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# Athens Journal of Business & Economics

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Gregory T. Papanikos
President
ATINER

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# Variations of Self-Employed in Eurozone Countries: The Role of Corruption and Wage Rate Growth

*By Gregory T. Papanikos*[*]

*This study emphasizes two variables as significant determinants of the number of individuals who choose self-employment. First, it is assumed that the opportunity cost of self-employment has a negative effect. This cost is measured as the income that would be earned in wage employment. Second, self-employment provides more opportunities for tax evasion and tax avoidance. The higher the corruption rate, the higher the self-employment rate. These two variables—wages and corruption scores—are used as potential determinants of the ratio of self-employed persons to the total labor force. Data from the twenty Eurozone countries are employed to test these hypotheses. Both hypotheses cannot be rejected based on the empirical evidence.*

**Keywords:** *Eurozone countries, wage growth, self-employment corruption, labor force, unemployment*

## Introduction

Self-employment is promoted in many countries as a policy tool to decrease unemployment (OECD, 2022). The choice of self-employment is an individual decision. However, like many other economic decisions, the option of self-employment is subject to constraints determined by aggregate economic and non-economic conditions. These conditions are country-specific. For example, variations in wage growth and differences in the prevalence of corruption between countries may explain the fluctuations in self-employment ratios.

As a control to test other country-specific effects, this study uses a homogeneous group of countries with a common currency and well-integrated markets. The twenty Eurozone countries share a common currency, constituting an ideal sample to test the roles of corruption and wages. In addition, the Eurozone employs fiscal and monetary policies, along with various other policy instruments such as subsidies, to promote the development of entrepreneurship and the creation of small businesses.

This paper investigates these two basic determinants of self-employed persons and tests their statistical significance using data from the twenty Eurozone countries. The opportunity cost of self-employment is defined as the foregone income of a job that pays a wage. The higher this wage rate, the greater the cost, and therefore, the lower the number of people who opt for self-employment.

[*]President, Athens Institute for Education and Research, Greece.

On the other hand, self-employed individuals may exploit a country's administrative tax mechanisms to pay fewer taxes, either through tax avoidance or tax evasion. A more corrupt country may grant more concessions to self-employed groups by enacting laws that promote tax avoidance. Additionally, a more corrupt country reduces the risk of identifying and punishing those who systematically evade taxes. Therefore, corruption increases rates of self-employment.

These two variables—the wage rate and the level of a country's corruption—are used to explain variations in the number of self-employed persons in the twenty Eurozone countries. To overcome cyclical effects and account for long-run trends, average values from the 2010s are used.

This paper is structured as follows: the next section examines a simple model of self-employment determination, leading to an empirical equation. The following two sections discuss the descriptive evidence of the three variables of interest and report the regression results of the estimates of the parameters of the empirical equation model. The last section concludes.

## A Theoretical Framework

The labor market has been extensively analyzed in economics, encompassing various aspects of the self-employment issue. However, this section does not review this literature.[1] Instead, it provides a simple theoretical framework based on the perceived employment alternatives for an individual.

Individuals who decide to work have two choices. First, they can participate in the labor market, where their labor services are demanded by others, such as private (profit and nonprofit) firms and public organizations.[2] The supply of their labor time in this market depends on a real net-wage rate, defined as gross wages minus taxes on wages. Second, individuals may choose to work independently as self-employed. In this case, their labor supply services depend on expected income minus taxes.[3] Taxes on wages and taxes on income from self-employment do not coincide, primarily due to tax avoidance and, most importantly, tax evasion. The extent of tax avoidance and tax evasion depends on the level of corruption in a

[1]There are numerous categories of self-employed individuals, including solo entrepreneurs and small business enterprises. Typically, these businesses employ family members and a limited number of hired workers who receive wages. Even within these distinctions, various sub-categories may exist. Van Stell & de Vries (2015) extensively reviewed the literature on different forms of solo employment.

[2]In many instances, individuals working for public organizations, such as public schools, may engage in non-reported self-employment, not accounted for in the official data used in this study.

[3]The impact of taxes on self-employed individuals has been the subject of examination in numerous studies. For a recent study with an accompanying literature review, please refer to Arulampalam & Papini (2023). However, it's important to note that their study is confined to Norway, and the authors themselves acknowledge that their dataset does not allow for the analysis of tax avoidance and tax evasion—factors contributing to a positive correlation between self-employment and tax increases. The body of literature concerning tax evasion and tax avoidance is extensive; for instance, you can consult studies by Slemrod (2007) and Sugata et al. (2017).

country. The higher the corruption, the greater the level of tax avoidance and tax evasion.[4]

Let E be the total number of persons employed, with $E_w$ representing those in wage-employment and $E_{se}$ in self-employment occupations. Total employment is then calculated as:

$$E = E_w + E_{se}$$

Dividing it by the total labor force (L), the self-employed labor force ratio is calculated as

$$E_{se}/L = E/L – E_w/L$$

It is assumed that over a ten-year period, the unemployment rate (UR) is constant and defined as follows:

$$UR = U/L = (L-E)/L = 1 – E/L$$

Here, U represents the total number of unemployed persons. If UR is constant in the long run, the employment rate (E/L) is also constant. Thus, in the long run, the self-employed employment ratio depends on the number of wage-earners to total employment. Wage-earners' employment is positively influenced by net wages, defined as the total wage rate (w) minus the tax rate (t). Therefore, the self-employment rate is a function of both the total wage rate and the tax rate on wage income:

$$E_{se}/L = E/L – E_w/L\ (w-t)$$

or

$$E_{se}/L = \text{constant} – E_w/L\ (w-t)$$

An increase in the wage rate decreases the ratio of self-employed individuals. Conversely, an increase in the wage tax rate raises the ratio of self-employment to the total labor force.

It is assumed that tax enforcement differs between wage employment and self-employment. Wage earners pay taxes when they receive their wages, unless it is an illegal employment situation. These taxes cannot be evaded or avoided.

On the other hand, taxes paid by self-employed individuals depend on voluntary compliance by taxpayers who report their true income from all sources. Income from self-employment can be underreported because there is a nonzero probability that tax authorities may not be able to determine the true income. As demonstrated in Papanikos (2015) for the case of Greece, this greatly depends on the effectiveness, efficiency, and, most importantly, the willingness of tax authorities.

[4]I do not delve into the theoretical counterarguments that render this hypothesis indeterminate. For a comprehensive discussion, please refer to Schuetze and Bruce (2004).

Here, it is assumed that self-employed persons pay fewer taxes than wage earners for the same income because the former conceal their total income. This opportunity to hide income from self-employment depends on several factors, with the most crucial one being the level of corruption. This is country-specific. The higher the corruption in a given country, the greater the likelihood of tax evasion and tax avoidance. In such countries, it is expected that, *ceteris paribus*, the percentage of self-employed persons will be higher. The simple model to be estimated is as follows:

$$E_{se}/L = b_0 + b_1*\text{Corruption} - b2*\text{Wage} + \mathbf{b}*\mathbf{Z}$$

where **Z** is a column vector of dummy variables, including the year of entry into the Eurozone, Mediterranean country status, etc., and b is a row vector of the corresponding coefficients.

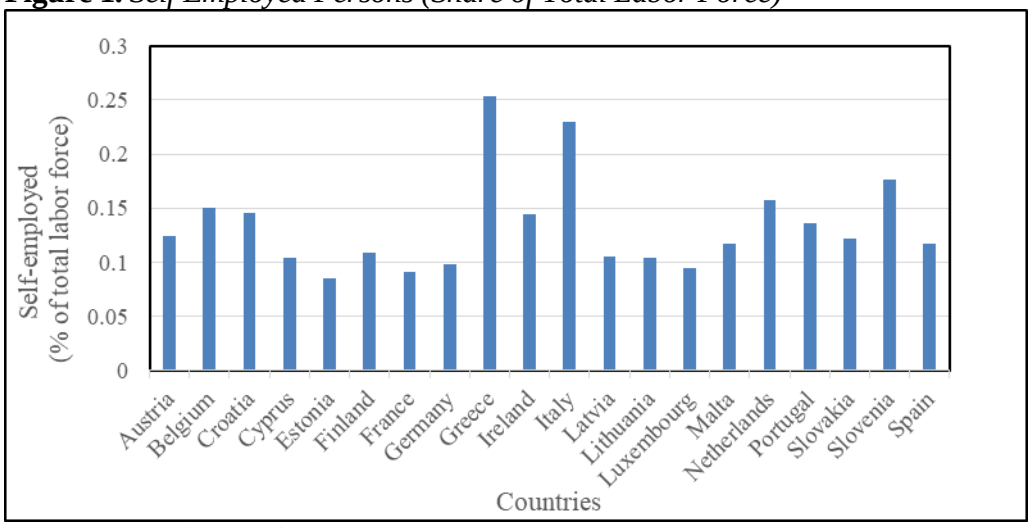
The aforementioned simple specification was estimated using data averaged over a ten-year period (2010-2019) from Eurozone countries to account for long-term trends. Another possible estimation approach could have been panel data, but many regressors are time-invariant (e.g., Eurozone year, density, area).

The next section presents the descriptive statistics of the model variables, and the following sections report the results of two simple specifications.

## Descriptive Statistics

This study concentrates on three key variables: self-employed individuals, the level of corruption, and the real wage rate. Figure 1 illustrates the proportion of self-employed persons in relation to the total labor force, averaged over a ten-year period (2010-2019).

**Figure 1.** *Self Employed Persons (Share of Total Labor Force)*




Source: Eurostat (AMECO)

The first obvious observation is the substantial variation in self-employment among the 20 Eurozone countries. Greece and Italy notably stand out with 25.29% and 22.94%, respectively. As indicated in Table 1, in four Eurozone countries, the percentage of self-employed persons was less than 10 percent (Estonia, France, Germany, and Luxembourg). More than half of the Eurozone countries had self-employment ratios between 10 and 15 percent. It is evident that 75 percent of the countries (15 countries) had a ratio less than 15 percent.

**Table 1.** *Distribution of Self-employed Shares in the Eurozone Countries*

| Self-Employment Shares | Count | Percent | Cumulative Count | Cumulative Percent |
|---|---|---|---|---|
| [0.05, 0.1) | 4 | 20 | 4 | 20 |
| [0.1, 0.15) | 11 | 55 | 15 | 75 |
| [0.15, 0.2) | 3 | 15 | 18 | 90 |
| [0.2, 0.25) | 1 | 5 | 19 | 95 |
| [0.25, 0.3) | 1 | 5 | 20 | 100 |
| Total | 20 | 100 | 20 | 100 |

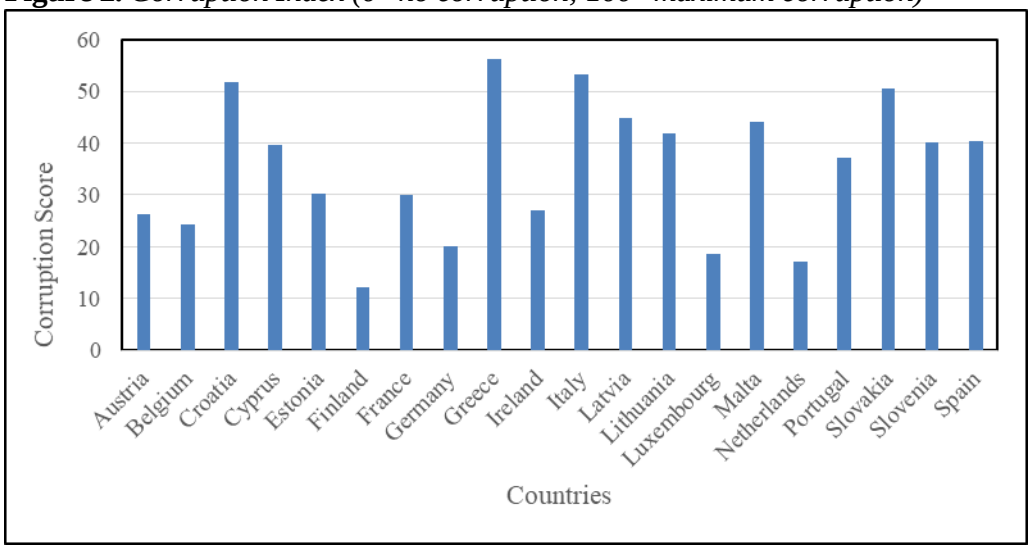
One conclusion that arises from the above descriptive evidence is the significant variation among the twenty Eurozone countries. As illustrated in Table 3 below, the average share of self-employment in the twenty Eurozone countries is 13.33%, with a maximum of 25.28% (in Greece) and a minimum share of 8.48% (in Estonia).

