dönem boyunca, incelenen ilişkilerin istikrarını gösteren önemli bir yapısal kırılma olmadığını ortaya koymuştur. Bu bulgu, Arjantin'de enerji tüketimi, finansal gelişme, ekonomik büyüme ve kentleşme arasındaki dinamiklerin yıllar içinde nispeten tutarlı kaldığını göstermektedir.

Bu tezin temel bulgularından biri, finansal gelişme ile enerji tüketimi arasında doğrusal olmayan, tersine çevrilmiş U şeklinde bir ilişkinin tanımlanmasıdır. Bu, finansal gelişme arttıkça enerji tüketiminin başlangıçta arttığı, ancak belirli bir noktada daha fazla finansal gelişmenin enerji tüketimi açısından getirilerin azalmasına yol açtığı anlamına gelir.

Bu bulgu, Arjantin'de sürdürülebilir ve verimli enerji tüketimini sağlamak için optimal düzeyde bir finansal gelişme bulmanın öneminin altını çizmektedir. Ayrıca çalışma, enerji tüketimi ile finansal gelişme arasındaki çift yönlü nedenselliği de ortaya çıkarmıştır. Bu, enerji tüketimindeki değişikliklerin finansal gelişmeyi etkileyebileceğini, finansal gelişmenin de enerji tüketimini etkileyebileceğini göstermektedir. Benzer şekilde, enerji tüketimi ile ekonomik büyüme arasında çift

yönlü nedensellik gözlenmiş ve bu değişkenler arasında karşılıklı olarak pekiştirici bir ilişki olduğu öne sürülmüştür.

Anahtar Kelimeler: Enerjitüketimi, Finansal Gelişme, ARDL, YapısalKırılma, Arjantin.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

1.1 Research Background

It is predicted by the Energy Information Administration (2010) that worldwide energy consumption will rise by 56 percent between 2010 and 2040. Numerous studies (Yu and Choi, 1985; Soytas, Sari, and Ewing, 2007; Menyah and Wolde-Rufael, 2010; Shahbaz, Khan, and Tahir, 2013; Anwar and Alexander, 2016; Sineviciene, Sotnyk, and Kubatko, 2017; Nyasha, Gwenhure, and Odhiambo, 2018) have shown that economic expansion is the primary driver of this rise. Energy consumption is expected to rise the most in non-OECD nations, where rapid economic expansion is driving up demand (Shahbaz et al., 2013). Rising incomes in developing nations, according to Wolde-Rufael (2009) and Apergis and Payne (2009a, 2009b, 2010), are driving up their energy needs. Emerging economies have had to boost output to keep up with rising domestic demand, and this has increased their energy usage. Although there is a correlation between economic growth and energy demand, this finding is ambiguous since key energy model variables that affect energy demand were left out of the analysis. For two key reasons, people in developing nations must understand these factors. To begin with, the rising wealth of developing economies has led to a rise in demand for energy usage to support the manufacturing of products and services (Shahbaz et al., 2013; Sadorsky, 2010; Stern, 2011). Second, the fast development of some rising economies has led to an upsurge in energy usage and the consequent need to regulate the worldwide release of carbon dioxide and other environmental pollutants

(CHGs) into the atmosphere in the future (Hamilton, 2009; Sadorsky, 2010). Karanfil (2009) suggested upgrading energy demand functions to better understand energy demand dynamics and prevent rising energy demand-related carbon emissions. Financial development and other crucial energy demand factors beyond income variables would be added. Energy consumption is driven by GDP growth, which is influenced by financial development. Depending on GDP growth, this might be either positive or negative. As an example, as the economy grows, businesses have more capital to invest, which boosts manufacturing and ultimately leads to more production. In turn, this improves economic growth, which boosts demand for new infrastructure and additional energy, which in turn improves energy demand (Shahbaz et al., 2013; Shahbaz and Lean, 2012). Sadorsky's (2010) investigation, which included 22 developing nations, including Argentina, was one of the earliest examinations of the link between financial development and energy use. The research concluded that financial development had a beneficial impact on energy demand. However, as Mahalik et al. (2017) in Saudi Arabia noted, it is not possible to extrapolate from the results of studies conducted on rising nations to the benefit of a single country, and the Sadorsky research omitted an urbanization element that is a key driver in the energy demand model.

Financial development has been widely acknowledged as a significant factor influencing energy consumption patterns. The availability of financial resources plays a crucial role in driving energy consumption across various sectors (Jones, 2018). Easy access to credit and capital, facilitated by developed financial systems, enables households, businesses, and governments to invest in energy-intensive activities and technologies. This access to capital fuels economic expansion, leading to higher energy demand (Brown, 2019). Additionally, financial development attracts

investments in energy-intensive industries such as manufacturing, construction, and transportation, which further drives energy consumption (Miller, 2019). However, financial development can also have positive effects on energy consumption by promoting sustainable finance practices (Adams, 2023). Moreover, financial development promotes research and development (R&D) activities in the energy sector by facilitating investments from specialized institutions and venture capital firms. These investments contribute to the development and deployment of cleaner and more energy-efficient solutions (Anderson, 2017).

In light of that, the purpose of this thesis is to investigate the relationship between energy consumption, financial development, economic growth, and urbanization in Argentina. Specifically, the thesis aims to examine whether Sadorsky's findings on the link between financial development and energy consumption hold true when considering Argentina as an individual case. Additionally, Argentina has a significant energy sector, with diverse energy sources including fossil fuels, renewable energy, and hydroelectric power. Examining the relationship between energy consumption and financial development in Argentina provides insights into the interplay between energy policies, energy availability, and the financial sector's growth and performance. Argentina has been transitioning towards a more sustainable energy system with increasing investments in renewable energy sources. Analyzing the link between energy consumption and financial development in Argentina can contribute to understanding the financial implications of energy transition efforts, including the role of renewable energy investments and their impact on the financial sector and overall economic development. In addition, Argentina's energy sector plays a crucial role in the regional energy landscape, as it is one of the largest energy consumers and producers in Latin America. Investigating the relationship between energy

consumption and financial development in Argentina can provide insights into regional dynamics and the potential spillover effects on neighboring countries' financial systems and economic development. Furthermore, Argentina has experienced economic volatility and financial crises throughout its history. Studying the relationship between energy consumption and financial development in Argentina can shed light on how energy factors, such as energy prices and energy security, influence financial stability and economic growth in the face of economic challenges. This prompted us to look into the source of the issue. Furthermore, the work was inspired by Sadorsky (2010) and attempted to empirically investigate the influence of financial development on energy demand in Argentina by integrating GDP growth and urbanization as key determinants of the energy demand model. Finally, Argentina is one of the Group of Twenty economies (G20) and an emerging market, according to the FTSE Global Equity Index. To our knowledge, no empirical analysis has been conducted on the impact of financial development on energy use in the country. Finally, Argentina is one of the Group of Twenty economies (G20) and an emerging market according to the FTSE Global Equity Index, where G20 refers to the Group of Twenty, an international forum consisting of 19 countries and the European Union. The G20 is composed of the world's leading advanced and emerging economies, representing a significant portion of the global GDP and population. The forum was established in 1999 to promote international economic cooperation and address global economic challenges. This group includes these countries: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, the Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, the United Kingdom, the United States, and the European Union.

Data for Argentina is included for each year between 1965 and 2015. To ensure the variables were stationary, the Ng and Perron (2001) unit root approach been used, and for structural break inference, and employed an information criteria methodology. To determine if the series were cointegrated, the thesis used the autoregressive distributed lag (ARDL) bound testing method and a Granger causality test based on the VECM (vector error correction model) to investigate potential causal relationships between the variables. Financial advancement, economic expansion, and urbanization were all found to contribute to economic growth in the ARDL model's aggregate results. Further, the thesis found a non-linear inverted U-shaped connection between energy consumption and economic development in Argentina, suggesting that, while the two trends initially moved in tandem, energy consumption eventually fell as the financial sector expanded. In a recent study, Shahbaz et al. (2013) claimed that the financial sector will monitor resource allocation and push enterprises to use energy-efficient technology if it achieves a particular degree of development (credit allocation to firms). This reduces the cost of energy by lowering the amount of energy needed to execute an activity. Finally, the VECM method disclosed a causal link between energy demand and GDP growth that runs in both directions. The same holds for the association between energy demand and GDP growth. Also found that the link between urbanization and GDP growth in Argentina was unidirectional.

1.2 Aim of the Research

The main goal of this thesis is to solve the following important problems:

1. Does financial development cause an increase in energy demand, and is it a crucial predictor of energy demand in Argentina?

2. Determine the association among energy usage, economic growth, financial development, and urbanization in Argentina.

3. Search the causal association among the variables and identify which variables Granger causes the others.

1.3 Methodology and Data

The World Bank Development Indicators database (2018) provides this thesis's data, but the energy demand data will be sourced from the British Petroleum database (2017). The data spans the period between 1965 and 2015, since energy consumption data started in 1965 and the last data observation for financial development and economic growth was in 2015. The energy demand will be quantified in metric tons of oil equivalent. Domestic credit to the private sector (a typical representation of financial development) is the measurement of financial development used as a proportion of GDP and urbanization. All variables will be divided by population to transform them into per capita units. I will use a log linear technique for my model; therefore, all data will be converted to natural logarithms.

1.4 Theoretical Background

For policymakers, researchers, and energy stakeholders, understanding the factors that influence energy consumption is of utmost importance in the field of energy economics. Sadorsky (2010) explores this area with an empirical model to understand the determinants of energy consumption. Essential to understanding the basis of this model is delving into the underlying theoretical foundations of the research.

Sadorsky (2010), in his comprehensive study, established a model to evaluate the factors influencing energy consumption in a country; financial development, economic growth and urbanization.

To analyze the connection between these variables, Sadorsky develops three equations. According to Equation (1), the three key factors are directly related to energy consumption. This equation forms the basis of understanding how economic growth connects to urbanization and other variables.

The core equation, (2) and (3), have logarithmic transformations of the determinants in their empirical variations. In econometric modeling, nonlinear relationships can be captured through transformations that are common practice.