In this paper, these variations are explained by two variables: the level of corruption over a nearly ten-year period (2012-2019) and the opportunity cost of self-employment, measured as the average rate of growth of the real wage rate over the 2010-2019 period.

Figure 2 shows variations in corruption among the twenty Eurozone countries. The two countries with the highest corruption in the Eurozone were Greece (56.25/100) and Italy (53.25/100). As discussed above, these are also the countries with the highest self-employment ratios. However, two more countries exceeded the 50% mark of corruption (see Table 2): Croatia (51.75) and Slovakia (50.63). Three countries had a corruption score of less than 20 percent: Finland, Luxembourg, and the Netherlands. It is shown that 80 percent of the Eurozone countries had a corruption score less than 50.

The last variable of interest in this study is the wage rate. Figure 3 shows the variations in the average growth of the real wage rate over a period of nearly ten years (2010-2019). Greece experienced the most dramatic decrease in its wage rate, with an average fall of 2.66%. Lithuania, with 3.47%, had the highest increase, followed by Latvia (3.13%), Slovakia (2.93%), and Estonia (2.26%). Apart from Greece, nine other countries experienced negative or very low wage rate changes.

**Figure 2.** *Corruption Index (0=no corruption; 100=maximum corruption)*

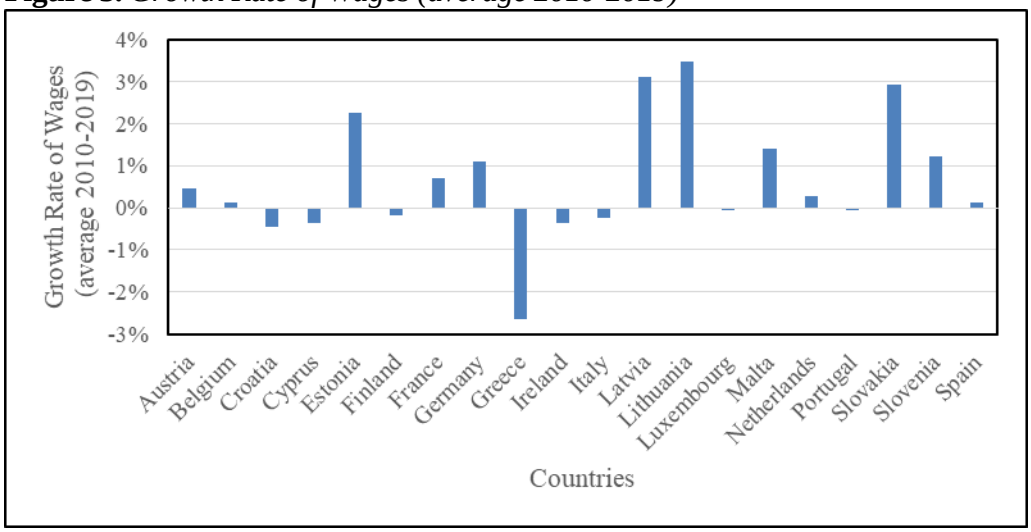



Source: Transparency International (https://www.transparency.org/)

**Table 2.** *Corruption in the Eurozone Countries*

| Value | Count | Percent | Cumulative Count | Cumulative Percent |
|---|---|---|---|---|
| [10, 20) | 3 | 15 | 3 | 15 |
| [20, 30) | 5 | 25 | 8 | 40 |
| [30, 40) | 3 | 15 | 11 | 55 |
| [40, 50) | 5 | 25 | 16 | 80 |
| [50, 60) | 4 | 20 | 20 | 100 |
| Total | 20 | 100 | 20 | 100 |

**Figure 3.** *Growth Rate of Wages (average 2010-2019)*




Source: Eurostat (AMECO)

In conclusion of the above discussion, the descriptive evidence reveals significant variations in the three variables under study. Table 3 presents summary statistics for these variables.

Greece provides an intriguing case study for the hypotheses of this research. In the 2010s, Greece had the highest self-employed ratio at 25.28%, the highest corruption score of 56, and the lowest growth in the wage rate at -2.66%.

Conversely, Estonia had the lowest share of self-employed persons, Finland boasted the lowest corruption score of 12, and Lithuania recorded the highest wage rate growth at 3.47%.

**Table 3.** *Descriptive Statistics*

| | Self-employed (Share of Labor Force) | Corruption Scores (0-100) | Wage Rate Growth |
|---|---|---|---|
| Mean | 0.1333 | 35 | 0.0064 |
| Median | 0.12 | 38 | 0.0021 |
| Maximum | 0.2528 | 56 | 0.0347 |
| Minimum | 0.0848 | 12 | -0.0266 |
| Std. Dev. | 0.0442 | 13 | 0.0146 |
| Skewness | 1.44 | -0.10 | 0.23 |
| Kurtosis | 4.47 | 1.89 | 3.19 |
| Observations | 20 | 20 | 20 |

Notes: The data on self-employed and wage rate growth are averages of 2010-2019; the corruption is averaged over a period of 2012-2019.

The next section tests these two hypotheses using the data presented earlier.

## Regression Results

The simple regression equation was estimated and is considered heteroscedastic. Table 4 reports the empirical results of two simple models. The estimators are heteroskedasticity- and autocorrelation-consistent (HAC) estimators of the variance-covariance matrix. However, the results did not differ significantly when using either the OLS estimators or White's heteroscedasticity-corrected standard errors.

Several other variables were tested, but they were not statistically significant, including economic variables such as the unemployment rate, the rate of growth of (per capita) output, and the inflation rate. These variables are correlated with wage rate growth. Higher real wage rate growth may result from higher economic growth and a lower unemployment rate. In such cases, the economy may experience inflationary pressures.

On the other hand, additional variables were used to account for specific country characteristics, such as whether the country belongs to the group of Mediterranean countries, population densities, area, number of airports, number of inhabited islands, etc. None of these variables were statistically significant (the

results are not reported in the table). The only additional variable that demonstrated statistical significance was the year the country entered the Eurozone.

The two variables explained 52% of the variations in the share of self-employed persons in the total labor force. When the year of Eurozone entry is included as an explanatory variable, the adjusted coefficient of determination increases to 56%.

**Table 4.** *Regression Results*

| Variable | Model I | Model II |
|---|---|---|
| Constant | 0.085***<br>(4.71) | 4.63**<br>(2.30) |
| Corruption | 0.002***<br>(2.75) | 0.002***<br>(3.43) |
| Wage Growth Rate | -1.78***<br>(-4.45) | -1.37***<br>(-4.12) |
| Year entering the Eurozone | ---- | -0.002**<br>(-2.25) |
| R-squared | 0.573112 | 0.626492 |
| Adjusted R-squared | 0.522889 | 0.556459 |
| F-statistic | 11.41152 | 8.945688 |
| Prob(F-statistic) | 0.000721 | 0.001033 |

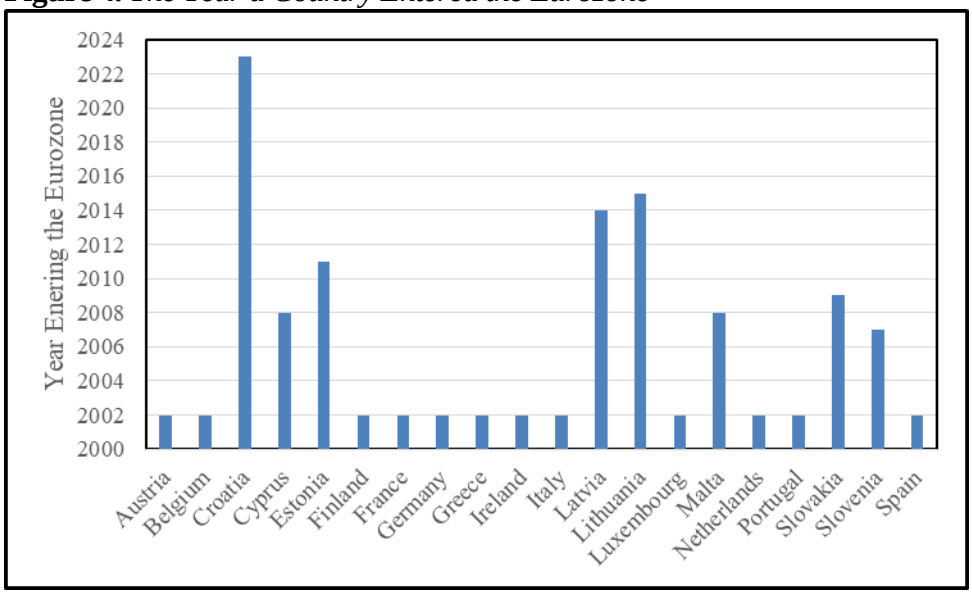
** Prob. < 0.05; *** Prob. < 0.01; t-statistics in parentheses.

All three variables exhibit the expected outcomes. The hypothesis that an increase in corruption raises the share of self-employed persons cannot be rejected. Evaluating the average value of corruption, a 10% increase in the corruption score (from 35 to 38.5) will raise the self-employment ratio by 0.007 (0.002 × 3.5). Assessing this increase at the average value of the ratio of self-employed persons (13.33%), the ratio will rise to 14.03%, representing a 5% increase.

Consistent with the theoretical arguments presented in section two of the paper, the wage rate has a negative effect on the ratio of self-employed persons. Higher wage rate growth increases the opportunity cost of choosing self-employment, leading fewer individuals to opt for self-employment and instead prefer wage employment.

Finally, this paper utilizes the twenty countries of the Eurozone to test the two hypotheses regarding corruption and wages because they constitute a cohesive group of countries with common characteristics. Figure 4 displays the year in which each of the twenty countries entered the Eurozone. Twelve countries were part of the original Eurozone members, commencing the common currency in 2002. Eight additional countries joined later, with Croatia being the most recent addition in 2023.

**Figure 4.** *The Year a Country Entered the Eurozone*




According to the empirical evidence reported in Table 4, the year a country joined the Eurozone has a statistically significant effect on the ratio of self-employed persons. The effect is negative, implying that the later a country joins the Eurozone, the lower its self-employment ratio. One possible explanation might be that being a member of the Eurozone and utilizing a common currency creates a more favorable economic and business environment for individuals to start their own small businesses.

## Conclusions

Self-employment is an integral component of labor markets in both developed and less developed countries. The economic macro environment within each country influences the decision to become self-employed or remain a wage-earner. This environmental factor varies across countries, accounting for significant disparities in the proportion of self-employed persons as a share of the total labor force.

The objective of this paper was to examine the impact of only two variables as determinants of the self-employment ratio at the country level, while abstracting from other micro or macro effects. The twenty Eurozone countries constitute an ideal sample of otherwise homogeneous nations. These countries share a common currency and numerous policies that promote self-employment and entrepreneurship.

Nevertheless, substantial variations exist in their self-employment rates. Data from the 2010s reveal that the self-employment ratio ranged from a minimum of 8.48% (Estonia) to a maximum of 25.28% (Greece), with an average of 13.33% among the Eurozone countries.

These variations can be attributed to differences in corruption and wage growth during the 2010s. Regression results indicate that corruption had a positive effect on the proportion of self-employed persons, while wage growth had a

negative impact. These findings align with the theoretical predictions developed in this paper.

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# Trademarks and Denomination of Origin in Portuguese Wine Sector (1918-1924)

*By Carla Sequeira*[*]

*In the Portuguese wine sector there was a strong adhesion of companies, producers and traders to the registration of trade marks since the modern commercial brands emerged after the creation of the legal framework for their protection, at the end of the 19th century. We also must consider the existence of different regions of production, from north to south of the country, and the historical process of recognition of the different denomination of origin, which occurred since the beginning of the 20th century, in a context of post-phylloxera reconversion, market instability and the proliferation of imitations and counterfeits. Because wine sector was strategic in the Portuguese economy, in this article we will analyze the marks of different companies, traders and producers representative of various Portuguese wine regions, between 1918 and 1924 from the Trademark Registration in the Boletim de Propriedade Industrial (Industrial Property Bulletin). The aim is to understand the relationship between trademarks and appellations of origin, to understand if there was the growth of the different terroirs and their types of wines, and to identify, on a semiotic basis, representative and identifying elements of the indication of provenance, used in countless brands.*

**Keywords:** *Portuguese wine regions, brands, trademarks, labels, semiotics*

## Introduction

We begin the article with an overview of the different Portuguese wine regions between the 18th and 20th centuries, as well as the discussion on the legal recognition of regional brands and appellations of origin, which we consider important to contextualise the main research question of the study: the quantification of the types of Portuguese regional wines, from the applications for registration of trademarks and respective labels between 1918 and 1924, an inter-war period marked by the growth of wine markets.

Portugal has a great wine tradition since immemorial time, from North to South and the islands (Azores and Madeira). In the second half of the 18th Century the Demarcated Region of the Douro was established. On the same date, and with the argument of guaranteeing the authenticity of Douro wines, it was also decreed that the vines were to be grubbed up in the national territory considered unfit for growing vines.