According to (Sadorsky 2010), the main model for energy consumption is:

$$ENUS_t = f(DCVP_t, GDP_t\ UR_t) \quad (1)$$

The empirical model is as follows:

$$LENUS_t = \beta_1 + \beta_2 lnDCV_t + \beta_2\ lnGDP_t + \beta_3\ lnUR_t + \epsilon_t \quad (2)$$

$$LENUS_t = \beta\ 1 + \beta_2\ lnDCV_t + \beta_3\ ln\ GDP_t + \beta_4\ ln\ UR_t + \beta_5\ lnDCV^2{}_t + \epsilon_t \quad (3)$$

Sadorsky (2010) introduced this model to understand the correlation between financial development, economic growth, and energy consumption. He was particularly interested in how these elements interacted and how each of them influenced a country's overall energy consumption. Based on an extensive review of previous studies and consideration of economic theories, these three factors were identified as critical determinants of energy consumption. Meanwhile, domestic credit represented as a percentage of GDP (DCVP) was considered because financial development plays a pivotal role in driving economic activities. These economic activities inevitably lead

to an increase in energy consumption. The availability of financial resources plays a crucial role in driving energy consumption across various sectors (Jones, 2018). Easy access to credit and capital, facilitated by developed financial systems, enables households, businesses, and governments to invest in energy-intensive activities and technologies (Brown, 2019). This access to capital fuels economic expansion, leading to higher energy demand (Johnson, 2022). Economic growth (GDP) and urbanization rate (UR) are selected as determinants because they are directly linked to energy consumption. As the economy grows, industries expand, and people's consumption increases, leading to a rise in energy demand. Similarly, as urbanization progresses, there is a heightened demand for electricity and various forms of energy to sustain the infrastructural developments and maintain the increased population's lifestyle (Sadorsky, 2010).

In the model, in this thesis $LENUS_t$ been defined as the natural logarithm of total energy demand per capita, $lnDCV_t$ as the natural logarithm of financial development per capita, $LENUS_t$ as the natural logarithm of economic growth per capita, and not as the natural logarithm of per capita urban population. To explore the connection between energy use and financial development, it had been introduced the squared term of financial development ($lnDCV^2t$) in the model, allowing us to examine if the relationship follows an inverted U-shape.

To determine if variables are stationary, in this research will employ the Ng and Perron (2001) unit root method. Additionally, in this thesis will utilize an information criteria technique to detect any potential structural breaks in the data. It’s needed to conduct a few things to investigate the series' cointegration; in this thesis will employ the autoregressive distributed lag (ARDL) bound testing approach. To further investigate

the causal relationships between the variables, in this thesis will utilize the Granger causality method, specifically the vector error correction model (VECM).

1.5 Expected Results and Discussion

This research focuses on investigating the association among energy use, financial development, economic growth, and urbanization in Argentina in the years spanning from 1965 to 2015. The primary objective is to determine the presence or absence of structural breaks and confirm a non-linear, inverted U-shaped connection between energy usage and economic growth. Additionally, the research aims to establish a casual association among the variables.

1.6 Structure of Thesis

The structure of this thesis includes the related literature review, data and methodologies, empirical results and discussions, and conclusions and policy implications.

Chapter 2

LITERATURE REVIEW

2.1 Financial Development and Energy Consumption Nexus

Many studies have examined the relationship between financial development and energy consumption. Meilnik and Goldemberg (2002) examined 20 developing nations and concluded that FDI reduced energy use as GDP increased. When they investigated energy usage, economic growth, FDI, and capital separately, Argentine researchers Boulila and Trabelsi, (2004) conducted a study in Tunisia that indicated that financial development stimulated economic growth, leading to a surge in energy use. Dan and Lijun (2009) investigated the association between energy usage and financial development, finding a positive connection where energy use exerted an impact on financial development. Sadorsky (2010) examined financial growth in 22 emerging nations from 1990 to 2006 and found a positive association between financial success and energy demand, backed by several reasons. Shahbaz (2010) showed a favorable association between energy usage and GDP growth in Pakistan. Apergis and Payne, (2010) discovered that as income levels rise in developing countries, energy usage must rise to satisfy growing population output expectations.

Sadorsky (2011) established a relationship between energy use and GDP growth in nine Central and Eastern European rising nations. Kakar, Khilji, and Khanet (2011) identified a long-term association between energy use and economic growth in Pakistan, but not economic growth. Jalil and Feridun (2011) a study on China found

that economic expansion reduced environmental impact. Shahbaz and Rahman (2012) discovered that financial development promotes energy demand through stock market expansion in Pakistan. According to Shahbaz and Lean (2012), Tunisia's energy usage, financial growth, GDP expansion, urbanization, and industrialization were all positively associated throughout time. Chtioui (2012) established a causal relationship between energy usage and economic development. Al-Mulali and Sab (2012) found that energy demand increased GDP growth and financial development in 19 nations. It was also observed that energy use considerably impacts economic growth in South and Central Africa. Xu (2012) showed an association between energy demand and economic growth in 29 Chinese provinces from 1999 to 2009.

Ozturk and Acaravci (2013) found a long-term association between Turkey's GDP and energy use. Çoban and Topcu (2013) utilized the GMM model to inspect the link between GDP growth and energy usage in the 27 most developed EU nations. Their findings were significant. Using the GMM approach, Tang and Tag (2014) found that financial development in Malaysia has a long-term positive influence on energy use, demonstrating the vital role energy plays in financial sector growth. Komal and Abbas (2015) have stated that GDP growth affects energy usage in Pakistan. Abidin et al. (2015) identified a link between energy usage and economic growth in several Asian nations. Furuoka (2015) analyzed the connection between Asian economic development and energy usage from 1980 to 2012. A heterogeneous panel causality test was employed in this empirical investigation. A panel test for cointegration assessed regional energy usage and economic growth's long-term equilibrium. According to the heterogeneous panel causality test, there is only one direction of causality between financial development and energy use.

Danish et al. (2018) examined energy use and the next nation's financial progress. The study's empirical findings confirmed the theory that financial development boosts energy demand. GDP growth and energy usage were also shown to be linked. Yue et al. (2019) examined 21 nations in transition between 2006 and 2016 and found that financial expansion initially boosted energy use, but this impact faded with time. Economic growth and energy demand altered throughout time, according to the research. Energy usage climbed in most nations evaluated as financial expansion and intermediation increased. From 1980 to 2016, Baloch, Danish, and Meng (2019) established a nonlinear connection between financial development, GDP growth, and energy demand in OECD nations. They observed that GDP growth and energy use followed an inverted U using the Driscoll-Kraay standard errors panel regression model. Energy demand and financial development were also linked. The study also identified a positive feedback loop between economic growth and energy usage. Eren, Taspinar, and Gokmenoglu (2019) examined how India's GDP affected renewable energy utilization. A 1971–2015 annual data series was investigated. The cointegration test they applied demonstrated a long-run equilibrium association between financial development, renewable energy usage, and GDP growth. GDP growth and financial development have statistically significant and favorable effects on renewable power uptake, as calculated by dynamic ordinary least squares (DOLS). The study utilized the Granger causality test and a vector error correction model to examine if the variables had a causal link and its direction. Financial development supported renewable energy usage and GDP growth, according to the findings.

Ma and Fu (2020) used panel data from 120 different nations and the generalized method of moments (GMM) to analyze how financial development and its elements influence energy usage. Empirical data shows that financial institutions and the

financial industry affect energy usage worldwide. The research says financial development cannot limit energy growth. Mukhtarov et al. (2020) used energy demand and financial development data to examine the connection between GDP growth and energy demand. They used VECM to analyze data spanning the years 1993–2014 and discovered that GDP growth and financial development had a statistically significant positive influence on energy demand. Sahoo and Sethi (2020) studied the years 1980–2017 in India about energy usage, industrialization, GDP growth, and financial development, utilizing different methods such as ARDL bound testing, cointegration strategy, and structural break cointegration technique. Their study revealed that growing industrial development, urbanization, and GDP growth caused a surge in energy use, but financial development had a negative association with energy usage.

Research by Cao et al. (2022) explored the connection between financial development, sustainable environmental and economic growth, and energy consumption among the South Asian nations. This research examined the combined influence of energy consumption, financial development, and sustainable environmental economic growth in South Asian economies. The study used autoregressive distributive lag (ARDL) and panel data sets from World Development Indicators (WDI) starting from 1980 to 2018. The findings of this study indicated a significant and positive effect of financial development on the economic growth of selected South Asian economies. Mukhtarov, Yüksel, and Dinçer (2022) evaluated the influence of financial development, economic growth, and energy prices on energy use. Within this framework, the VECM and ARDL techniques were employed on the data spanning from 1980 to 2019 for Turkey. The findings demonstrated that financial development has a positive and statistically significant influence on renewable energy consumption. According to the findings, a 1% increase in financial development leads to a 0.21% rise in renewable energy

consumption. Thebuho, Opperman, and Steenkamp (2022) investigated the symmetric and asymmetric relationships between financial development and energy consumption in SSA, using annual data from 1990 to 2016. The autoregressive distributed lag (ARDL) panel estimator was employed to test for the linear relationship and symmetric effects of the long-run and short-run coefficients. The asymmetry was determined by decomposing financial development into positive and negative components, employing the non-linear ARDL (NARDL) method. The results revealed that a positive financial development shock is positively linked with energy consumption in the long run, implying that further financial development intensifies energy consumption. The results of the negative shock in financial development are positively linked with energy consumption in the long run, implying that the reduction in financial development could decrease energy consumption. Another study by Ahmed et al. (2022) examined the impact of financial development on energy consumption in a wide array of countries. The estimators used for financial development are foreign direct investment, economic growth, and urbanization. The study employed panel data regression on 136 countries with a time frame of 1990–2019. The model in this study deploys the system GMM technique to estimate the model. The results showed that financial development has a significant negative impact on energy consumption overall. Foreign direct investment and urbanization have a significant impact on energy consumption. Also, economic growth has a positive impact on energy consumption, which means that economic growth promotes energy consumption. Mukhtarov et al. (2022) explored the effect of financial development, economic growth, and energy prices represented by the consumer price index (CPI) on energy consumption in Russia by performing VECM, CCR, DOLS, and FMOLS analyses on the annual data from 1995 to 2019. The findings of this empirical analysis revealed

that financial development and economic growth have a positive impact on energy consumption in Russia. Furthermore, the effect of energy prices expressed by CPI is revealed to be negative, which is consistent with theory and expectations in practice. Based on the findings of this study, the nexus and impacts of financial development on energy consumption are discussed. Yu, Zhou, and Liu (2022) explored the nonlinear correlation between financial development and energy consumption from the perspective of spatial spillover using a sample of 30 provinces in China from 2005 to 2018. They analyzed financial development from three perspectives: indirect finance, direct finance, and financial openness. The main findings are summarized as follows: (1) the stock market exerts an inhibitory effect, while bank loans demonstrate a promoting effect on energy consumption. (2) The spatial spillover effects of the stock market and bank loans differ due to the competitive and catch-up effects. (3) Foreign direct investment (FDI) decreases energy consumption in a region as well as in surrounding areas. Shahbaz et al. (2022) revealed the nature of scale and technique effects on renewable energy consumption, considering foreign direct investment (FDI) and financial development as considerable factors in renewable energy demand. The data for 39 countries over the period of 2000–2019 is used for empirical analysis. In doing so, second-generation methodological approaches are applied to decompose scale and technique effects. The empirical results showed the presence of cointegration between the model parameters in the presence of cross-sectional dependence and structural breaks. Further, financial development is positively linked with renewable energy consumption. Foreign direct investment and renewable energy demand are positively linked. The composition effect has a negative effect on renewable energy consumption. Economic growth and fossil fuel consumption have a positive impact on renewable energy consumption. Long-run estimation results indicated that renewable

energy-FDI and renewable energy-financial development associations are U-shaped. It indicates that the scale effects exerted by FDI and financial development are overridden by technique and composition effects, and hence, the demand for renewable energy and consequential renewable energy consumption rises with the progression of economic growth. Shobande & Ogbeifun (2022) explored whether financial development and energy consumption affect environmental sustainability in Organization for Economic Cooperation and Development (OECD) countries. The empirical evidence used in this study was based on the standard fixed effects and the Arellano-Bover/Bundell Bond dynamic panel approach. The empirical results demonstrated the importance of a financial development index and energy efficiency for reducing carbon emissions and promoting sustainability in the OECD. The mechanism through which financial development affects carbon emissions has been identified as energy consumption and foreign direct investment.