Phylloxera, in the second half of the 19th Century, brought about a change in the "wine geography" in Portugal. There was a real "wine fever" (Pereira 1983, p.

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143), particularly in the South, following the trend that started in the 1860s and was now accelerated by commercial freedom and the end of the regulation of the demarcated Douro region, instituted in 1865. With the growth of production in the Centre and South of the country, the press would defend specialisation by regional types of wine, in articulation with the specificity of regional characteristics and the "taste of consumer markets" (Pereira 1996, p. 185). At the same time, various initiatives supported the creation of regional brands and export regulations. Thus, since the mid-19th Century, there were various initiatives towards the creation and regulation of the various Portuguese wine regions, corresponding to differentiated brands and appellations.

At the beginning of the 20th Century, Cincinato da Costa (1999) identified 13 regions in his "Portugal Vinícola". For this author, Portugal was already known not only for its fortified wines but also for its common wines, in greater numbers and of high quality. Cincinato da Costa (1999) begins by establishing five main classes: fortified wines (Porto, Madeira, Carcavelos, Moscatéis and Bastardinhos); common or direct consumption wines (Colares, Bucelas, term of Lisbon, Azeitão, Santarém, Tomar, Torres Vedras, Dão, Bairrada); blended wines (wines exported to France to be mixed with the low-grade French wines); sparkling wines (still incipient in Portugal, but already of considerable importance and highly rated in the Brazilian markets and in the colonies); distillation wines (used to prepare fine brandies used in shipping and fortified wines). The division presented by Cincinato de Costa (1999) proves the growth in wine production in the Centre and South of the country, which would reinforce the defence of specialisation by regional types of wine.

Some personalities from the Douro region would precisely defended the creation of the regional brand for wines produced solely from Douro grapes, defending the specialisation of other regions in their own types of wine which would then be sold or exported with the region's brand. In the mid-1880s, the Alto Douro was in crisis due to the devastation caused by phylloxera and the growing use of wines from outside the region by the commercial sector, as a result not only of the decline in production caused by the plague of the vines, but also the institution of a free trade regime in 1865, which facilitated the proliferation of fraud and forgery. The Region claimed the guarantee of the regional brand, that is, the use of the denomination of origin "Port" exclusively for wines produced in the Alto Douro. In the midst of a crisis, the regional brand was seen as a means of economic recovery by guaranteeing the genuineness of the product and preventing fraud, forgery and mystification.

At first, the central power responded to the demands by approving the Trade Marks Act of 4 June 1883, whose aim was to guarantee fair competition in commercial transactions. The trade marks were created in the context of industrial property law and following the signing of the Paris Convention on 20 March 1883. The Trade Marks Act established that it was illicit to indicate, in the brand of a product, a country or region where it had not been produced. In the specific case of wines, it also required the indication of the producing country or region, along with the name of the farm or parish where it was located. On 14th April 1891 the Madrid Agreement was signed, constituting the first important step towards the

recognition of Appellations of Origin as an autonomous entity from a legal point of view (Almeida 1999). Article 4 of the Madrid Agreement enshrined the indication of provenance of wine products, establishing that the indication of origin given by the geographical name of the country or region of production could never become the generic name of a type of wine. Ratified on 11th October 1893, it was transposed into Decree-Law nº 6 of 15th December 1894 and the respective regulation of 28th March 1895. In 1901, the Decree-Law of 1 March was published, which adjusted the way in which the registration of trademarks would be carried out (Rocha 2022). This decree, which remained in force until 1940, presents a more systematized organization for product categories, which became 9, divided into 80 classes.

The debate about the regional brand would intensify and the representatives of the several Portuguese winegrowing regions would claim the creation of regional brands, invoking article 4 of the Madrid Agreement. But only in 1907 would some of the claims prevail, through the publication of the decree of 10 May 1907, which demarcated the regions of regional type fortified wines (Porto, Madeira, Carcavelos and Moscatel) and the regions of regional type consumption wine (Colares, Bucelas, Dão, Bairrada, Minho and Monção, among others).

Since modern commercial brands emerged at the end of the 19th century, the Portuguese wine sector (companies, producers, and traders) adhered firmly to the registration of trade marks. However, the existence of diverse production regions and the historical recognition of the different appellations of origin, which occurred during the 20th century in a context of post-phylloxera reconversion, market instability, and the proliferation of imitations and counterfeits, also influenced the registration process. It is, therefore, necessary to ascertain how the recognition of new appellations of origin was reflected in the registration of trade marks in the Portuguese wine sector, the sector with the greatest weight in the Portuguese trade balance during the period under study. To achieve these purpose, in this paper we will analyze the trademarks of different companies, traders and producers representative of some Portuguese wine regions, between 1918 and 1924 from the Trademark Registration in the *Boletim de Propriedade Industrial* (Industrial Property Bulletin).

We will analyse the brands of different traders since the aim is also, through the number of trade marks applications and the analysis of labels, to understand the growth, or otherwise, of the different Portuguese wine-producing regions and the respective specialisation in different types of wine. Through the labels present in the requests we aim to understand the relationship between trademarks and appellations of origin, the importance of the different *terroirs*, their types of wines, and the use of semiotic representative and identifying elements of the indication of provenance, used in countless brands. As François Guichard says, “it is worth paying a little attention, not only to what the label says, but how it says it, because it is in a way a faithful mirror of the society to which it is addressed” (Guichard 2001, p. 33).

The article is structured in the following way: after the introduction (where we made a brief historical background and present the scope and research question), we will review the literature on the subject; next, we will present the

methodology used and the results obtained; finally, the conclusions that the research allows to be obtained at this stage of the study.

## Literature Review

As we aim to ascertain the relationship between the creation of trademarks and the designations of origin of Portuguese wines between 1918 and 1924 and how they are made visible and merged in the trademarks applications and their labels, we will now address some of the authors who have been investigating on the legal evolution of trademark registration and the image and authenticity of trademarks. In this way, we present the state of the art that supports the study we developed.

Most studies on trademarks and brands have focused on legal, economic and business aspects (Sáiz and Castro 2018) in the contemporary era, in conjunction with the development of international trade, large companies and consumer society from the late 19th century onwards (Wilkins 1992).

According to Belfanti (2018), it will have been in the 18th century that the need to represent the business through the adoption of a "company brand" that could be recognised by consumers became evident. It would have been at that time that the "trademark", in which works of art, mottos and other graphic elements were incorporated, began to be adopted, although still before its legal protection.

Paul Duguid's studies point in the same direction, stating that in order to understand the birth and development of trademarks, it is necessary to take into account the background of the legislation of the late 19th century, focusing on the court cases that preceded and immediately followed it. On the other hand, Duguid emphasizes the role of consumption in the development of brands. According to this historian, distribution chains composed of small firms played a significant and pre-nineteenth century role in the genesis of modern brands, since these firms used the brand not only as a competitive strategy, but also to discipline other elements of the distribution chain over which they had no direct control (Duguid 2003).

According to Patricio Sáiz and Rafael Castro, trademarks are the visible, measurable and documented face of brands (Sáiz and Castro 2018). From a historical point of view, trademarks emerged before modern brands as a way to establish origin, quality and differentiation between similar products. Trademarks were registered and authorised at a local level at first, and later at a national/ international level. According to these authors, the study of legal and ownership issues constituted one of the first guiding topics in trademark studies. However, in trademark studies within the framework of business history, trademark management has transcended the initial objective: the legal aspect of trademarks. Trademarks are a more complex phenomenon, resulting from registered trademarks or company names, but also from unregistered symbols or from a process in which marketing and advertising play a crucial role, of "emotional" connection between the values and reputation of the producer and the sensations/ feelings of the consumer, creating symbiotic, long-lasting and transnational relationships.

On the other hand, there has been a concern in several countries to quantify trademark registrations, referring to the development of the history of trademarks. New lines of research have been established and investment has been made in building databases of trademarks from various countries (Spain, France, England and the USA). For example, Paul Duguid, Teresa da Silva Lopes and John Mercer emphasize the importance and potential of this methodology (analysis of trademark registration patterns) for understanding modern business activity, as well as the evolution of modern trademarks and their management (Duguid et al. 2007).

In the wine sector, the pioneering spirit of the demarcation of the region of origin of Port wine is recognised, associated with the basic principles of modern controlled appellations of origin (Unwin 1991). In this context, we highlight the context in which it emerged, in the 18th century, with the expansion of international trade, increased competition and the adoption of imitation and counterfeiting processes of wines with greater notoriety in the markets (Pereira and Barros 2013). Other studies have looked into the evolution of this denomination of origin from the pombaline model to the corporative regime of the Estado Novo (Pereira 1996), including the free trade phase (1865-1907), when the regulation mechanisms were abolished, raising a strong regional and sectorial conflict (Sequeira 2011) and the mobilisation of Douro winegrowers for the recovery of the Porto regional brand in a context of wine crisis and great competition in international markets, along with the proliferation of industrial processes of imitation and counterfeiting (Lopes et al. 2019).

For a different chronological period than the present study, the article by Gaspar Martins Pereira and Marlene Cruz sought, through the registration of brands between 1883 and 1900, to understand how commercial agents in the Port wine sector used rural images associated with regions of origin as elements of distinction and enhancement of their brands (Pereira and Cruz 2017).

Regarding the analysis of the labels that we present in forward pages, we took into consideration the studies of Guichard (2001) and Lobo (2014). As Helena Lobo tells us, “the paper label is probably one of the most abundant art forms, and, given the number of people it reaches, one of the most influential. They are the link between production and consumption, and since they began to be used frequently in the mid-19th century, and particularly after the Second World War (1939-1945), they have been of crucial importance to the wine market” (Lobo 2014, pp. 169–170).

In the post-phylloxera period, national and international markets were flooded with fraudulent wines bearing misleading labels. At the beginning of the 20th Century, fraud was even considered “legitimate” by most of the sector’s agents. In this context, two fundamental concepts gain strength and shape to ensure the perennity of the wine industry: the definition of the product and delimitation of the producer’s space and its control guaranteed by law. “Demarcated regions with their statutes and laws are born, and labels acquire their first legal attributes. At the beginning of the 20$^{th}$ century, in addition to informing about the bottled wine, the label also began to guarantee its authenticity. The act of bottling is accompanied by the act of labelling, identifying the producer and the origin, going beyond its

elitist beginnings towards the defence of authenticity and quality" (Lobo 2014, p. 172). In this context, one must bear in mind that "different label cultures exist in Portugal" and "in a label there are many things to read, which means that it is not limited to being a mere language support. It is a complete cultural message, in which symbols, shapes, objects, colours, an arrangement, a graphic" (Guichard 2001, p. 95).

## Materials and Methods

We will examine the trademark applications filed between January 1st, 1918 and December 31st, 1924, published in the *Industrial Property Bulletin*, a periodical publication of the Industry Department of the Ministry of Public Works, Commerce and Industry. It is our intention to understand, in a period of growing wine markets (Martins 1990), the growth of the different Portuguese wine regions taking into account the claims of regional specialisation by types of wine and the efforts made, both by the state and by representatives of the different regions, in this direction. To achieve this goal, we performed both a quantitative and qualitative analysis. In the quantitative analysis, we proceeded to an accounting of the total trademark application, which includes several categories of products, such as health products, metallurgical products or pharmaceutical products. We then selected alcoholic products and made a second selection of wine products. We also carried out a statistical analysis of the number of trademark applications per wine-growing region.

The analysis of this documentation was complemented with the research in several legal diplomas related to the implementation of trademark registration (Trade Marks Act of June 4, 1883, the Law-Decree no. 6 of December 15, 1894, the Regulations for the implementation of Decree No. 6 of 15 December 1894, the Regulation for the execution of Decree-Law No. 6 of 28 March 1895, the Law-Letter of 21 May 1896, the Law-Decree of 1 March 1901), as well as the Decrees of 10 May 1907 and the Law-Letter of 1 October 1908, by which the demarcation of several wine-producing regions in Portugal was carried out. The questions under analysis were framed using specialised bibliography, as described in the Literature Review.

The qualitative analysis was made through the labels from a semiotic perspective, besides taking into account the studies of François Guichard and Helena Lobo, as already mentioned. The label is a communication piece which, as a rule, contains indication of the brand, information and promotional communications which may contribute to promote the product. In addition to functional referencing, it has an aesthetic function and contains appealing elements. In alcoholic beverages, the label assumes greater importance than other mass consumption products, becoming, in recent history, the main, if not the only, form of communication with consumers. The observation of the constituent elements (visual, textual/graphical, and symbolic signs) of wine labels operationalises the interrelation of the three dimensions of semiological analysis based on the trichotomy of signs: syntactic, pragmatic, semantic, and a)

qualitative-iconic, b) singular-indicative, c) conventional-symbolic. The theoretical and methodological approach followed is inspired in classic authors of semiotics (Peirce 2010, Sebeok 2001, Eco 2014). The functional and aesthetic, or semiotic, analysis applied to the selection of labels presented in next pages is based on the modern semiotic studies of Santaella (1983), according to the epistemological model of Charles Sanders Peirce, whose theoretical understanding of the matrixes of thought language is based on sound, visual and verbal content. The essential dimensions of signs are mobilized in the interpretation of product communication: the syntax, which implies the technical mode of operation of the object in the interrelationship of its physical structural, visual and aesthetic formal constitutive elements; the semantics, which designates the will to say and denotes the meanings and significance of the textual and visual object; and the pragmatics, which expresses to consumers the internal logic of the object and choices that users/interpreters are led to make.

## Discussion – Portuguese Wine-Growing Regions through Trademark Applications

Between 1918 and 1924, 10,329 trade mark applications were published in the *Industrial Property Bulletin* for all the product categories listed in the 1901 Decree. In category 68, which encompasses alcoholic beverages, there was a total of 1,431 applications, which is equivalent to 13.85% of the total referred to. Of these 1,431 we took into account only 1,167 for the present study because they relate directly to wine products. Let us now see which regions and types of wine were included in these requests. The aim is to assess the number of applications per producing region concerning the total number of applications between 1918 and 1924 and to identify, through the labels included in the applications, the relationship between trademarks and producing regions identifiable through figurative or non-verbal elements. Reference is made to the territorial configuration of the current demarcated regions (Figure 1), some of which were not yet regulated during the period covered by this study.

**Figure 1.** *Portuguese Wine Regions Today*


*Source*: https: //www.ivv.gov.pt/np4/regioes/.

*Vinho Verde (Green Wine)*

Vinho Verde, with 51 trade mark applications, corresponds to 4.37% of all applications submitted. Some of the labels feature symbology and language that easily allows the wine's production area to be identified. This is the case of Figure 2 (label "Vinho Verde de Braga"), which represents the high vineyard, in a branch or grapevine, a method of conducting the vine characteristic of the Vinho Verde region, and the Minho costume worn by the female figure. The identifying element of the city is also added, with the Bom Jesus de Braga staircase. Also the Figure 3 (label "Vinho Verde de Vianna") shows the toponym Viana in the brand name, and a female figure in the centre, wearing the typical costume of the municipality.

**Figure 2.** *Label "Vinho Verde de Braga"*


*Source*: Industrial Property Bulletin.

**Figure 3.** *Label "Vinho Verde de Vianna"*


*Source*: Industrial Property Bulletin.

*Bairrada*

At the end of the 19th Century, Bairrada specialised in the production of

sparkling wines. Despite its recognition in legislation from 1907/1908, the Bairrada region was only demarcated in 1979 (Portaria 709-A/79, de 28-12). In that year, it was given the Denomination of Controlled Origin for white and red wines and in 1991 for sparkling wines. The Wine-growing School of Bairrada (Escola Prática de Viticultura da Bairrada), created by the Government in 1887 and run by the agronomist José Maria Tavares da Silva, who came from the Anti-Phyloxera Station at Régua, played an important role in the establishment of this industry.

In relation to the territory of the present Bairrada region, 27 trademark applications were filed, corresponding to 2.31% of the total. Of this total, 16 applications were filed by the same company: Lucien Beisecker, Limitada, a French company and one of the first sparkling wine producers[5]. Besides Lucien Beisecker, there are also applications submitted by Justino Sampaio Alegre, also one of the first sparkling wine producers in Bairrada[6]. The identification with the producing region is made through the toponym and the town's coat of arms, as it's shown in Figure 4 (label "Bairradino"). Accompanying the mention to the producing region Bairrada, the Figure 5 (label "Bairrada Vinho Espumante do Douro") indicates the type of wine produced – Sparkling Wine from the Douro – confirming that the sparkling wine production technique was imported from the Douro region.

**Figure 4.** *Label "Bairradino"*


*Source*: Industrial Property Bulletin.

[5]Lucien Beisecker was cellar master of Caves Monte Crasto and in the mid-1890s he created his own company, Caves Lucien Beisecker, Lda.

[6]Justino Sampaio Alegre was a member of the Bairrada Wine Association and, when it ceased its activity, he founded the company Caves Monte Crasto, with its own facilities.

**Figure 5.** *Label "Bairrada Vinho Espumante do Douro"*


*Source*: Industrial Property Bulletin.

*Região do Tejo (Tagus Region)*

The applications submitted for wines from the Tejo region represent 1.88% of the total (21 applications). Liqueur wines were also produced in the Tagus region. For example, "Bastardinho" and others only called liqueurs. It is curious how this type of wine is identified in the trademark register. The Figure 6 (label "Americano") contains the mention "Indication of fortified wine from southern Portugal" (Vinho Licoroso do Sul de Portugal). The brand name is a clear reference to grape variety Americano. It also includes the indication of guarantee of the genuineness of the product and of exported wines by the firm.

**Figure 6.** *Label "Americano"*


*Source*: Industrial Property Bulletin.

*Região de Lisboa (Lisbon Region)*

The Lisbon region includes the three historic regions of Colares, Carcavelos and Bucelas, all of them demarcated in 1908. Wines from the current Lisbon region account for 6.43% of trademark applications between 1918 and 1924. It includes requests for fortified and table wines, such as "palhete" and "clarete" (claret). The largest number of applications concerns wines from Colares regional type wine. In Figure 7 we see a brand with toponymic and grape variety references. The Figure 8 has also some graphic elements allusive to the brand "S. João" (Saint John), represented by the figure of S. John, the Baptist (qualitative-iconic dimension).

**Figure 7.** *Label "Collares Ramisco"*


*Source*: Industrial Property Bulletin.

**Figure 8.** *Label "S. João Vinho Regional de Cintra"*


*Source*: Industrial Property Bulletin.

In the label of Carcavelos wine (Figure 9) we can see that the author of the request included a toponymic reference and to the noble and ancient character of the wine (vinho velho: "old wine").

**Figure 9.** *Label "Vinho Velho Carcavelos"*


*Source*: Industrial Property Bulletin.

The Bucelas label (Figure 10) also includes a toponymic reference, complemented with the identification of the company and its activity (export and consumption).

**Figure 10.** *Label "Bucellas Flock"*


*Source*: Industrial Property Bulletin.

*Dão*

In the second half of the 19th Century, Ferreira Lapa classified the "Dão River basin" as a very productive centre in generally good wines, some of which were distinctive and fortified wines (Lapa 1975). The Dão region was demarcated in 1908 as a regional table wine region. Currently, it is called "Terras do Dão" and includes two delimited areas for the production of wines with Denomination of Origin (DO): DO "Dão" and DO "Lafões".

Dão it's the region with the lowest number of trademark applications: only nine, equivalent to 0.77%. The labels and names of these brands have similar characteristics to those already mentioned for other winegrowing areas of

Portugal. For example, in the label "Ribadão" (Figure 11), there is a direct toponymic identification in the brand name. The Figure 12 (label "Vinho de Lafões" – Lafões Wine) corresponds to an area that is now recognised as DO Lafões. In this case the identification is made by the toponymy – wine of Lafões, adding the municipality of S. Pedro do Sul. The label is also completed with bunches of grapes and the image of a manor house.

**Figure 11.** *Label "Ribadão"*


*Source*: Industrial Property Bulletin.

**Figure 12.** *Label "Vinho de Lafões"*


*Source*: Industrial Property Bulletin.

*Região de Setúbal (Setúbal Region)*

Setúbal became famous for Azeitão muscatel, Palmela and Calhariz wines (Lapa 1975). The demarcation of the muscatel region of Setúbal took place in 1908. Nowadays, it also produces DOC Palmela (white and red wine, and semi-

sparkling wine) and Setúbal (fortified wine).

Applications submitted for the Setúbal region account for 1.46%. The labels selected highlight the mention of the region, plus the type and category of wine. The location of the company's head office is also added. In some cases, the labels also present medals as a sign of nobility and character (qualitative-iconic dimension). This is the case of Figure 13, a label from José Maria da Fonseca, one of the main wine producers in the region.

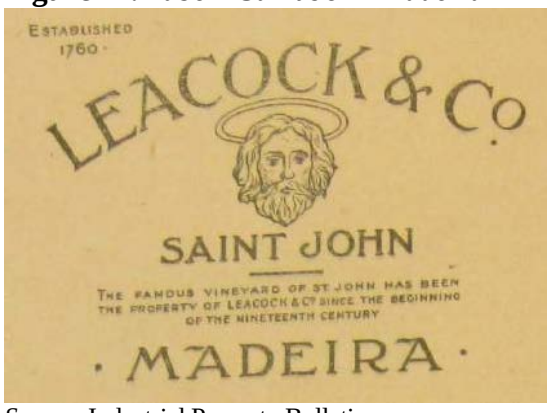
**Figure 13.** *Label "Fine Moscatel"*


*Source*: Industrial Property Bulletin.

*Madeira*

With 45 trademark applications, Madeira accounts for 3.86% of the total number of applications. The labels show a greater concern with the graphic representation of elements clearly identifying the producing region. Thus, we have a label with an image corresponding to the name of the wine, which derives from the vineyard where it is produced - S. John vineyard (Figure 14). It is presented entirely in English, as it is intended for export wines. As a label with an advertising function, it also expresses a guarantee of genuineness and antiquity, not only by indicating 1760 as the date of foundation of the company but also by stating that the vines have belonged to the family for over 100 years. Likewise, the Figure 15 is intended for export. It is written in French and contains a careful indication of authenticity through the brand name (singular-indicative dimension). It's illustrated with a picture of the bay of the island, with a caption.

**Figure 14.** *Label "Saint John Madeira"*




*Source*: Industrial Property Bulletin.

**Figure 15.** *Label "Véritable Madére d'Origine"*


*Source*: Industrial Property Bulletin.

*Port Wine/ Douro Demarcated Region*

With 330 applications, this is the Portuguese wine-growing region with the greatest weight in the group of trademark applications, corresponding to 28.28% of applications. The applications are for various types of wine produced in the Douro Demarcated Region: liqueur wine, table wine, sparkling wine and muscatel.

Figure 16 refers to Caves dos Vinhos Espumosos V. N. Gaia (sparkling wines), a request made by Gaston Mennesson, a French industrialist and oenologist who also worked for companies in Bairrada. This label is very simple and only contains a toponymic reference and the emblem of the company. The label "Vinho Velho do Porto Moscatel" (Figure 17) by a distribution company that has submitted applications for registration of numerous products in Class 68 from various Portuguese wine-growing regions has the particular feature of indicating that it is a wine produced in the Douro, identifying it as an old Portwine, at the same time as mentioning the sub-region in which it was made (Alto Corgo, in which Favaios, a municipality which produces Moscatel do Douro, is situated).

**Figure 16.** *Label "Vinho Espumoso do Alto Douro"*


*Source*: Industrial Property Bulletin.

**Figure 17.** *Label "Vinho Velho do Porto Moscatel"*


*Source*: Industrial Property Bulletin.

The following label (Figure 18), from a well-known and old company in the sector (Kopke), accurately indicates the origin of the wine: the estate where it was produced (Quinta de S. Luiz, where the company's wines are still produced today), the locality (Ferrão – parish of Adorigo and municipality of Tabuaço) and the region (Alto Douro). The female figure holding a bottle and at the same time the vineyard seems to want to indicate the provenance of the wine, guaranteeing its genuineness (conventional symbolic dimension).

**Figure 18.** *Label "Quinta de S. Luiz"*


*Source*: Industrial Property Bulletin.

The Real Vinícola label emphasises the company itself (Figure 19). Thus, it includes, in a central place in the upper part, the emblem of the firm; in the lower part, the indication that it is a private label; in the centre, several medals alluding to

participation in wine exhibitions (qualitative-iconic dimension). The brand (Audaz) is presented in a smaller font.

**Figure 19.** *Label "Vinho do Porto Audaz"*


*Source*: Industrial Property Bulletin.

The label "Vinhos Velhos do Porto" (Figure 20 – Old Portwine) was illustrated with the Douro landscape (the river and the riverbanks with their terraces). The information shows that it is a wine from a producer (João Eduardo dos Santos, indicated by the respective insignias at the top) bottled for another company (J. Rebello, Lda, from Lisbon). Like the previous label, this one also includes several medals from wine exhibitions because, as Helena Lobo says, "producers soon realised that their products sold better if they had an element of prestige attached to them. The presence of a royal coat of arms, a string of medals at exhibitions or the testimony of a respected analyst attesting to the quality of the product gave the consumer the necessary confidence" (Lobo 2014, p. 168).