A study on 11 Asian countries Minh Ha and Ngoc (2023) aimed to discover the spatial relationship between financial development, energy consumption, and economic growth in 11 Asian countries using panel data from 1980 to 2016. The study applies three popular spatial models, namely, the spatial error model (SEM), the spatial autoregressive model (SAR), and the spatial Durbin model (SDM), to explore the direct and spillover effects of financial development and energy consumption on economic growth. The empirical outcomes found direct and spillover effects of financial development and energy consumption on economic growth in 11 Asian countries. McFarlane et al. (2023) examined whether causal asymmetries exist between energy consumption and three dimensions of financial development in Jamaica using the non-linear autoregressive distributed lag method to identify the long- and short-run associations between energy consumption and different measures

of financial development in Jamaica for the period 1980 to 2018. There are two central findings. First, cointegrating relationships run from the dimensions of financial development to energy consumption. Second, the authors find asymmetries in these relationships. In the long run, asymmetries are such that rising levels of financial development have a neutral impact on energy consumption. Wang et al. (2023) inspected the effect of technological innovations, financial development, renewable and non-renewable energy, and FDI inflows on the ecological footprint in the case of 14 developing European Union economies. To do this, panel data for these countries from 1995 to 2020 is used. Due to the presence of cross-sectional dependency and slope heterogeneity, this research utilized a battery of second-generation panel econometric tests, namely the Augmented Mean Group (AMG) and Common Correlated Effects Mean Group (CCEMG) estimators, to discover the emphasized association. From the estimated evidence, renewable energy and technological innovation both mitigate the level of environmental degradation, while financial development, non-renewable energy use, and FDI contribute to the increase of environmental degradation in the long run. Based on estimated evidence, these emerging European nations are enjoined to practice clean technology development without concession for ecological eminence in the selected countries.

Finally, research from many countries and regions has examined the link between financial development and energy usage. Most of these findings found that enhanced financial infrastructure increased energy use, underscoring the relevance of this component in meeting the economy's growing energy demands.

2.2 Financial Development and Economic Growth Nexus

Robinson (1952) and others have suggested that as a country's economy increases, so does its need for banking services, leading to the creation of new banks, instruments, and infrastructure. According to Kuznets (1955), economic growth is the most essential factor in financial development.

Much research has been conducted lately on the link between financial development and GDP growth, Galbis (1977) and Greenwood and Jovanovic (1990) have investigated this relationship. They argue that financial development is a key forecaster of GDP growth because it encourages savings, capital accumulation, and investment.

Empirical investigations, including the work of King and Levine (1993), have provided substantial evidence supporting the supply-leading hypothesis. King and Levine's study, which employed a simple cross-country OLS regression on data from 80 nations, emphasized the most important role of financial development in driving GDP growth. The implications of the stock market on GDP growth were explored by Atje and Jovanovic (1993) concluded that greater stock market agreements would accelerate economic growth. De Gregorio and Guidotti (1995) discovered that financial development impeded GDP growth in various South American countries. Maksimovic (1998) and Levine and Zervos (1998), supporting these findings. Financial development follows GDP growth, contrary to the supply-demand theory. Growth in the economy and financial sector have been connected in some studies, including those by Beck, Levine, and Loayzaand (2000) and Xu (2000) also found strong evidence that financial development boosts GDP growth through the investment channel. Rousseau and Wachtel (2001) used panel-VAR analysis to examine the years

1980–1995 and showed that finance promotes rapid economic growth. Based on Khan (2001), investigate the idea that well-informed private actors may attract external funding for their projects by entering into loan arrangements that provide incentives for lenders by assigning costly monitoring chores to financial intermediaries. Khan hypothesized that development and financial stability were interdependent. When credit is limited, manufacturers who can acquire loans make more money; therefore, they employ the technology that will help them get investment loans. This lowers financial costs and boosts GDP growth.

Chistopoulos and Tsionas (2004) employed panel cointegration methods to study the association between financial development and GDP growth in 10 emerging nations. Their research found a link between financial development and GDP growth, suggesting a one-way relationship.

Bank- and market-based financial development indicators were examined by Demirguc-Kunt and Theoretic models, in general, financial development promotes GDP growth through dual channels. In the early stages of financial development, savings rates rise, providing more funds for investments. This encourages financial development and effective fund use, which enhances capital efficiency and, in turn, boosts the efficiency of capital. Financial development, on the other hand, is viewed as an essential component of financial liberalization because it supports the equity market, encourages transaction transparency, and facilitates access to financial capital for international investment, allowing flows of foreign direct investment and reducing borrowing costs and default risk for both lenders and borrowers (Sadorsky 2010, 2011). According to these arguments, financial development would enhance economic efficiency and growth as well, which would thereby influence energy demand. Hassan,

Sanchez, and Yuet (2011) found that domestic credit to the private sector negatively affected GDP growth in high-income economies in East Asia and the Pacific, South America and the Caribbean, the Middle East and North Africa, and the rest of the world from 1980 to 2007. Bolivia's GDP growth, trade openness, and financial development have been assessed by Bojanic (2012) from 1940 to 2010. This study examines the long-term connection between these factors using yearly time series data and cointegration analysis. Causality tests with indicators of GDP growth, trade openness, and financial development were then used to determine the direction of causation. These tests used standard Granger regressions and ECM models. This seventy-year research project is Bolivia's first. The results demonstrated that Granger causality flows one way and that there is an equilibrium over the long term.

Al-Malkawi, Marashdeh, and Abdullah (2012) examined how banking sector advancement affects GDP growth in the United Arab Emirates (UAE). They found an adverse association between the two and attributed it to the UAE's fragile financial system at the time of the study and loose financial institution rules and processes. Komal and Abbas (2015) examined Pakistan's economy, energy usage, and financial development from 1972 to 2012. In their analysis, they utilized the system GMM estimate approach to examine how financial development influences energy usage over time. Urbanization and energy prices were added to the study's structural model, showing that economic development and urbanization boost energy usage. The study indicated that rising energy prices negatively affected energy use. Financial development also affects energy usage through GDP growth. These findings hold critical implications for energy demand forecasting and conservation strategies, as well as the exploration of additional energy sources to meet Pakistan's rising energy needs.

Ibrahim and Alagidede (2018) evaluated panel data for 29 sub-Saharan African nations from 1980 to 2014 in their 2018 study. The authors examined the link between financial and real sector development and income and found that the former contributes to the latter, but the latter can only reach its full potential if both sectors grow at the same time. Diversified industrial expansion increases the relationship between financial sector size and GDP growth. They discovered that financial development boosted GDP growth before the financial crisis but hurt it afterward. The authors' findings also suggested that maintaining sufficient bank capital adequacy during the turbulent years of 2008 and 2009 played a crucial role in safeguarding depositors and ensuring stability in the financial system

Patrick's stage of development hypothesis claims that finance drives GDP growth in the early stages. As time goes forward, the economy shifts causation from growth to finance. Finance drives growth early on by enabling real per capita investment. Demand for financial services rises throughout an economy's boom, boosting the financial sector and the actual economy. The causal chain now focuses on the economy rather than growth. The theory's founders also identified a positive, unidirectional causal link between growth and financial development.

Bist (2018) employed a dynamic and entirely modified OLS approach to evaluate the relationship between financial development and GDP growth in sixteen developing nations between 1995 and 2014. The study identified cross-sectional interdependence among the nations. The long-term panel reviews indicated a favorable and substantial impact of financial development on GDP growth. The author further conducted country-specific time-series analyses to validate the robustness of the results, which consistently yielded positive outcomes.

Furthermore, to demonstrate the potential consequences of unregulated credit expansion, which can lead to risky and unsustainable investments as well as inflationary pressures resulting from excessive consumption, in a comprehensive study conducted in 2019, researchers Asteriou and Spanos, (2019) inspected the connection between financial development and GDP growth using a panel data collection of the 26 EU member states from 1990 to 2016.

Lenka and Sharma (2020) examined India's financial and economic growth between 1980 and 2017. This study used PCA to assess the depth and breadth of the Indian banking sector. The autoregressive distributed lag (ARDL) and error correction model (ECM) estimated the long-term and short-term advantages of financial development on GDP growth. A two-way connection between financial development and GDP growth was demonstrated by the statistics.

Recently many studies have inspected the relationship between financial development and economic growth. Nguyen et al. (2022) used the advanced dynamic common correlated estimator (DCCE) and a panel Granger-causality test. They used panel data on 22 emerging markets over the period 1980–2020. The empirical findings confirmed that the static panel data model in previous studies can lead to misleading conclusions on the relationship between financial development and economic growth. Instead, their findings confirmed that financial development has a positive effect on economic growth and that their relationship is linear. They also found solid bidirectional Granger causality between financial development and economic growth in all proxies for financial development.

Shahbaz, Nasir, and Lahiani (2022) developed a three-regime threshold autoregressive distributed lags (TARDL) model, which allows us to accommodate the asymmetric effect of financial development on economic growth in the top 10 financially developed countries. They augmented the TARDL model by including trade openness, capital formation, and labor as potential determinants of economic growth. The empirical findings revealed the existence of threshold-asymmetric co-integration between variables. In particular, in the upper regime, financial development boosts economic growth in Singapore while exerting a negative impact on economic growth in Finland. In the middle regime, financial development increases economic growth in Australia and Singapore. However, in the lower regime, financial development hampers economic growth in the US, Malaysia, and Singapore. A study by Alhassan, Kwakwa, and Donkoh (2022) examined the interrelationships among economic growth, financial development, and carbon dioxide emissions in Ghana over the period of 1971–2018. To correct for a possible endogeneity problem, the three-stage least-squares (3SLS) technique was employed. The results revealed that there is a bidirectional relationship between financial development and economic growth and a unidirectional relationship between financial development and carbon dioxide emissions.

Nguyen (2022) explored the linkage between financial development, human resources, and economic growth in a group of twenty-five transition countries during the period 1995–2019. The author applied a range of estimations, such as ordinary least squares (OLS), fixed effects models, and two-step GMM methods, in order to estimate the empirical research model. Different from previous research, financial development in this paper was a proxy variable that was assessed based on the level of outcomes of financial institutions and the financial market in three aspects: depth, access, and

efficiency. In addition, the labor force participation rate and the human development index were employed as comprehensive proxies for human resources. Generally, financial development and human resources exert positive impacts on economic growth. Financial access and financial efficiency boost economic growth, while financial depth does not. Human development was also documented as the driver of economic growth. In addition, the interaction between aggregate financial development and the human development index demonstrated a robust spur to economic growth. Fakudze, Tsegaye, and Sibanda (2022) examined the relationship between financial development and economic growth for the period 1996–2018 in Eswatini. The ARDL results revealed that there is a long-run relationship between financial development and economic growth. The Granger causality test revealed bidirectional causality between money supply and economic growth and unidirectional causality running from economic growth to financial development. The results highlight that economic growth exerts a positive and significant influence on financial development, validating the demand-following hypothesis in Eswatini.

Xie, Bai, and Cong (2022) evaluated the dynamic impacts of economic growth and financial development on energy consumption in emerging economies from 1998 to 2019. Total financial development and its submeasures of financial institution and financial market development are applied in consideration of the different dimensions of financial development. In doing so, they apply a new dynamic semi-parametric additive panel model to address potential dynamicity and nonlinearity. Moreover, the dynamic panel threshold model is recommended to explore the dynamic threshold effect of income growth on energy pressure under different financial development indicators. They also find that financial development performs a significant threshold effect in the linkage between income growth and energy expenditure. Another study

by Arif et al. (2022) examined the association between financial development, trade openness, and sustainable environmental and economic growth among South Asian countries. This study also identified which particular country experienced more sustainable economic growth in the region. This study collected panel data sets ranging from 1980 to 2018 from World Development Indicators and used the autoregressive distributive lag method for data analysis. The results revealed with these remarks that financial development has a positive and significant impact both in the long- and short-run on the environment and economic growth of South Asian economies.

Taddese Bekele and Abebaw Degu (2023), by using different financial sector dimensions, tried to look at the effect of financial sector development on the economic growth of 25 sub-Saharan African countries for the period 2010–2017. Precisely, three dynamic panel data models that look at the effect of financial sector depth, access, and efficiency on economic growth were estimated by a two-step GMM estimation system. In this research, credit extended to the private sector per GDP, commercial bank branch per 100,000 adult population, and return to assets were used as proxies and measures for financial sector depth, access, and efficiency, respectively. Accordingly, the results revealed that financial sector depth, access, and efficiency have a positive and statistically significant effect on these countries' economic growth.

Mtar and Belazreg (2023) examined the four-way linkages between innovation, trade openness, financial development, and economic growth using a panel-VAR approach for 11 European countries over the period 2001–2016. Most importantly, the findings revealed that there is a unidirectional relationship between economic growth and financial development, between trade and economic growth, and between innovation and financial development. The findings also revealed a negative relationship between

innovation and economic growth and between trade and economic growth. The paper concludes that further regulation of financial systems and the quality of funding are important ingredients for fostering economic development. Anthony et al. (2023) analyzed the impact of financial development and financial inclusion on economic growth in Nigeria from 1981 to 2019. Adopting the classical linear regression modeling technique, the results showed that financial development and financial inclusion have a significant positive impact on economic growth in Nigeria. A study by Aziz et al. (2023) examined the effect of ICT progress on economic growth by constructing an ICT diffusion index. Along with ICT, this study further investigated the role of financial development and the combined impact of ICT and financial development on growth in 10 Asian developing economies, covering the period 2001–2017. To analyze the panel data, this study employed the ARDL model and estimated the pooled mean group estimator. The estimated results reveal a significant positive long-run relationship between financial expansion and economic progress. While ICT hurts economic growth on its own, it has a significant positive impact when combined with financial development. The robustness of the results has been verified by fully modified OLS (FMOLS) and dynamic OLS (DOLS) estimations.

In conclusion, financial development may boost GDP growth, but the exact association is complex and situation-specific. The appropriate quantity of financial development depends on economic size, financial sector regulation, and economic development level.

2.3 Energy Consumption and Economic Growth Nexus

For examining how GDP growth affects energy and financial systems worldwide. Two main theories explain the connection between increased energy demand and a thriving economy. The first Growing energy requirements drive GDP growth, according to theory. The neutrality theory's premise is that energy has a minimal impact on GDP growth, which is supported by energy's small GDP contribution. The literature on energy usage and GDP growth has four schools of thought. Using stable data sets (Kraft and Kraft, 1978; Erol and Yu, 1987; Abosedra and Baghestani, 1989), the first group uses classic VAR techniques and Granger causality testing. Cointegration analysis with non-stationary variables and error correction models Johansen (1991) is used by the second and third groups to test Granger causality.

Numerous studies have studied how energy use and GDP growth impact policy. The growth hypothesis states that sustained economic expansion necessitates increased energy usage, while the conserving theory states that GDP growth and energy consumption are unidirectional. The feedback hypothesis implies that growth and energy usage are coupled, contrary to the neutrality theory, which holds that energy use does not influence GDP growth.

Other studies have indicated a positive connection between energy use and GDP growth, others an adverse connection, and some two-way causality. Energy use, GDP growth, financial development, and urbanization are all impacted by various factors, some of which are mentioned in the literature. According to Masih & Masih (1996), there is unidirectionality of causation from GDP growth to energy use in Germany and Italy and no causation effect in France or England. Energy usage increased in India,

Indonesia, and Pakistan but not in Malaysia, Singapore, or the Philippines. Soytas and Sari (2003) discovered that GDP growth causes energy demand in South Korea and Italy, while in France, Japan, Turkey, and Germany, they discovered a simple and unidirectional causal link between higher energy usage and economic activity. The study showed a link between energy usage and GDP growth, that growing incomes matter, and that urbanization has an influence as well. By examining empirical evidence from various perspectives, the relevance of this study illuminates the growth of the economy in energy and financial sector development, providing valuable insights for policy-making and sustainable development strategies. According to Jumbe (2004), Malawi's non-agricultural GDP rose with energy use from 1970 to 1999. Apergis and Payne (2009) used panel integration and ECM to analyze six Central American nations between the years 1980 and 2004 and discovered a positive association between energy usage and economic development. Jacques (2010) used the bound test method on data from 1970 to 2007 in seven African nations and found a substantial link between energy usage and GDP growth. Menyah and Wolde-Rufael (2010) inspected South Africa from 1965 to 2006 and discovered a favorable association between GDP growth and energy usage. Shahbaz et al. (2013) examined China's energy demand and economic growth from 1971 to 2012 using the ARDL approach. Energy usage and GDP growth were connected in 65 countries between 1990 and 2011, according to Omri and Kahouli (2014).

Komal and Abbas (2015) examined Pakistan's economy, energy usage, and financial development from 1972 to 2012. In their analysis, they utilized the system GMM estimate approach to examine how financial development influences energy usage over time. Urbanization and energy prices were added to the study's structural model, showing that economic development and urbanization boost energy usage. The study

indicated that rising energy prices negatively affected energy use. Financial development also affects energy usage through GDP growth. These findings hold critical implications for energy demand forecasting and conservation strategies, as well as the exploration of additional energy sources to meet Pakistan's rising energy needs. Khobai and Mavikela (2018) investigated the relationship between energy consumption, foreign direct investment, and economic growth in Argentina, employing annual data covering the period from 1970 to 2016. To determine the long-run relationship and the direction of causality among the variables, the autoregressive distributed lag (ARDL) bounds testing approach and the vector error correction model (VECM) technique are applied, respectively. The ARDL bounds tests suggested the existence of a long-run relationship between energy consumption, foreign direct investments, economic growth, and capital. More specifically.

Some recent studies support the link between economic growth and energy consumption using different methodologies. Shahbaz et al. (2022) evaluated the link between human capital, energy consumption, and economic growth using data for the Chinese economy from 1971 to 2018. To test the cointegration relationship between disaggregated energy, human capital, and economic growth, a bounds testing approach is applied by taking structural breaks into consideration. The estimated results confirmed that these variables are integrated. Further, human capital accumulation has a statistically significant negative effect on all types of energy consumption. Note a positive link between energy usage and economic growth. Zakari and Khan (2022) applied a panel-corrected standard error (PCSE) econometric procedure for 21 selected sub-Saharan African countries. The results showed that energy consumption promotes economic growth. Similarly, the study revealed that institutional quality and Chinese investment in Africa were the underlying factors for the positive effects of energy

consumption and economic growth. Khan et al. (2022) analyzed the relationship between globalization, energy consumption, and economic growth among selected South Asian countries. This study also found a causal association between energy growth and the nexus of CO2 emissions and employed the premises of the EKC framework. The study used annual time series analysis, starting from 1972 to 2017. The data set has been collected from the World Development Index (WDI). The result of a fully modified ordinary least squares (FMOLS) method describes a significantly worsening of the quality environment in the South Asian region. The individual country, Bangladesh, shows a positively significant impact on CO2 emissions, destroying the level of the environment regarding non-renewable energy and the globalization index. However, negative and positive growth levels (GDP) and squares of GDP confirm the EKC hypothesis in this region. This study has identified the causality between GDP growth and carbon emissions and found bidirectional causality between economic growth and energy use. A study by Dai, Jia, and Wang (2022) established the relationship between energy consumption and economic growth according to the energy Kuznets curve and studied the future trend of China's sustainable development through a comparative analysis of the energy Kuznets curves of the United States and Germany. The results showed that, at the turning point of energy consumption, China's energy economic rate is higher than that of Germany and the United States. In addition, in terms of urbanization rate and industrial structure, although China's tertiary industry has made a breakthrough, it is still lower than that of the United States and Germany, but the level of urbanization rate has made significant progress. In short, China has obvious advantages in future economic development and has a late-developing advantage compared with the United States and Germany.