**Figure 20.** *Label "Vinhos Velhos do Porto"*


*Source*: Industrial Property Bulletin.

Figure 21 shows an advertising label, intended to demonstrate that this is a wine sold internationally, reflected by the brand "Porto Monte Carlo" and the presentation of its casino image (conventional symbolic dimension).

**Figure 21.** *Label "Porto Monte Carlo"*

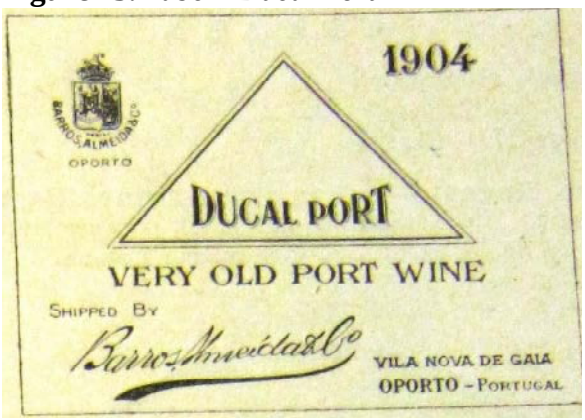

*Source*: Industrial Property Bulletin.

The next two figures represent the labels of the wine from a vintage year. The first one (Figure 22) has, besides the year, the type of the wine (Reserve), reinforcing the quality of the product. The next one (Figure 23), from an exceptional vintage year (Pereira and Almeida 1999), is more elaborated and it also bears the mention of Very Old Portwine, together with the name of the company and the place of the headquarters. The brand appears inscribed inside a triangle, also characteristic of many Port wine labels.

**Figure 22.** *Label "Reserva 1870"*


*Source*: Industrial Property Bulletin.

**Figure 23.** *Label "Ducal Port"*




*Source*: Industrial Property Bulletin.

Finally, the last brand we selected has a label with an advertising function, with a lot of symbolism and several references to the Douro region, the quality of the product and the grapes used to produce it (Figure 24). It is complemented by a female figure with a Phrygian barette and the flag in her right hand, representing the Portuguese Republic already referred to in the brand name (Portugalia).

**Figure 24.** *Label "Portugalia Vinho Velho do Porto 1864"*


*Source*: Industrial Property Bulletin.

## Conclusion

The data obtained from the research undertaken allow the initial research questions to be answered. The number of trademark applications seems to confirm a gradual specialisation and identity affirmation of the different Portuguese wine

regions. However, future studies will need to confirm this conclusion by cross-referencing this data with quantitative export data.

From the analysis of the data collected, it can be concluded that the wines with the greatest representation are the Douro wines, far away from the wines from the other regions. This fact confirms the predominance that Douro wine had acquired in the national economy. On the other hand, we found that other historical regions, such as Vinho Verde, Madeira and Lisbon, have a relative importance and were subsequently targeted by state policies with a view to their development and affirmation. The trademark applications submitted between 1918 and 1924 allow us to conclude that the much-demanded regional specialisation would eventually materialise. In a period marked by the growth of wine markets (Martins 1990), each winegrowing region managed to develop and sustainably affirm its identity and its own types of wine.

With regard to the legal recognition of the different appellations of origin, whose historical overview we dealt with very briefly in the Introduction, it can be seen that the current legislation has consecrated legal concepts that have been discussed since the end of the 19th century and throughout the 20th century and which have been reflected in applications to register trademarks and the respective labels, such as, for example, "regional wine" (which currently corresponds to protected geographical indications).

We also found that most of the trademark applications were filed by traders or exporters and, to a lesser extent, by wine growers. Many companies apply for the registration of wine brands of different types and origins and appellations of origin. This is related to the economic activity performed: they are distribution companies, a kind of wholesalers, which buy to sell or export stock of wines from all over the country. This conclusion is reinforced by the fact that these companies filed trademark applications for other product categories. In these cases, the brands tend to be generic, often corresponding to the name of the company itself, and the labels may not have specific identifying signs of the wine's region of origin.

As far as labels are concerned there is a concern to identify the production region by means of graphic and visual elements in all the regions analysed. However, it should be noted that labels tend to be more sophisticated when they correspond to regions with established tradition and consolidated foreign trade, such as Douro Demarcated Region or Madeira, and when they are related to producers rather than traders. What confirms the claims of François Guichard: "instead of simply advertising a generic Port wine, for example, the consumer could be given detailed notions, such as the exact provenance, age, grape variety, the names of the producer, bottler and importer, elements that the final distributor was not always careful to provide" (Guichard 2001, p. 35).

In future studies, we intend to confront the data obtained from other sources, such as export statistics and production reports from the regional viticultural commissions, to allow for a comprehensive characterisation of the wine sector in Portugal during the inter-war period.

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# Born Outside of Wedlock, Died as a Millionaire: Getting Wealthy by Being Entrepreneurially Resourceful

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*The rise from rags to riches i.e., from poverty to wealth has inspired as a topic both novelists and historians, but often their texts are just chronological or sub-thematic writings without any clear theoretical focus. In the present study, the learned entrepreneurial resourcefulness has been selected to be the main theoretical perspective. In addition, we can follow from a life-long description how a youngster called Julius (Julius Johnsson; 1845-1923) born in the poverty rose to wealth. The context is Finland, mainly in the 19th century, and the historian's biographical data are used as empirical evidence. Our analytical tool is a 2x2-matrix, which makes it possible to study both individual and collective resourcefulness and both proactive and reactive behaviour in the growth process. The key findings emphasize proactive, self-initiated behaviour. Both individual and collective resourcefulness have helped the youngster in his development "from a Russian bastard" to a Finnish millionaire. The nature of his resourcefulness has been not only cognitive but also affective and, most of all, conative. Resourcefulness has helped Julius to recognize opportunities and overcome resource constraints in the transition to a wealthy habitual entrepreneur and a respected businessman. Earlier body of knowledge regarding resourcefulness is complemented with our analytical matrix which can be regarded as the main methodological contribution and which offers a novel framework for the forthcoming studies aiming at adding knowledge on entrepreneurial resourcefulness.*

**Keywords:** *biography, entrepreneurial behaviour, entrepreneurial resourcefulness, habitual entrepreneur, learning*

## Introduction

The present study is based on the textual interpretation of a biography (Tuomi and Nikula 2007). The original text describes the eventful life of Julius Johnson, a self-made-man who was born outside a marriage to a Finnish mother and a Russian father in 1845 and who died as a millionaire and donator in 1923. At that time the birth outside of the wedlock was regarded as shameful and nearly illegitimate. Julius's mother was a poor maid servant Mathilda, and his father was a Russian soldier, Grigori, who later got married with Mathilda when Julius was about six years old. Only three years later, Julius lost, due to the Crimean war, the contact to both of his parents, and he had to move to his uncle.

The process from rags to riches is analysed through the lens of individual and social resourcefulness. The geographical context is Finland in the 1800's when

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Finland was an autonomous dutchy of a Russian empire (Finland became an independent state in 1917, only six years before the death of Julius).

Entrepreneurial resourcefulness has both individual and collective dimensions (Erozkan and Deniz 2012). Both of these dimensions can help coping with challenging and stressful situations. Resourcefulness helps to overcome resource constraints. Since 1966 (Levi-Strauss 1966) the concept of bricolage has frequently been used to describe the mindset of a resourceful entrepreneur. A frugal entrepreneur has the ability to think and act resourcefully with scant resources (Michaelis et al. 2020).

It is interesting and useful to study entrepreneurial resourcefulness in different contexts (temporal, spatial and other contexts). This study takes us back in time over 150 years. To the times of strong industrialisation, first railways, first telephones, and first electronic bulbs, and to the times when societies developed from primary industries (like agriculture and forestry) to a wider range of industries. Geographically, the case starts from the Aland Island (between Finland and Sweden) and ends in the Central Finland where Julius died at the age of 78 years.

The research questions are as follows:

1) *What kind of entrepreneurial resourcefulness has helped a penniless youngster called Julius to become a wealthy businessman during seven decades?*
2) *What kind of proactive and reactive behavior can be recognized in his process of wealth creation.*

Methodologically the study is a qualitative content analysis and the approach is a single-case study (Anttila 2005). The data is a published book, a biography of 151 pages, based primarily on archival data, publications, and historical newspapers (Tuomi-Nikula 2007). The nature of the study is interpretative. The main contribution is to experiment the created framework of two dimensions (those being individual vs. collective resourcefulness and proactive vs. reactive behaviour). Another stimulus of the study is to get experience whether the theories of resourcefulness that have been developed and published many decades after the death of the studied person are applicable in the interpretations. The central thread is to analyze Julius's life from the entrepreneurial and ownership perspective by paying attention to the evolution of his resourcefulness in the wealth creation.

## Literature Review: Entrepreneurial Resourcefulness

Rosenbaum (1990) elaborated the concept of learned resourcefulness. His key themes are adaptive behaviour, coping, and self-control. He has also developed scales to measure resourcefulness. One of his key messages is that people high in resourcefulness can minimize the negative effect of stress on their performance. Therefore, they can do better than less resourceful individuals under pressure. This finding has been often quoted especially in the so-called stress literature dealing with the context of managerial and entrepreneurial pressure, but also in the educational and health-related studies.

Resourcefulness, i.e., human's capacity to overcome problems and to recognize opportunities to make do with what is available, is a fascinating, yet challenging, topic for studies. Human's resourcefulness is a very general concept related to the ability to act effectively or creatively in challenging situations. A resourceful person is able to put resources to efficient or ingenious use, using what is available wisely, skilfully, and productively. One of the leading journals in the research of entrepreneurship, Journal of Business Venturing, had recently published a special issue (36:4) in 2021 about entrepreneurial resourcefulness. In that journal Williams et al. (2021) conclude that entrepreneurial resourcefulness is a boundary-breaking behaviour of creatively bringing resources to generate value.

Being resourceful, according to Rosetti and Zlomke (2021) can be regarded as a combination of problem solving, coping, self-control, and emotional regulation. We would like to add to this list specifically also the overcoming of resource constraints (cf. Corbett and Katz 2013), but it can, of course, be in their taxonomy an element of coping. In addition, as Erozkan and Deniz (2012) have reminded, social self-efficacy can be regarded as a building block of *collective resourcefulness. It can be concluded that entrepreneurial resourcefulness seems to have both individual and social (collective) dimension.* Entrepreneurial resourcefulness have been studied, for example, by Misra and Kumar (2000), Corbett and Katz (2013), Bradley (2015), Welter and Xheneti (2017). Quite recently also Williams et al. (2021) and Zahra (2021) have written about entrepreneurial resourcefulness.

Levi-Strauss (1966) introduced the concept of bricoleur. With this concept he meant a person who combines the resources on hand to solve problems. In the similar vein, Corbett and Katz (2013) suggest that "(entrepreneurial) resourcefulness is competing with constraints." This kind of thinking has earlier been discussed under the title of resource construction through entrepreneurial bricolage by Baker and Nelson (2005, pp. 329-366): "creating something from nothing." They remind that even during the times of scant resources some entrepreneurs succeed better than others because they deploy the scant resources in a more creative and resourceful manner.

Welter and Xheneti (2017) suggest that resourcefulness means ***"a dynamic concept encompassing multiple practices, which change over time, and it results in a close interplay of multiple contexts with entrepreneurial behaviour."*** They have studied entrepreneurial resourcefulness in challenging evnvironments, such as the transition economies of post-Soviet countries. Powell (2011, p. 378) remind that the core of entrepreneurial resourcefulness "… lies in the patterned variation in making use of limited resources."

Koiranen's (2016) single-case study on entrepreneurial resourcefulness was also based on biographical data and covered some 40 years of another habitual entrepreneur. The conclusion was that the roots of entrepreneurial resourcefulness in the studied case were the contextual sharpness as combined with the entrepreneurial mindset. In his behaviour the habitual entrepreneur was characterirized by the following features: a) alertness and proactiveness to utilize new ideas and opportunities; b) ability to mobilize resources in action and to compensate lacking resources; c) perseverance to get things done and win the

competition; d) contextual and emotional intelligence to apply knowledge and skills when dealing with a new or trying situation.

Unfortunately, the prior study (Koiranen 2016) did not pay enough attention whether th entrepreneur's behaviour was proactive or reactive. This is why we want to introduce this lacking dimension to this newer case study. See Table 1 and Enclosure 1.