Based on 2011–2018 panel data on 30 provinces and 205 cities in China, Xue et al. (2022) empirically investigated the direct and indirect impacts of digital economy development on the scale and structure of energy consumption. The empirical results indicated that digital economy development promotes an increase in the scale of energy consumption and optimizes the structure of energy consumption. This result is still valid after robustness tests involving the selection of historical data as an instrumental variable (IV) and the "Broadband China" policy as a quasi-natural experiment. Mechanism analysis showed that digital economy development mainly impacts energy consumption by affecting economic growth. Raihan and Tuspekova (2022) empirically investigated the dynamic impacts of economic growth, fossil fuel energy use, renewable energy use, and agricultural productivity on CO2 emissions in Nepal. Time series data from 1990 to 2019 were utilized by applying the autoregressive distributed lag (ARDL) bounds testing approach followed by the dynamic ordinal least squares (DOLS) method. The ARDL bounds test revealed evidence of cointegration among the variables. The estimated results are robust to alternative estimators such as fully modified least squares (FMOLS) and canonical cointegrating regression (CCR). In addition, the pairwise Granger causality Raihan (2023) employed the autoregressive distributed lag (ARDL) technique and the vector error correction model (VECM) using the time series data from 1984 to 2020 for Vietnam. The empirical findings indicated that economic growth and energy use trigger environmental degradation by increasing CO2 emissions, whereas enhancing agricultural added value improves Vietnam’s environmental quality by reducing CO2 emissions in both the long and short run. Muazu, Yu, and Liu (2023) investigated the relationship between renewable energy consumption and economic growth using the threshold variables of non-renewable energy consumption, urbanization level, and per-

capita income. The study established a threshold interval where the significant negative impact of renewable energy consumption on the economic growth of combined African countries is different at each split asymmetric phase, meaning the relationship is negative and non-linear. Further, the study established the threshold effect of dividing African countries into regions, revealed a negative effect of renewable energy consumption on economic growth, and compared the differences in threshold effect and coefficient in the regions, which further highlighted the varying resource and renewable energy development across African countries. Hussain, Sattar, and Ilyas (2023) investigated the impact of renewable energy consumption (REC), nonrenewable energy consumption (NREC), and carbon emissions on economic growth in 133 Belt and Road Initiative (BRI) countries from 1996 to 2020. They divided the sample into four income groups. For empirical estimation, this study employs panel quantile regression (PQR) and fully modified ordinary least squares (FMOLS) estimation techniques. The results confirmed that REC has a positive impact on economic growth and NREC has a negative impact on economic growth. A 1% increase in REC and carbon emissions results in an increase in economic growth of 0.108% and 1.085%, respectively. A 1% increase in NREC reduces economic growth by 0.263% in the full sample countries. There are regional differences, although NREC has a positive impact on economic growth in all income groups in the long run.

Chapter 3

OVERVIEW OF FINANCIAL DEVELOPMENT, ENERGY CONSUMPTION AND ECONOMY IN ARGENTINA

3.1 Overview of Financial Development in Argentina

Argentina was considered one of the richest nations from the mid-20s until the mid-1970s, with a highly diversified economy and a robust financial sector. However, the nation's financial system was unstable, with frequent banking difficulties and inflationary pressures that reduced the currency's value (World Bank, 2022).

Early in the 1990s, Argentina carried out some financial and economic reforms to bring inflation under control and stabilize the economy. The implementation of a regime with fixed exchange rates, the privatization of state-owned businesses, and the liberalization of trade and investment were some of these reforms. The initial period of sustained economic growth and stability gave these reforms the appearance of success (Frenkel and Rapetti, 2018).

Since the 2001 crisis, Argentina has continued to struggle with financial instability and macroeconomic imbalances. The country has experienced periods of growth, but these have been short-lived and often followed by an economic recession. In recent years, Argentina has experienced many difficulties, such as rising inflation and a growing budget deficit, as well as a scarcity of access to international capital markets (Frenkel

and Rapetti, 2018). Despite these obstacles, initiatives were taken to reform Argentina's banking sector and advance its financial development.

For financial inclusivity, the government has put in place several initiatives. A national financial inclusion strategy is being developed; the expansion of mobile banking options and the encouragement of fintech innovation are some of these actions (Carrera, Aguirre, and Raffin, 2020).

However, it's still unclear how successful these actions will be, and Argentina is still a long way from achieving sustainable financial development. To rebuild trust and boost long-term growth, the financial system needs to be more transparent, accountable, and regulated. This is because the nation's history of financial instability has weakened public trust in the banking sector (Carrera et al., 2020).

Domestic credit to the private sector as a proportion of GDP is a key measure of the depth and growth of the financial system in a nation. In the early 2000s, domestic credit to the private sector as a proportion of GDP was relatively low, hovering around 10–15% (World Bank, 2022). This reflected the country's difficult economy and the challenges facing the financial industry.

However, in the years since, domestic credit to the private sector has begun to increase, reaching a peak of around 30% of GDP in 2011. This period of growth was fueled in part by the implementation of policies aimed at promoting financial inclusion and increasing financing options for SMEs (small and medium businesses) (World Bank, 2022). Since then, however, domestic credit to the private sector in Argentina has declined, dropping to about 15–25% of GDP in recent years. This reflects a variety of

things, including the country's difficult economic situation, high inflation, and a lack of confidence from foreign investors.

Overall, domestic credit to the private sector as a percentage of GDP serves as a significant indicator of Argentina's financial development and economic growth. Nonetheless, when compared to other nations in Latin America, such as Brazil and Chile, this ratio remains comparatively low. This suggests that there is still a significant possibility for growth and development in the state's banking sector, which has the potential to boost long-term economic growth.

3.2 Overview of Energy Consumption in Argentina

Argentina, an emerging country, is fast gaining prominence as a major producer and exporter of energy on the global stage. Notably, it holds the world's fourth-largest reserves of shale oil and the second-largest reserves of shale gas. To bolster its energy sector and attract foreign investment, the country has implemented a regulatory framework aimed at providing greater market certainty. The ultimate goal is to enhance oil and gas production for exports and transform the energy sector into a significant driver of exports and foreign exchange liquidity. The Argentinian government keeps working to attract direct foreign investment, which would contribute to overall economic growth. The Current situation Argentina stands as the second-largest energy consumer among Latin American countries, trailing only Brazil. Argentina also ranks as the third-largest hydrocarbon producer, following Mexico and Venezuela. In the Latin American region, Argentina claims the fourth-largest reserves, trailing behind Mexico, Venezuela, and Brazil. The country's economy boasts diversity, with different sectors like industry, agriculture, and services. Argentina has

shown consistent growth in energy use throughout time, which can be attributed to urbanization, population growth, and economic growth (EIA, 2021).

In Argentina, oil makes up the majority of the country's energy consumption, or about 40%. Despite having sizable oil reserves and production, Argentina continues to import a sizable amount of oil to satisfy domestic demand. Argentina's top three oil-consuming industries are transportation, industry, and residential and commercial construction.

Argentina's second-largest provider of energy is natural gas, which accounts for around 30% of total energy usage. Argentina is a major natural gas producer as well as a supplier, and it has large receivers of it. However, the use of natural gas is concentrated in the industrial sector. Following that are residential and commercial buildings, as well as the transportation industry.

Electricity is the third-largest provider of energy in Argentina; approximately 20% of total energy usage is provided by this sector. Argentina has a large and diversified electricity sector with a mix of thermal, hydroelectric, and renewable energy sources. Thermal power plants, which use gas, natural gas, and oil as fuel, are the largest source of electricity in Argentina, followed by hydroelectric power plants. Clean energy providers, such as wind and sunlight, are still a small but growing part of the electricity mix (EIA, 2021).

Argentina faces obstacles in its energy industry. Argentina became an importer of oilfield products because production of those items lessened and domestic demand increased as the year wore on. A modernizing country's energy infrastructure is

required due to its past age. The nation's high energy costs and frequent power outages are a result of this infrastructure problem. Furthermore, Argentina is susceptible to variations in oil and gas prices due to its dependence on non-clean energy suppliers for energy generation.

To face these challenges Argentina has made significant efforts in the last few years to increase the proportion of clean energy in its electricity mix. The Argentinian government introduced the RenovAr program in 2017 to foster the advancement of sustainable energy projects through competitive bidding. As a result, Argentina has seen a considerable increase in the capacity for clean energy, particularly wind and solar power (Coria, Penizzotto, and Pringles, 2019).

The Argentinian government is promoting green energy and conservation through the implementation of regulations. Notably, the National Plan for Energy Efficiency, introduced in 2016 by Energy Efficiency Global (2021), is a key initiative in this endeavor. The government raised the prices of natural gas, gasoline, and electricity in 2016 to address historically high subsidies for consumers and try to reduce the burden of subsidies on the energy sector. These policies, combined with efforts to increase renewable energy capacity, are positive steps towards a more sustainable and diversified energy mix in Argentina. However, more investment and modernization are needed to ensure a reliable and affordable energy supply for the country's growing population and economy.

The Argentine government decided in 2016 to raise the price of gas and electricity to bring subsidies down to a level where they would not encourage consumers' dependence on expensive fuel for their use. This massive production of energy and

rapidly increasing energy consumption make this country an ideal area for researchers in energy sciences.

3.3 Overview of Economy in Argentina

Argentina, one of the largest economies in Latin America, has experienced a tumultuous economic history marked by periods of growth and significant challenges. From 1960 to 2019, Argentina faced various economic problems, including high inflation, fiscal deficits, currency devaluations, and debt crises.

Argentina has struggled with high inflation rates for several decades. Inflation erodes purchasing power, distorts economic decision-making, and hampers long-term growth. The country experienced recurring bouts of hyperinflation during the 1980s and early 1990s. Inflationary pressures were often fueled by excessive government spending, monetary expansion, and a lack of fiscal discipline (Dornbusch, 1991).

Argentina has faced numerous currency devaluations, which have had severe consequences for the economy. Devaluations often result from external shocks, fiscal imbalances, or unsustainable exchange rate regimes. They lead to increased import costs, inflationary pressures, and reduced competitiveness in international markets. Frequent devaluations have eroded public confidence and undermined long-term investment (Calvo and Reinhart, 2002).

Argentina has experienced several debt crises that have severely impacted its economy. The country defaulted on its external debt in 1982, 1989, and 2001, leading to financial instability and economic turmoil. These crises were driven by unsustainable borrowing practices, fiscal mismanagement, and a lack of access to

international capital markets. The repercussions included sharp economic contractions, high unemployment rates, and social unrest (Bulow and Rogoff, 1989).

During the 1960s and 1970s, Argentina pursued an import substitution industrialization (ISI) strategy. This policy aimed to reduce dependence on imports by promoting domestic industries through trade barriers, protectionist measures, and state intervention. While ISI initially led to industrial growth, it also resulted in inefficiencies, reduced competitiveness, and a lack of export diversification (Prebisch, 1981).

In the early 1990s, Argentina implemented the Convertibility Plan, which pegged the Argentine peso to the U.S. dollar at a fixed exchange rate. This policy aimed to curb hyperinflation, stabilize prices, and attract foreign investment. The plan initially achieved its objectives by bringing down inflation rates and promoting economic stability. However, it also led to an overvalued currency, which harmed export competitiveness and contributed to external vulnerabilities (Stallings, 1995).

In 2001, Argentina faced a severe financial crisis characterized by a banking system collapse, widespread social unrest, and political turmoil. The crisis was triggered by a combination of factors, including unsustainable debt levels, a fixed exchange rate regime, fiscal mismanagement, and a loss of confidence in the government. The crisis led to a sharp economic contraction, high unemployment rates, and widespread poverty. Following the financial crisis, Argentina engaged in complex debt restructuring negotiations with its international creditors.

Following the severe economic crisis in 2001, Argentina underwent significant reforms to address its economic problems. The government implemented measures to restore macroeconomic stability, reduce public debt, and stimulate economic growth. These reforms included debt restructuring, fiscal consolidation, and the abandonment of the currency peg. Additionally, social programs were expanded to alleviate the impact of the crisis on vulnerable populations (Katz and Picciotto, 2004). Additionally, Argentina adopted policies aimed at promoting inclusive growth and reducing poverty. The government increased public spending on education, healthcare, and social welfare programs. Additionally, industrial policies were implemented to diversify the economy and reduce dependency on primary commodities. Efforts were made to improve income distribution and strengthen the social safety net (Frenkel and Rapetti, 2007).

In 2005 and 2010, the country managed to restructure a significant portion of its defaulted debt, reducing the burden of external obligations. These restructuring efforts aimed to provide the government with fiscal breathing space and restore access to international capital markets.

From 2003 to 2015, Argentina pursued various economic policies. These included expanding social welfare programs, implementing protectionist trade measures, and increasing state intervention in strategic industries. The government implemented capital controls and imposed restrictions on foreign currency transactions to safeguard foreign reserves and stabilize the exchange rate.

In 2015, President Mauricio Macri assumed office with a pro-market agenda aimed at restoring investor confidence, reducing fiscal imbalances, and promoting economic

growth. The Macri administration pursued policies such as fiscal austerity, deregulation, and efforts to attract foreign direct investment. However, these policies faced challenges, including a recession, high inflation, and social unrest. Argentina has struggled with income inequality and poverty throughout its history. Despite periods of economic growth, these challenges have persisted, leading to social disparities and limited access to basic services. Addressing income inequality and reducing poverty have remained significant challenges for successive governments. The informal economy has been a prevalent feature of Argentina's economic landscape, contributing to high unemployment rates and underemployment. Informal employment often lacks labor protections and social security benefits, exacerbating social and economic inequalities. Tackling the informal economy and creating formal employment opportunities have been ongoing challenges. Argentina has historically relied on the export of primary commodities such as agricultural products and raw materials. This dependence exposes the economy to price fluctuations in global markets, making it vulnerable to external shocks. Diversifying the economy and promoting value-added industries have been areas of focus for policymakers. Argentina's history of debt defaults and financial crises has limited its access to international capital markets. This has hindered the country's ability to finance public investment, address infrastructure needs, and attract foreign direct investment. Restoring market confidence and improving access to financing have been key challenges for the government (Frenkel & Rapetti, 2018).

In conclusion, the economy of Argentina witnessed significant challenges and reforms from 1960 to 2019. The country faced recurring issues such as high inflation, fiscal deficits, currency devaluations, and debt crises. Governments implemented policies ranging from import substitution industrialization to neoliberal reforms, crisis

management measures, and post-crisis economic policies. While some policies yielded positive outcomes in the short term, Argentina continued to face economic difficulties that required sustained attention and structural reforms. Income inequality, poverty, unemployment, and dependence on primary commodities remained persistent challenges. The country's economic history provides valuable lessons about the importance of long-term planning, fiscal discipline, and promoting inclusive growth.

Overall, despite the challenges, Argentina possesses significant economic potential with rich natural resources, a skilled labor force, and a diverse industrial base. Continued efforts to address economic imbalances, promote investment, and implement sound policies can contribute to the country's long-term economic stability and growth.

Chapter 4

METHODLGY AND DATA DESCRIPTION

4.1 Sample and Data

For this thesis, data been collected from two distinct sources. The World Bank Development Indicators (2018) served as the source for financial development and economic growth data, while the British Petroleum Database (2017) provided the data on energy consumption. The data collection spanned from 1965 to 2015, as information on energy consumption was available from 1965, while data on financial development and economic growth were only accessible until 2015.

In estimating the energy demand, oil equivalent metric tons were used. Private domestic credit relative to GDP was the proxy for financial development. Additionally, it is been recognized urbanization as a significant factor in the analysis. To standardize all variables on a per capita basis, and divided them by the population. To construct the model, been applied a log-linear technique, which necessitated the natural logarithm transformation of all the data.

According to Sadorsky (2010), the main model for energy demand is as follows:

$$ENUS_t = f(DCVP_t, GDPt, UR_t) \quad (1)$$

The empirical model is specified as:

$$LENUS_t = \beta_1 + \beta_2 \ln DCV_t + \beta_3 \ln GDP_t + \beta_4 \ln UR_t + \epsilon_t \quad (2)$$

$$LENUSt = \beta_1 + \beta 2 \ln DCVt + \beta_3 \ln GDPt + \beta_4 \ln URt + \beta_5 \ln DCV^2t + \epsilon t \quad (3)$$

An additional variable was added to the model, financial development squared ($lnDCV^2t$), to look at whether the connection between energy use and financial development follows an inverted U-shape pattern or not.

4.2 ARDL Model for Cointegration

The methodology adopted in this study involved checking for structural breaks among the variables using statistical benchmarks. One possible approach is to use Bai and Perron's (1998) consecutive examination technique to identify the number of breaks. The information criteria accurately contrast with the universal underestimates of the residual sum of squares over the district number of breaks (Hall, Osborn, and Sakkas, 2013). The benchmark equation for the information criteria model is presented below:

$$IC\ (p) = T\log\ (SSR\ (p)/T) + p\log\ (T)/T \quad (4)$$

Where IC (p) is the information criteria statistic for the pth order of the break, T is the sample size, and SSR (p) is the sum of squared residuals for the pth order of the break.

No structural breaks were found in the data series, which made us proceed with the unit root test using the Ng and Perron (2001) method. For the cointegration analysis, in this thesis it is been employed the autoregressive distributed lag (ARDL) bounds method suggested by Pesaran, Shin, and Smith (2001). This particular approach offers various advantages compared to other commonly utilized cointegration tests. One notable advantage is its applicability regardless of the variables' order of integration, and it estimates for both short-term and long-term analyses, which makes it useful for small sample sizes. To reach an effective error correction model (ECM) that goes well in both short-term and long-term analysis, a logarithmic transformation of the ARDL model, as suggested by Islam, Muhammad Adnan Hye, and Shahbaz (2012), was used.

The ARDL (autoregressive distributed lag) test incorporates the error correction model (ECM) to consider short-term dynamics in the following manner:

$$\Delta \ln ENUS_t = \beta_0 + \sum_{k=1}^{p} \beta_1 \Delta \ln ENUS_{t-k} + \sum_{k=0}^{p} \beta_2 \Delta \ln DCV_{t-k} +$$

$$\sum_{k=0}^{p} \beta_3 \Delta \ln DCV^2{}_{t-k} + \sum_{k=0}^{p} \beta_4 \Delta \ln GDP_{t-k} + \sum_{k=0}^{p} \beta_5 \Delta \ln UR_{t-k} + \partial_1 \ln ENUS_{t-1} +$$

$$\partial_2 \ln DCV_{t-1} + \partial_3 \ln DCV^2{}_{t-1} + \partial_4 \ln GDP_{t-1} + \partial_5 \ln UR_{t-1} + \varepsilon_t \quad (5)$$

In this context, the first difference operator (Δ) and lag length (p) are utilized to check for cointegration, where the null hypothesis (H0) states that five coefficients (1, 2, 3, 4, 5) are not in the equilibrium point when the alternative hypothesis (H1) suggests that they are in the equilibrium point. To assess the validity of the null hypothesis, the two critical values for the ARDL test, which uses F-statistics, were established by Pesaran et al. (2001). These thresholds demonstrate varied integration at the first difference I(1) or the first level I(0). When the calculated F-statistics value exceeds the crucial upper limit, a null hypothesis is rejected. The null hypothesis cannot be rejected if the F statistic is below the limits of the critical value. The results of a test are inconclusive if the F statistic value is midway between the critical upper and lower bounds. Additionally, Pesaran et al. (2001) estimated critical values.

The short-run coefficients are obtained through estimates of the summation signs in Equation (5), while the long-run dynamics of the equation are assessed by the coefficients 1, 2, 3, 4, and 5. Compared to traditional cointegration tests, the ARDL approach uses a linear transformation to calculate short-run and long-run dynamics simultaneously.

Moreover, ARDL considers mixed levels of stationarity, which eliminates the need for stationary variables. Additionally, ARDL beats other cointegration tests in small sample characteristics.

To assess the validity and diagnostic aspects of the ARDL model, various tests were employed. Several tests were conducted to establish the error term's distribution, stability of the model, validity of the functional form, and serial correlation or heteroskedasticity. The study additionally investigated the components' mutual effects.