**Table 1.** *Matrix for Classifying Empirical Data*

| ENTREPRENEURIAL RESOURCEFULNESS IN / AS BEHAVIOUR | Individual Resourcefulness | Collective Resourcefulness |
|---|---|---|
| Proactive behaviour | *Proactive behaviour based on individual resourcefulness* | *Proactive behaviour based on collective resourcefulness* |
| Reactive behaviour | *Reactive behaviour based on individual resourcefulness* | *Reactive behaviour based on collective resourcefulness* |

The motive to add proactive vs. reactive behavior in the analysis was simply that proactiveness is regarded as one of the key dimensions of entrepreneurial orientation when strategies are crafted and opportunities are exploited (Lumpkin and Dess 1996).

The recent study of Rautamäki and Koiranen (2021) reports that resourcefulness in entrepreneurship self-regulates and directs one's behaviour to successfully cope with difficult, stressful and challenging situations, and to overcome resource constraints. It appears both at the individual and collective level and includes three main dimensions which seem to be cognitive ability, affective empathy, and conative activeness.

## Methodology and Data

The analysis is based on a longitudinal single-case study. The approach is both theory driven (theories of entrepreneurial and learned resourcefulness ) and data driven (the narrative reported in the biography). The development of the case is presented in the chronological stages (1845-1864), (1864-1869), (1864-1877), and (1877-1923) which means nearly eighty years of historical data.

The nature of the analysis is interpretative. To minimize misinterpretations or overinterpretations our strategy was to use two authors who have earlier made together a survey-based conceptual analysis of entrepreneurial resourcefulness and after that both of them thoroughly read the bibliography. In addition, the earlier theories of resourcefulness have guided the authors' interpretations. This is important because both the original biography and the observations in fact are interpretations made many years afterwards of second-hand sources and subject to possible insufficiencies and even misunderstandings. Both the bibliography and our report are based on written documents, but the possibility of wrong or biased judgments cannot be totally avoided.

It is therefore important to mention the key limitations. The biography that has been used as an empirical case has not been written for research purposes, although the author Jorma Tuomi-Nikula, was an experienced historian and a journalist. Due to his background he has had a good access to newspapers and archives. The documents he has used are authentic. But still his writing is based on his interpretation, and this paper of ours is, in turn, an interpretation of his text.

Neither should we forget the impact of the timepoint. Julius (1845-1923) lived in the social and economic contexts that were very different than those of today. Although the surrounding circumstances were very different, one thing remains the same: Entrepreneurial resourcefulness appears as the contextual sharpness, although the context may be very different. We should not forget the spatial dimension either. Julius lived all his life in Finland that belonged on those days (till 1917) to the czarian Russia being an autonomous Grand Duchy. Due to these limitations the results may be less generalizable outside their original temporary and spatial contexts.

## Results: Julius Johnson's Life Stages

### *From Birth to Marriage (1845-1864)*

Julius Johnson's mother Mathilda fell in love with a Russian soldier, became pregnant and had to retun home to Aland Island. A son was born 2nd January 1845. His father had to stay in St. Petersburg. Soon after Julius's birth Mathilda moved to her relative Carl, and the whole extended family learned quickly to like the young Julius as their own family member. Mathilda firmly believed that Grigori (Julius's father) will return to Finland as soon as possible, but she had to wait until Julius was six years.

Russian Czar Nikolai I had declared the war against Turkey ("the Crimean War"). Finland as a part of the old czarian Russia had to participate. The allied parties of Turkey fighting against Russia were France, England, and Sardinia. The Baltic Sea became a war arena and French and English troops (some 15,000 soldiers) marched into the Bomarsund fortification where Grigori, Mathilda and Julius were. Both Grigori and Mathilda were forced to leave for France as prisoners, and the young Julius did not see them afterwards. At the age of nine years he totally lost the contact to his parents and moved again to Carl, who for the second time started to take care of him.

French soldiers had left a lot of animal bones behind them. They bought from the houses cows and sheep, and slaughtered them outdoors to make food and to get skins. Bones were left on the ground in the forests and on the fields. Julius started to collect them and sold them to the bone mills for grinding. Bone powder was used as a fertilizer and as a raw material for some industries. As an old man Julius told how he collected bones from the fields of a large farm, and sold them back to the estate manager of the same farm. Making money by collecting bones was taught to young Julius by his uncle and stepfather Carl. Later he took Julius as a shop assistant to his retail store, where Julius learnt the basics of bookkeeping.

When he was 14, he got his first outside employment as a bookkeeper in the South-West of Finland. In addition to the big farm, where he was a bookkeeper, the owners had also iron industry, brick manufacturing, sawmill, flourmill, and even distillery of spirits. In just one place he learned the basics of several industries, worked hard, and was enthusiastic and curious in learning new things. He could speak Swedish and Russian, and (not so fluently) Finnish which he had to study as the third language.

The people who enhanced Julius's entrepreneurial resourcefulness were clearly his uncle Carl, his boss on the farm Mr. Aspelin, who were clearly mentors in his development. His strong own willpower for learning new things helped this process. Both the bone business and the employment as a bookkeeper can be regarded as a proactive behaviour from this period of time. Both individual and collective resourcefulness had started to develop.

*New Job and Forming a Family (1864-69)*

Julius had moved in 1863 to Ostrobothnia, in the more northern area of Finland, as a more experienced bookkeeper. The main business from where he got a job was iron production from the iron ore. The big manor house owning the iron business had also a very large farm. The former bookkeeper had two sisters, Hilda and Matilda, and in December 1864 Hilda and Julius were married. Julius was about five years younger than his wife. The wife came from a big family of 11 children, and her father was a priest. Marrying the priest's daughter meant a rise in the social status of Julius. Before that he had been "only" the son of a poor Finnish maidservant and a lower-rank Russian soldier, but now he became first time the member of an upper class. Funny enough, his uncle and stepfather Carl had also twice married a priest's daughter.

Carl made money by buying farms for development. He sold them with a profit, as he had better education in farming than a typical farmer of that time. Likewise, Julius bought bankrupted companies, and made them to flourish again. Both Carl and Julius became members of local government. Both of them had five children.

When iron business where he was a salaried employee started to struggle due to the recession of iron industry, Julius started to aim at becoming self-employed. He got a permission from the government to be a shopkeeper in a named village in Ostrobothnia. He moved there with the family and opened his first shop. Unfortunately in 1868 the winter came much earlier than normally and the people in Ostrobothnia were faced with shortage of food. From the middle of hunger and spreading diseases the family moved to the Aland island. The business situation was chaotic in the mainland Finland. The family could use the ice road (i.e., a horse and a sleigh) over the sea for the journey from Ostrobothnia to Aland. Just when he was about to start a new shop in Aland, he heard that a Russian group Putilov was opening new iron factories and sawmills in Finland. Julius decided to travel in 1869 to those areas in order to get a new job with the Putilov group. Very soon he became a mill manager with a high salary and a free 5-room house including free heating.

These phases include both proactive and reactive behaviour. Opening a new shop was a proactive step. Closing it soon to escape from hunger was mainly reactive behaviour caused by the chaos. The decision to move to the Eastern Finland and become employed by a Russian company was again a proactive move. Julius's family and the wife's siblings were to some extent a collective source of resourcefulness, but his own proactive resourcefulness was, however, the most dominant form of it.

## Becoming a Habitual Entrepreneur and a Portfolio Investor (1864-1877)

When working as an employee for the Putikov group as a mill manager Julius learnt soon what kind of riches were available in the collection of iron ore from the bottoms of lakes, iron production, and in timber trade. The former trader Julius became also an industrialist in large-scale manufacturing industries. In addition, he became a habitual entrepreneur both as a serial entrepreneur and a portfolio entrepeneur. He kept his employment with the Putikov Group till 1874 but had also started to make investments in the shipping by becoming an owner of 25 % in four different cargo ships (two schooners, one frigate and one bark). He split the risk of owning by investing in four different vessels, and started to earn additional money from freight income.

After leaving the Putikov Group Julius was eager to grow his assets. Uncle Carl helped him again in financing investments. Julius was active in trading raw wood, sawn timber, firewood, and he recruited a competent purchase manager Fredrik Immonen to manage the logistics of timber business. A small side line in entrepreneurship was his decision to become a bottler of beer, and later he owned two different breweries which made beer and soft drinks.

In 1876 he utilized his earlier knowhow in iron production, but now as an entrepreneur. Together with his partner Mr Lang he bought an old iron mill. At the same time he started to produce tar and turpentine. This company he owned till 1918.

During this period Julius behaved very proactively and his individual resourcefulness was complemented by his uncle Carl, Mr Immonen and Mr Lang. Very little is reported in the biography about the participation of Julius's core family. It may well be that the main source of collective resourcefulness at this stage was not the family but the business colleagues and employees.

### *Final Breakthrough (1877-1923)*

The end of the 1870's was very successful to Julius's timber business. He had just moved with his family from the Eastern Finland to Central Finland, namely to the city of Jyväskylä. His business achievements were reported in the local newspapers, he was invited to business clubs, and he continued takeovers of sawmills and brewing companies. He was the first user of electrical lighting in the city at the beginning of the 1880's in one of his sawmills, and 1902 he started to produce elecricity to the city. He invested more in cargo ships, he participated

actively in the social life, and he was active in getting the railway connection from Helsinki to Jyväskylä. He made many real estate investments. In 1892, the Russian czar Alexander III gave him the honorary title of commercial councelor. He made donations to the municipalities and parishes where he had lived. The donations were mainly targeted to improve schools and church buildings. He started a traffic company with a new steam ship, and he sold the steam ship as late as in 1917.

On the family side he had losses and harms. His parents who had returned to Aland died, his eldest son died in the heart attack at the age of 32 years. His daughter-in-law became economically dependent on Julius's benevolence. His daughter had several divorces. His wife Hilda died in 1904 at the age of 61 years. Despite these losses he decided to build a big manor house in Jyväskylä to where he moved in 1904. Julius himself died in 1923 at the age of 78 years. He had made a will. He died as a multi millionaire. Most of his wealth was inherited by his daughter Sigrid and her three children, but Julius in his will had wanted to give considerable donations also to philanthropic purposes. His grave is in the old church yard of Jyväskylä.

Julius was able to preserve his strong business orientation and resourcefulness till the very end of his life. He learnt to rely on his partners and social contacts which was necessary as the assets and businesses increased and his own physical condition started to weaken. His proactiveness during the last decade is exemplified more with real investments than business start-ups or takeovers. He became more an owner and investor than an entrepreneur. Envious people wanted to spread gossips of his personality and personal matters, and despite his benevolence he had also political opponents who desired to disturb his businesses. However, with his resourcefulness this self-made man managed to become a multi millionaire, and in that process his proactiveness as combined with individual and social resourcefulness were the most valuable resources.

## Results of the Case: An Interpretation

The narrative offers a lot of examples of Julius Johnson's individual and social resourcefulness. In the early years, when the social network was very limited, his uncle Carl was the warp and woof in his life. In Carl's home Julius had to become also individually resourceful, which is exemplified by his first businesses when he was just nine years old (collecting, cleaning, and selling of animal bones from forests and fields). Carl offered him a job as a shop assistant where he learned bookkeeping and a lot of economic thinking. He was able to work as an employee, when he moved to Ostrobothnia and became a bookkeeper at the age of 14.

The more experienced he became, the more his resourcefulness increased. He learnt quickly how to work in buying and selling, he became alert to see and seize opportunities, and he learnt how to overcome resource constraints. He understood that he has to learn more, and Finnish language was not the easiest new thing to be learnt.

His two native languages (Swedish and Russian) helped him to get an employment in the Putikov Group which was an important phase of his professional

development. He learnt how bigger companies act, and how raw materials (like iron ore or raw wood) can be processed. He started to really understand the importance of good logistics and the success factors of industrial processes.

In addition, he was able to grow and renew his networks and so increase his collective resourcefulness. He made some new start-ups to use his salary for investments.

There are less examples of reactive behaviour in his biography. The escape from Ostrobothnia back to Aland can be interpreted either as a proactive move backwards or as a reaction caused by economic and health risks. Some strategic moves, especially divestment decisions, that he made can be interpreted as reactions to the changed market situation or emerging opportunities.

The relationships in the birth family did not offer a lot of financial resources or social capital. The exception is his uncle Carl who seems be a role model of intiative and entrepreneurial behaviour to young Julius. From him Julius got some seed funding for his start-ups. The marriage opened doors to an upper social class as his wife Hilda was the daughter of a priest. Later the Putikovs were also his role model in industrial developments.

Alertness in utilizing proactively new technologies was clearly one aspect of Julius's resourcefulness. He had electrical lightning about 20 years before it was common in Europe as he knew one friend of Thomas Alva Edison. He had one of the first telephones and his manor house had many conveniences that were rare in those days.

Ability of making strategic turnarounds by purchasing cheap and suffering firms and changing them back to profitable ones was characeristic to Julius. Especially this was the method that he used when buying and selling sawmills. The ability of making strategic renewals as combined with courage to risk taking are evidence of his proactive entrepreneurial resourcefulness.

Julius understood the value of politics in advancing matters. After creating an industrial dynasty as a habitual entrepreneur he became elected to the city council and also its chairman. He acted in business clubs and in some cultural activities. These contacts and networks were helpful in the light of collective resourcefulness.

His individual resourcefulness seems to be a good combination of enthusiasm, alertness to new ideas (both commercial and technological), creating and utilizing opportunities, will-power to realize the plans despite of obstacles, endurance, and assertiveness. He had also skill and emotional sensitivity to understand what the situation at hand requires, in other words: situational sharpness. Both intra-organizational and external social networks have added his resourcefulness to the level of collective resourcefulness.

Somewhat surprisingly, very little is reported about the females' roles in the bibliography. The text reveals that Julius lost the contact to his mother at the age of nine years and later married a priest's daughter but hardly anything more. No doubt, the marriage with Hilda opened him doors to an upper social class, due to Hilda's background. Our interpretation is that this "invisibility" of family does not mean, however, that their role was insignificant in the development process of Julius Johnsson, but rather it tells that there is no documented history available which would make it visible. The females have been, as they often were during

those times, background influencers whose role was important at home and less visible in business, media or politics.

## Discussion and Synthesis

The first research question was: *What kind of resourcefulness has helped a penniless youngster called Julius to become a wealthy businessman during seven decades?* On the basis of this case it can be summarized that the entrepreneurial behaviour has been much more proactive than reactive. The other conclusion is that entrepreneurial resourcefulness seems to have cognitive, affective, and conative dimensions. The proactive entrepreneurial behaviour has led Julius to habitual entrepreneurship which, in turn, has led to a major portfolio of created assets. Entrepreneurial mindset is a specific state of mind which orientates human conduct towards entrepreneurial activities and outcomes. People with entrepreneurial mindset are often drawn to opportunities and new value creation. They take affordable risks and accept the realities of change and the uncertainty of the future.

The second research question was: *What kind of proactive and reactive behaviour can be recognized in the process of wealth creation?* In Julius's case his career has included both salaried jobs as an employee and being an owner-entrepreneur. His entrepreneurial career has changed from a solo self-employed shopkeeper to a notable portfolio entrepreneur. His biography tells hardly anything about possible reactive behaviour, but it has many descriptions of proactive behaviour.

The strategic moves he has made as an entrepreneur indicate that he has created or controlled emerging situations, not just responded to them afterwards. He has caused changes, not just reacted to them. He has shown a lot of self-initiated behaviour.

The 2 x 2 matrix at the end of Chapter 2 looks balanced, but to describe Julius's behaviour can be a bit misleading (see also enclosure 1). The proactive "boxes" should be larger and the reactive "boxes" should be smaller. One explanation can be that for the author of the biography the proactive moves have been more inspiring to report or have originally been documented better. In hindsight, the division between proactive and reactive behaviour in the matrix appeared to be less relevant in this particular case.

The findings from the Julius Johnson's case and the earlier findings of Jalo Paananen's case (Koiranen 2016) are very similar. Both entrepreneurs have been self-made men, exceptionally resourceful, grown from rags to riches by being habitual entrepreneurs, and created a portfolio of companies. The big contextual difference is, however, that Julius Johnson (born 1845) died 17 years before Jalo Paananen was born (1940). The former was born during the times of the Crimean war and latter during the times of World War II. However, both were youngsters in the post-war society with very limited economic resources.

## Suggestions for Further Research

Entrepreneurial resourcefulness may mean different things in different cultures. It would interesting to make a cross- or multinational study, how the meanings may differ between the different cultures.

Resourcefulness could be studied in extreme conditions (like in the extreme poverty or among the people who live in the refugee camp). There are amazing stories, for example, about the jews who survived in the ghettos of Warsaw during the second world war without practically any other resources than their resourcefulness. All in all, we should increase our knowledge and improve our understanding about the contextuality of entrepreneurial resourcefulness.

Teamworking has increased its popularity in many areas of the worklife. There are strong indications that successful entrepreneurs either build teams or are a part of a team (Cooney 2010, 2005). Well-working teams form a natural basis for collective resourcefulness, but the phenomenon of being collectively a resourceful team needs still further investigations. We should know more about and understand better the psycho-dynamics causing the resourcefulness of a team.

Conceptual clarity what entrepreneurial resourcefulness really is should be advanced by a rigorous conceptual study. The authors of this paper have later been involved in this kind of a study.

One potential group of interviewees could be entrepreneurs in creative industries. Their business concept, by definition, is based on creativeness which can be regarded as closely related to resourcefulness. They quite often have to work, at least in the start-up phase, with the constraints of financial resources and they have to be able to cope with or overcome those constraints.

## Conclusion

The case study based on Julius Johnson's biography (Tuomi-Nikula 2007) has opened our eyes to see the inner growth of the entrepreneurial person from "a Russian bastard" (this expression was used when the neighbours mocked Julius when he was a small child) to an influential businessman. Together with his own mental growth also his assets increased substantially.

Much of this development can be evaluated to be due to his resourcefulness and proactive behaviour. His resourcefulness was from the beginning both individual and collective. His uncle and the formed family were important helpers in the growth process and getting contacts. Later on, some business colleagues became his partners and co-entrepreneurs.

Longitudinal, processual studies are necessary in understanding the development paths. In this case the time frame was 78 years, from birth to death of one self-made man. However, getting empirical data for such studies is sometimes extremely difficult. The use of biographies, despite their limitations, is one answer to that problem.

To sum up, Johnson's biography is a convincing story about individual and collective resourcefulness. He was able to get things done in the face of obstacles

and constraints. He approached what was in front of him and utilized in the optimal way what he had. The analysis results of his biography support strongly the view held by Welter and Xheneti ( 2017) that the outcomes of entrepreneurial resourcefulness are development and coping. Johnson's story is an example that resourcefulness is a boundary-breaking behaviour in the value creation process which has earlier been emphasized by Williams et al. (2021).

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**Enclosure 1**

*Synthesis of Empirical Results: Highlights in Julius' Life*

Julius Jonsson's life from the entrepreneurial and ownership perspective and his resourcefulness in the wealth creation can be summarized as follows:

| ENTREPRENEURIAL RESOURCEFULNESS IN / AS BEHAVIOUR | Individual Resourcefulness | Collective Resourcefulness |
|---|---|---|
| Proactive behaviour | *1845-1864 – years as youngster*<br>- Collecting animal bones and selling them<br>- Bookkeeper<br><br>*1864-1869 -starting a family*<br>-Opening a new shop<br>- Move to Eastern Finland and be employed by a Russian company<br><br>*1869-1877 – habitual entrepreneur & portfolio investor*<br>- riches available in iron material and processes as well as in timber industry<br>- breweries<br>- iron mill, tar, turpentine<br><br>*1877-1923 – breakthrough*<br>- new techologies, for example electricity company & steamship company<br>- active in social life | *1845-1864 – years as youngster*<br>- Stepfather Carl´s impact<br>- Learning basics of several industries<br><br>*1864-1869 -starting a family*<br>- Stepfather, wife and her siblings source for collective resourcefulness<br>*1869-1877 – habitual entrepreneur & portfolio investor*<br>- resourcefulness source stepfather, business collaegues and emloyees<br><br>*1877-1923 – breakthrough*<br>- stepfather´s impact<br>- active in community<br>- proactive in business start-ups |
| Reactive behaviour | *1864-1869 - starting a family*<br>- closing the shop due to tough times | *1869-1877*<br>- divestments to renew the portfolio of assets (reactively and proactively) |

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# Does Education Help Local Economies Reach Economic Potential? Evidence from South Africa

*By Brian Tavonga Mazorodze[*] & Harris Maduku[±]*

*It is widely understood in development circles that poverty alleviation is elusive unless local economies operate productively with limited resources and existing technology. With a high rate of poverty on the back of weak output growth at municipality level in South Africa since 1994, this background makes it necessary to establish factors that could increase the pace of economic development and help local economies produce at full capacity. Using a stochastic frontier analysis of South Africa's 234 municipalities observed between 1995 and 2018, this paper finds postgraduate education (Masters and Doctorates) relevant in explaining the ability of these local economies to reach their full potential and the effect increases with the size of the manufacturing sector, life expectancy and trade. The stock of high school, diplomas, bachelors, and honours does not significantly contribute towards productive efficiency of these 234 municipalities reinforcing concerns of a possible structural mismatch between lower-level qualifications and the labour market demands. Consequently, moving these municipalities closer to their full potential may be achievable through ensuring that the undergraduate cohorts reach Masters, and PhD level complemented by a manufacturing-oriented structural change.*

**Keywords:** *education, technical inefficiency, structural transformation, stochastic frontier model, local municipalities, South Africa*

## Introduction

Economists have long known that education matters for poor countries and its economic importance cannot be overemphasized. It increases labour productivity (Mankiw et al. 1992, Barro 2001, Krueger and Lindahl 2001, Sala-i-Martin et al. 2004, ElObeidy 2016), aids local innovation (Lucas 1998, Romer 1990, Aghion et al. 1998) and facilitates the absorption of imported innovation (Grossman and Helpman 1990, Phiri and Mbaleki 2022). Literature linking its effect on economic output is too numerous to cite but we still lack evidence on whether education helps local economies reach their economic potential. Understanding the effect of education from this angle is important and necessary given that skill shortage is generally cited as an important source of resource inefficiency in poor countries. Against this background, this study focuses on the relationship between education and the ability of local economies to reach their economic potential in South Africa. Methodologically, the analysis uses a panel dataset comprising 234

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municipalities between 1995 and 2018, 8 of which are metropolitans and 226 are local municipalities.

The study is similar in spirit with Bhorat et al. (2016) who establish a positive effect of higher tertiary education on economic growth in South Africa using a standard Cobb-Douglas production function. What Bhorat et al. (2016) do not capture methodologically is the fact that deviations from a production function not only reflect random factors. They also reflect technical inefficiency which is essentially the inability to produce maximum output with given resources and existing technology. South Africa is well known for having a skill deficit despite being technologically better-off than many countries in Africa. As a result, relying on an analytical approach that assumes full utilisation of existing technology can be empirically misleading. Secondly, Bhorat et al. (2016) do not consider an important caveat that the economic contribution of education to a larger extent depends on the economic structure, the population's health status and the exposure of local economies to foreign trade.

In a bid to improve the work of Bhorat et al. (2016) therefore, this study makes five contributions. Firstly, it models the effect of education on technical efficiency and not frontier output. This allows the paper to explain why certain local economies operate below their maximum possible output and what efficient municipalities have done to operate efficiently with limited resources and existing technology. Secondly, it conducts the analysis in a panel data framework comprising 234 local municipalities. Relative to a time series framework employed in Bhorat et al. (2016), a panel data framework employed here brings a larger sample size while capturing the diversity of local municipalities. Thirdly, it relies on a Cobb Douglas production function that categorises labour into low-skilled, semi-skilled and skilled workers. This categorization is important empirically as the heterogeneity of skills embodied in workers implies different effects on output. Fourthly and most importantly, it measures education in a manner that distinguishes different levels of education. This contribution acknowledges the possibility that different levels of academic qualifications may have heterogeneous effects on productivity. Fifth, it examines the interactive effect of education and different economic sectors, trade, and a health indicator to determine whether the effect of education depends on structural transformation, trade, and population health, respectively.

The empirical results are striking. Firstly, they show that output correlates positively with skilled and semi-skilled workers and negatively with low-skilled workers. Secondly, undergraduate degrees, diplomas, high school, primary school and honours degreed cohorts do not have a significant effect on productive efficiency. It is only postgraduate education that correlates negatively and significantly with productive inefficiency. Thirdly, the effect of postgraduate education increases with the manufacturing sector, trade and life expectancy suggesting that expanding the manufacturing sector, increasing trade and improving life expectancy does strengthen the positive effect of postgraduate education on productive efficiency.

The rest of the paper is organised as follows. Next section provides the analytical framework. The empirical model is specified in the following section and results are presented afterwards. Finally come the concluding remarks.

## Literature Review

In general, research looking at the effects of human capital on efficiency and productivity growth include both health and education aspects and they are divided into cross-countries studies and country specific studies as well. With regards to the education impact, which is the main target of this paper; variables that are commonly identified as proxies for education include but are not limited to literacy rate, mean years of schooling, educational level of workforce, and school enrolment rate and government expenditure on education. This varied approach on measuring human capital or education has led to mixed results in this area of research (effects of education on efficiency and productivity). The mixed results found might be attributed to the differences in measuring human capital, the disturbance made by influential outliers in the datasets used and lastly the endogeneity of human capital as well might seriously bias the estimation results.