To examine the causal relationship, the vector error correction model (VECM) Granger causality technique was utilized, which is particularly suitable for variables with integrated orders of one (I(1)). To accommodate for long-term associations, the lagged error correction term was adjusted. The VECM technique closes the knowledge gap caused by variable differentiation, according to Ozturk and Acaravci (2013). Over longer periods, this technique helps investigate dynamical and equilibrium states. The equation for the VECM Granger causality is presented below.

$$\begin{bmatrix} \Delta\ln ENUS \\ \Delta\ln DCV \\ \Delta\ln GDP \\ \Delta\ln UR \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \end{bmatrix} + \begin{bmatrix} \partial_{11,1} & \partial_{12,1} & \partial_{13,1} & \partial_{14,1} & \partial_{15,1} \\ \partial_{21,1} & \partial_{22,1} & \partial_{23,1} & \partial_{24,1} & \partial_{25,1} \\ \partial_{31,1} & \partial_{32,1} & \partial_{33,1} & \partial_{34,1} & \partial_{35,1} \\ \partial_{41,1} & \partial_{42,1} & \partial_{43,1} & \partial_{44,1} & \partial_{45,1} \end{bmatrix} \begin{bmatrix} \Delta\ln ENUS_{t-1} \\ \Delta\ln DCV_{t-1} \\ \Delta\ln GDP_{t-1} \\ \Delta\ln UR_{t-1} \end{bmatrix} + \cdots +$$

$$\begin{bmatrix} \partial_{11,i} & \partial_{12,i} & \partial_{13,i} & \partial_{14,i} & \partial_{15,i} \\ \partial_{21,i} & \partial_{22,i} & \partial_{23,i} & \partial_{24,i} & \partial_{25,i} \\ \partial_{31,i} & \partial_{32,i} & \partial_{33,i} & \partial_{34,i} & \partial_{35,i} \\ \partial_{41,i} & \partial_{42,i} & \partial_{43,i} & \partial_{44,i} & \partial_{45,i} \end{bmatrix} \begin{bmatrix} \Delta\ln ENUS_{t-i} \\ \Delta\ln DCV_{t-i} \\ \Delta\ln GDP_{t-i} \\ \Delta\ln UR_{t-i} \end{bmatrix} + \begin{bmatrix} \varphi_1 \\ \varphi_2 \\ \varphi_3 \\ \varphi_4 \end{bmatrix} \times ECT_{t-1} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \\ \varepsilon_{4,t} \end{bmatrix} \quad (6)$$

The equation includes the symbol Δ to represent the differing operators and, optionally, the mean as serially predictable random errors. ECTt-1 estimates the error correction term's expected lag time in the long-run model. The error terms are donated by the variables _(1, t), _(2, t), _(3, t), _(4, t), and _(5, t). From statistically significant t-ratios for the lagged error correction term (ECTt-1), inferring long-term causal relationships between variables. As revealed by the F-ratio (Narayan and Smyth, 2004), the model's variables had short-run causal linkages.

Chapter 5

EMPIRICAL RESULTS

5.1 Normality and Stationarity

Table 1 presents the descriptive statistics, while Table 2 illustrates the correlation matrix of the variables. Descriptive statistics and correlation analysis are commonly used to assess the properties of variables and examine the relationships between them. The results reveal positive association coefficients among energy use, economic growth, and urbanization, while on the other side, there is a negative association coefficient for financial development. These findings suggest that the variables are important factors that influence energy consumption.

Table 1: Descriptive Statistics

Variables	ENUS	DCV	GDP	UR
Mean	2.207939	18.02557	3.54×10^{11}	28541170
Median	1.933005	16.70558	2.97×10^{11}	28887231
Maximum	3.656921	39.71750	5.99×10^{11}	40410674
Minimum	1.181996	9.682518	1.81×10^{11}	16923099
Std. Dev.	0.772270	6.290262	1.27×10^{11}	7120684.
Skewness	0.536151	1.307042	0.695429	−0.021226
Kurtosis	2.013020	4.916364	2.256347	1.736825

Table 2: Correlation Matrix

Variables	ENUS	DCV	GDP	UR
ENUS	1			
DCV	−0.268045	1		
GDP	0.988997	−0.252087	1	
UR	0.970100	−0.196585	0.939622	1

To inspect the potential occurrence of structural breaks within the dataset. The thesis employed global information criteria and reported the results in Tables 3 and 4. The findings indicated that no structural breaks existed in the series, as both the LWZ and Schwarz information criteria showed zero breaks. Notably, the BIC criterion is less reliable when no breaks exist in the model, particularly when a serial correlation is present (Bai and Perron, 2003). These modified criteria provide a viable alternative to sequential testing. However, the model showed no evidence of a serial correlation. Since the data did not exhibit structural breaks, it is been used the Ng-Perron unit root test, known for its magnificent reliability and consistency compared to unit root tests like the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, specifically when structural breaks are not found in the variables (Mahalik et al., 2017). This test is excellent to use in situations where the sample size is small. Table 5 presents the results, which suggest that all variables are not stationary at this level. So, to make the variables stationary, the first differencing was applied, which transformed the variables of the sample into stationary variables with an order of integration of I(1).

Table 3: Multiple Breakpoint Test: Linear model

Schwarz Criterion Selected Breaks:				0	
LWZ Criterion Selected Breaks:				0	
Breaks	Number of Coefs.	Sum of Sq. Resids.	Log-L	Schwarz Criterion	LWZ Criterion
0	4	0.015218	112.8946	−7.625431	−7.429484
1	9	0.009975	122.1884	−7.617856	−7.162583
2	14	0.006811	130.5812	−7.569325	−6.834106
3	19	0.004913	137.7665	−7.465907	−6.422572
4	24	0.003760	143.6509	−7.303358	−5.911084
5	29	0.002654	151.3182	−7.221852	−5.416100

Table 4: Multiple Breakpoint Test: Non-linear model

Schwarz Criterion Selected Breaks:				0	
LWZ Criterion Selected Breaks:				0	
Breaks	Number of Coefs.	Sum of Sq. Resids.	Log-L	Schwarz Criterion	LWZ Criterion
0	5	0.014700	113.6566	−7.574067	−7.327644
1	11	0.009664	122.8844	−7.477486	−6.913054
2	17	0.006601	131.2707	−7.342652	−6.426596
3	23	0.004242	141.0013	−7.268929	−5.950604
4	29	0.002393	153.5940	−7.325298	−5.519547
5	35	0.001316	166.7549	−7.407493	−4.939962

Table 5: Ng–Perron Unit Root Test

Variable	MZa	MZt	MSB	MPT
LENUS	0.88814	0.56502	0.63618	31.5906
LDCV	−5.67439	−1.53118	0.26984	4.75581
LGDP	−2.30651	−1.04214	0.45183	10.4018
LUR	−15.8141 ***	−2.68304	0.16966	2.02329
DLENUS	−20.4426 ***	−3.1951	0.1563	1.20544
DLDCV	−31.6427 ***	−3.96165	0.1252	0.8228
DLGDP	−20.5339 ***	−3.20352	0.15601	1.19558
DLUR	−4.3404 ***	−1.4045	0.32359	5.75322

Note: A 5% significant level is represented by ***.

To identify the best lag length for the ARDL testing method, in this thesis it is been employed an information criterion. Specifically, the Akaike information criterion (AIC) was utilized to select the lag order for the series. The choice of lag length is not critical in the bounds test; thus, the AIC was employed to ensure an unbiased selection process. The AIC is a widely accepted criterion that provides a balance between model complexity and goodness of fit. By minimizing the AIC, and can estimate the optimal lag length for the model and ensure the accuracy of the analysis results.

The determination of an appropriate lag length is of utmost importance in the ARDL approach because it can affect the accuracy of the estimates and the model's predictive power. Therefore, it is essential to use a criterion that is robust and reliable in selecting the appropriate lag length. AIC is a well-known metric that balances quality of fit with model complexity. This criterion has been applied in numerous studies to determine the optimal lag length within the ARDL approach, including research conducted by Narayan and Smyth (2008).

5.2 Cointegration Test and Error Correction Term

To identify an acceptable lag order for the series in the ARDL testing method, the Akaike information criterion (AIC) was applied. The lag length selection process was conducted following the methodology outlined by Lütkepohl (2006) due to the sensitivity of the bounds test to this factor. The AIC criterion was chosen over the SIC criterion as it was found to be more relevant. Table 6 shows the ARDL-bound testing findings, which reveal a single cointegration vector among the variables. This study found a connection between energy demand, financial development, economic growth, and population growth.

The long-term energy use analysis considered financial development, GDP growth, and urbanization (see Table 7). After adjusting for other aspects, energy usage and financial development are positively connected. For every percentage point of financial development, energy usage increased by 0.109 percent. Based on these findings, financial development boosts energy usage. Karanfil (2009) and Naceur and Ghazouani (2007) concur with these findings.

The average rate of economic growth was 0.801%, which significantly increased energy use at a 5% level. Hence, GDP growth up to 1% raised energy use by 0.801%, which is comparable to the results of Aqeal and Butt (2001) in Tunisia and Pakistan, Halicioglu (2007) in Turkey, and Oh and Lee (2004) in Korea. A 1% increase in value-added urbanization led to a 0.909% increase in energy use.

Table 7 shows the short-term elasticity research results. For every 1% rise in financial development over the medium term, energy usage rises by 0.0359%. Energy usage rises by 0.458% for every percentage point of GDP growth. However, as urbanization expands, energy usage drops by 2.365% for every 1% increase, with insignificant effects for 5% and 10% increases. Statistics support the alternative model's inverted U-shaped connection between energy usage and financial development.

Table 6: ARDL Cointegration Test Result

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	9.970154	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.50%	2.88	3.87
		1%	3.29	4.37

Typically, the findings of the Error Correction Model (ECM) are anticipated to demonstrate negative and statistically significant outcomes. Banerjee, Dolado, and Mestre (1998) have provided a comprehensive definition of what is referred to as the convergence of the long-term connection in the economy. The coefficients of the Error Correction Model (ECM) are -0.57354 in the linear model and -0.590643 in the nonlinear model, representing the speed at which the variables of interest approach their long-term equilibrium.

For energy use, both models indicate a difference between short- and long-term consequences. Specifically, the annual differences are identified as -0.57354% and -0.590643%, respectively, in the linear and nonlinear models.

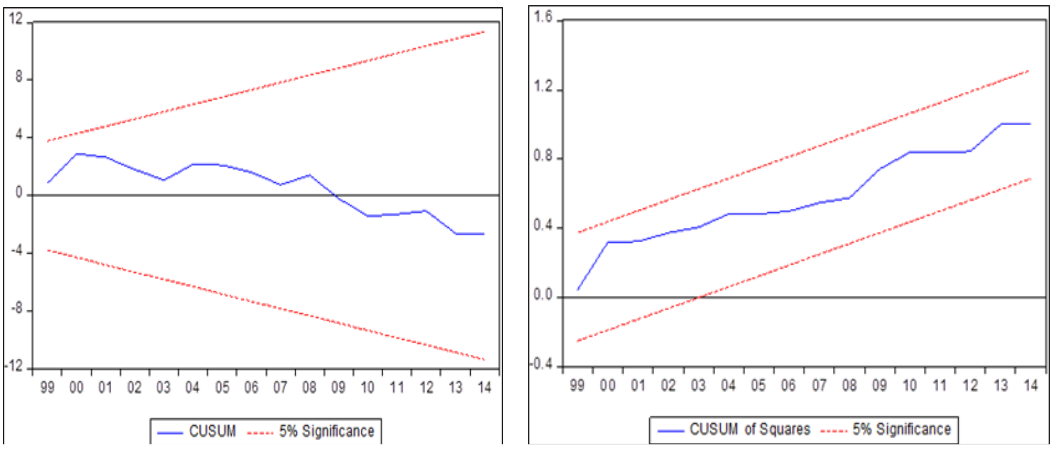

Figure 1. Non-Linear model

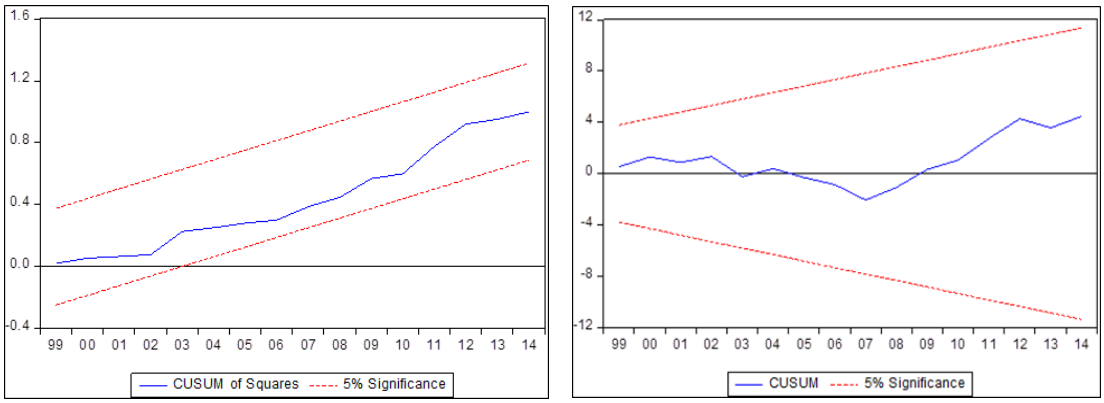

Figure 2. Linear model

A diagnostic test has been done to assess the error terms serial correlation, heteroskedasticity, autocorrelation, and non-normality. As given in Table 9, both of the models exhibited a good fit. Moreover, the (CUSUM) test and (CUSUMsq) test have been examined and the analyses approved the constancy of the parameters in short and long runs, as given in Figures 1 and 2.

Table 7: Long-Term Result and Short-Term Result

	Linear Specification		Non-linear Specification	
Variable	Coefficient	t-Statistic	Coefficient	t-Statistic
LDCV	0.109181	1.932223	0.858984	4.482415
LGDP	0.801011	5.780805	0.542135	7.154152
LUR	0.908919	5.552672	1.422841	9.43885
LDCV2	--	--	−0.433506	−4.475273
C	−20.7197	−8.49507	−26.20148	−18.04174
D(LDCV)	0.035851	1.168933	0.118277	4.074493
D(LGDP)	0.457646	8.468798	0.399856	9.276353
D(LUR)	−2.36523	−1.28891	0.652612	0.546604
D(LDCV2)	--	--	−0.038776	−4.433769
CointEq(−1)	−0.57354	−5.59052	−0.590643	−8.860867

5.3 Granger Causality Test

The VECM (Vector Error Correction Model) Granger causality analysis is a widely utilized approach for identifying the pattern of causality between variables. This method provides insights into the long-term and short-term dynamics of the variables and is particularly useful in testing causality between variables with integrated orders of one (I(1)).

In this study, VECM Granger causality analysis was used to assess variable trends. This study found a statistically significant difference between error correction factors. The energy usage, financial development, economic growth, and global urbanization equations also have negative error correction factors. These findings indicate a causal link between energy usage and financial development. Energy usage and GDP growth were also associated. Additionally, economic growth immediately promoted financial development, and urbanization and economic growth have a one-way causal link. Finally, a bilateral causal association was discovered between energy usage and financial development, suggesting that these two factors reinforce one another. Rising energy use has been linked to financial development, which in turn has the potential

to spur even more energy use. Energy usage and GDP growth also indicate a causal connection. Consistent with prior research by Apergis and Payne (2010), these results support the hypotheses of these researchers. Furthermore, GDP growth appears to drive financial development instead of vice versa, as suggested by the unidirectional causation between the two. This result agrees with it Levine and Zervos (1998).

Table 8: VECM Granger Causality Test Result

Variables	DLDCV	DLGDP	DLUR	DLENUS	ECT(-1)
DLENUS	4,51222***	3,004473**	0,335549	_	-0,767832***
	0,0057	0,0417	0,7997		[-2.71543]
DLDCV	_	2,514994**	1,690144	3,779617***	-0,994519***
		0,0879	0,2132	0,0272	[-3.26022]
DLGDP	0,098353	_	1,73852	2,628644***	-0,423418***
	0,1837		0,9602	0,0714	[-2.19297]
DLUR	2,342198	4,61652**	_	2,093591	-0,037783**
	0,1129	0,0176		0,1403	[-1.41648]

Note: A 1% level of significance is represented by ***, a 5% level of significance is represented by ** and a 10% level of significance is represented by*. The numbers in parentheses donate the t-statistics for the ECM.

The analysis of VECM Granger causality reveals significant results concerning the connection between financial development, GDP growth, and energy use. The findings indicate that both variables act as robust predictors of energy usage and vice versa. Furthermore, financial development emerges as a primary forecaster of economic growth, while economic growth serves as a predictor for both financial development and urbanization. To ensure the selection of the most suitable model, a rigorous evaluation was conducted.

Table 9: Residual Diagnostic Tests

Linear Model			Non-Linear Model		
Ramsey RESET Test			Ramsey RESET Test		
F-stat	1.124648	Prob. F (1.15) (0.3057)	F-stat	0.580443	Prob. F (1.15) (0.458)
Breusch-Godfrey Serial Correlation LM Test			Breusch-Godfrey Serial Correlation LM Test		
F-stat	0.141025	Prob. F (1.15) (0.7125)	F-stat	0.735801	Prob. F (1.15) (0.4045)
Heteroskedasticity Test: Breusch-Pagan-Godfrey			Heteroskedasticity Test: Breusch-Pagan-Godfrey		
F-stat	0.940603	Prob. F (20.17) (0.5566)	F-stat	0.286129	Prob. F (22.16) (0.9964)

Authors' Computation via E-views 10

The diagnostic tests for serial correlation, heteroskedasticity, autocorrelation, and non-normal distribution of the error terms have been verified, and the outcomes are given in Table 9, showing that both models fit well, validating the reliability of the this thesis conclusions.

The thesis looked at how all of the above variables relate to one another in Argentina. The association is positive between the variables and has a long-term relationship. Energy usage may fall when the financial sector remains a growing entity thanks to the inverse U-shaped connection between their energy use and financial development, meaning that energy use at first rises as financial development rises but then falls as the financial sector continues to grow.

Chapter 6

CONCLUSION

This thesis examined Argentina's energy consumption, banking sector development, economic growth, and urbanization from 1965 to 2015. Using the information criteria technique, and detected no notable breaks in the series.

Using the Ng-Perron technique, it has been observed that energy use, financial development, growth of the economy, and urbanization all stagnated after their first big shifts. Also used the ARDL approach to see if the variables were discovered to have a long-term relationship, and that association revealed a single cointegration vector. Energy usage, financial development, economic growth, and urbanization in Argentina were all determined to have positive long-term and short-term associations utilizing the ARDL model estimate. Also found that the series required 0.590643% of a year to revert to equilibrium in the long term.

The inverted U-shaped association between GDP growth and energy use was one of this study's most intriguing findings. This implies that a nation's energy consumption first grows with its level of living but then decreases at a certain point. Energy use should decrease as the financial sector continues to grow.

The results of the empirical test using VECM also showed Granger causality, which it interpreted as energy dependence. This study discovered high correlations using the

Granger causality test. In particular, it has been identified a two-way causation between energy usage and economic growth, implying that changes in one variable may affect the other. Energy consumption and GDP growth have a symmetrical connection, suggesting that changes in energy usage may affect GDP growth and vice versa.

However, it is been discovered that financial development was only connected to GDP growth in one direction, implying that economic growth may affect financial development but not vice versa. The link between urbanization and GDP growth was similarly unidirectional, suggesting that GDP growth may affect urbanization, but the opposite is not necessarily true. According to these results, it is evident that boosting the country's economic structure can positively influence energy usage and financial growth in Argentina. So policymakers should consider a program to create policies that enhance the overall financial structure of the country.

The way policymakers handle the environment, which supports economic activities, should not only support the growth of the economy but can boost economic performance by enabling economic benefits such as increased energy use and improved infrastructure. Sustainable energy sources and alternative energy usage may lead to economic and financial stability. The data suggest an inverted U-shaped association between economic growth and energy usage. This advocates that energy usage may increase with financial development, at least initially.

However, beyond a certain threshold, further increases in financial development can result in a decline in energy use. Based on these findings, we recommend that financial institutions prioritize the advancement of innovative technologies associated with

renewable energy sources, such as wind power. By directing their efforts towards these areas, financial institutions can actively promote sustainable energy utilization while simultaneously fostering financial development. It is well established that financial development has a positive influence on economic growth, which can ultimately enhance fund yield. This will support the upward slant in energy demand as the financial services sector grows. Foreign and local investment will increase in the country because of this very positive environment.

This conclusion leads us to recommend that the Argentinian government encourage financial organizations to make investments in development and research to generate innovative technology associated with clean energy sources. Which will keep the demand for energy increasing as the financial sector increases. This will create a conducive atmosphere for both local and international investors, as their equity funding will be enhanced. The government should also provide a considerable loan discount to investors in the country who have effective energy usage systems to decrease environmental energy-induced revenue loss as a result of huge energy consumption. The level of lending provided by domestic financial institutions (such as banks and other financial intermediaries) to the private sector, including households and businesses, should be increased. Finally, the Argentinian authorities should supply energy facilities in rural regions to regulate urbanization as well as environmental importance.

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