The relationship between education and efficiency has gained momentum among economists overtime mainly influenced by the narrative that, high efficiency leads to economic growth, increased incomes for labour and that of entrepreneurs (Qutb 2017). Analysing the education and efficiency relationship, Chevalier et al. (2004) found that education has an effect on wages but not clear on its relation to productivity and efficiency. Knight et al. (2007), explored the external effects of education on productivity and efficiency using Ethiopian data. Their study revealed the external benefits of education of productivity but not on technical efficiency. The central argument of their paper was that education externalities affect adoption and spread of innovation hence raise productivity especially in farming. On the other hand, using average and stochastic production frontier functions, Abdullah et al. (2011), discovered that household education significantly reduces both production and technical inefficiencies. However, their discovery could not shed light on the external benefits of education. For example, a neighbour's education does not affect productivity in the context of a farming community. Results from a Belgian linked panel data suggested that educational credentials have a stronger impact on productivity but not on wage costs (Kampelmann et al. 2018). In as much as their results are in line with that of Knight (2007), findings from Rukumnuaykit and Pholphirul (2016) and Kampelmann et al. (2018), further looked at the different stages of education and made a discovery that the impact of education on productivity is found too strong on young workers and women.

Wei and Hao (2011) tested the effects of human capital on total factor productivity (TFP) using a dataset spanning from 1985-2004. They found that human capital significantly impacts TFP, meaning that high educated employees are more productive when compared to those who are less endowed. Digging deeper into the education variable, the authors discovered that increasing quality in primary school had much impact compared to other learning levels. Although contacted in different countries and in different times studies from Wei and Hao (2011), Kampelmann (2018) and Setiadi et al. (2020) agreed that education young people does have a high impact of productivity and efficiency. Still on the quality of human capital, Qutb (2017) investigated human capital quality on productivity

growth in Egypt using data from 1980 to 2014. The study found that highly educated workers negatively impact labour productivity growth and those results are in contrary to the conclusions of Kampelmann et al. (2018) and Wei and Hao (2011) who reiterated that improving the quality of education does have a positive impact on productivity growth especially among young people.

Further, Rehman and Mughal (2013), looked at the influence of skilled and unskilled labour on productivity in Pakistan using a Cobb Douglas function. Their findings reflected that skilled labour a positive impact on productivity. Interestingly, their paper found that whilst skilled labour increases productivity by more than 40%, unskilled labour actually decreases productivity by more than 70%. Also, on Malaysia, using panel data for 14 states, Arshad and Malik (2015), analysed the impact of education of production efficiency. Their study employed a General Least Squares (GLS) model and found that, higher educational levels and better health status positively improve the level of productive efficiency in the 14 sectors that they looked at in Malaysia.

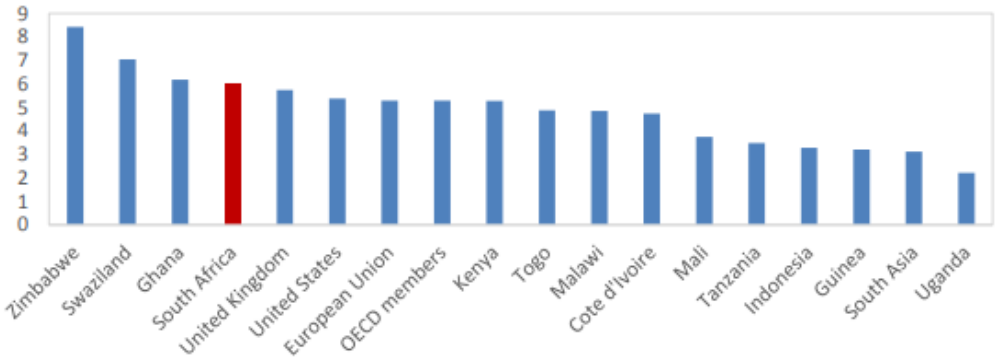
Appiah and McMahon (2002), considered the relationship of education and productivity growth using the total capital approach that includes both public and private, human and knowledge capital formation in the medium term model for productivity growth. The author found that education measured in average educational attainment of the labour was significant in determining productivity growth. Looking at a more recent paper than that of Appiah and MacMahon (2002), Ajri and Ismail (2010), analysed the extent of economic benefits that an economy can derive from educational expansion. The study used both production and productivity functions. Their findings were that education expansion has a positive contribution to productivity but its role is weaker than other forms of inputs like physical capital. It is clear from this literature that studies specifically related to South Africa are scanty at best, a gap which is surprising given the country's skill gap and weak economic performance.

## An Overview of South Africa's Education System

South Africa negotiated a new political path to move from an authoritarian governance system into one that seeks to re-align the balance of forces in favour of those that were historically excluded. One of the sectors that reflected that exclusion was the education sector. In the new democratic path since 1990, South Africa has drafted numerous policies that seek to improve access, participation and also boost societal class representation. However, in as much as progress has been made to improve the inclusion of those that were traditionally disadvantaged, there are concerns that, the expansion of access has failed to deal with the question on quality of output. Mlachila and Moeletsi (2019), iterated that the poor quality of education in South Africa deserves to be apportioned part of the blame for critical skills shortages and also the long-run low economic growth the country has been facing. They highlighted that low quality education has an impact on skills and employability of citizens, hence its negative impact on economic growth. The researchers, however, argued that, the low quality of education in the country is

not mainly as a result of low or poor public funding into the sector (See Figure 1). South Africa ranks high by international standards with respect to public funding into the education sector but the country still suffers from the inequality legacy of the colonisation era (Mongale and Magongoa 2020).

**Figure 1.** *Government Expenditure on Education as a Percentage of GDP*



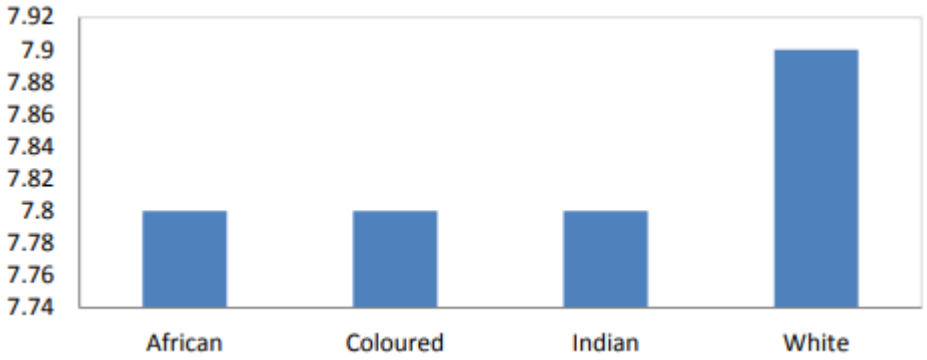

*Source:* World Bank Data (2017).

To add, the country's budget on education (6% of GDP) is comparable to the Organisation for Economic Co-Operation and Development (OECD), which puts it way ahead of many of its peers in Sub-Sahara Africa (Mlachila and Moeletsi 2019). This significant spending on education has however failed to improve the quality of output in the country. Mlachila and Moeletsi (2019), observed that most of the countries that spend less per learner in Sub-Sahara Africa have better quality on output compared to South Africa. The explanations for the inferior quality are multidimensional and considered complex as they range from history, race, inequality, corruption, socio-economic status, geographical location and in some cases low quality teachers (Sempijja and Letlhogile 2021).

Whilst on the quality of education in South Africa, Murtin (2013), cited infrastructure deficit as one of the main challenges leading to inferior quality of graduates in the country at both high school and University level. The study reiterated that primary and secondary schools are heavily underfunded in South Africa. Some of the things that come as a result of the underfunding are lack of classrooms, textbooks and shortage of teachers. However, this shortage is mainly in poor and rural communities mirroring the high level of inequality that engulfed the country during the apartheid era. So, one can argue that in as much as at macro level, public spending on the education sector is high, the distribution of that funding has failed to correct the high inequality between rural schools, township and those in affluent places. Besharati and Tsotsotso (2015), complimented Murtin's findings on the quality of primary and secondary education. However, he went further to suggest that teachers in government schools lack content and they have low accountability, hence the poor results they produce. They further went on to argue that, teachers have a huge wage bill and the salaries of entry level teachers is the same with those that have massive experience in the sector, killing motivation which then go on to impact the quality of output.

Linking the status of education in South Africa on productivity and growth, Mangale and Magongoa (2020) explained that, inequality and poverty have been hindering students from poor and rural communities from accessing University mainly because they attend dysfunctional schools compared to those in cities and from affording families. The scholars further argued that the dysfunctionality of rural and township schools has a long-term impact on completion rates which most public Universities are grappling with today. The poor quality of education from primary school is likely to impact more than just completion rates but also quality of the graduates as well, which also has an impact on productivity and later economic growth (Besharati and Tsotsotso, 2015, Mangale and Magongoa 2020).

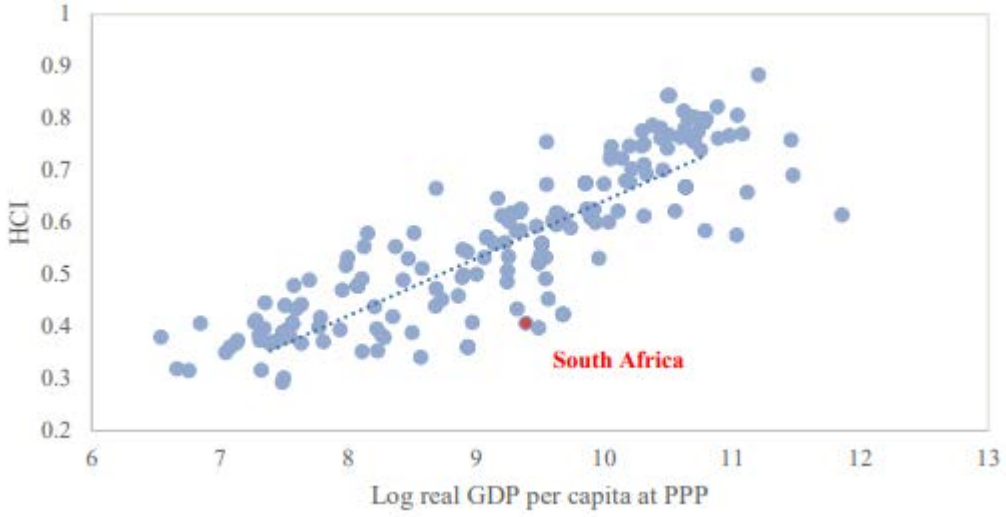
**Figure 2.** *Average Years of Primary Schooling by Population Group in South Africa*




*Source*: Stats SA (2016).

The quality problem on output from the education sector is concerning given the importance of education as a variable that affects skills, productivity and economic growth. Also education increases the quality and quantity of innovation incidences in an economy. A country that has high innovation incidences benefits from new products, new knowledge and new processes that can drive economic growth (Mlachila and Moeletsi 2019). All those possible benefits are threatened if a country's quality of education does not improve overtime. To boost the chances of innovation incidences and also on quality of graduates, a country should have a considerable quantity of learners that graduate with good mathematics and science grades. Looking at the International Association for the Evaluation of Educational Achievement (IAEEA), South Africa ranked second from last on learner performance in mathematics and last in science performance in 2015 (Bisseker 2019). Those rankings combined with low completion rates in Universities should be worrisome for a country struggling with poverty, unemployment, skills shortage and low growth.

**Figure 3.** *Human Capital Index versus GDP per Capita*




*Source:* World Bank (2019).

Figure 3 provides more evidence with regards to the lagging quality of basic education in South Africa. The Human Capital Index (HCI) measures the amount of human capital that a child born this year (2022) can expect to have by the time they are 18 years old. It also indicates the productivity of the generation of workers to come versus a benchmark of complete education and full health. Looking at the HCI rankings closely, South Africa ranks 126$^{th}$ out of a total of 157 countries that had available data. The ranking is not in line with expectations of a country with a respectable per capita income level which further shed light on the foundation of skills shortages the country.

## Analytical Framework

Local Economic Development (LED) is, in the main, intended to maximise the economic potential of all municipal localities throughout the country. This description clearly acknowledges that local economies, to a large extent, operate below their potential level and policy interventions to improve efficiency are imperative as far as local economic development is concerned. As indicated in the introductory section, the objective here is to determine the contribution of education on local economies' ability to close their productivity gap. To achieve this objective, a stochastic frontier analysis (SFA, hereafter) is applied. Pioneered independently by Farrell (1957) and Aigner et al. (1977), the SFA is a parametric method that relies on a production function to measure the gap between observed output and potential output. The study prefers this method over its alternative, the Data Envelopment Analysis (DEA) due to its advantage of separating random noise from technical inefficiency. As a starting step, the analysis is benchmarked with a stochastic frontier model for panel data proposed by Battese and Coelli (1995) and it builds from the following equation.

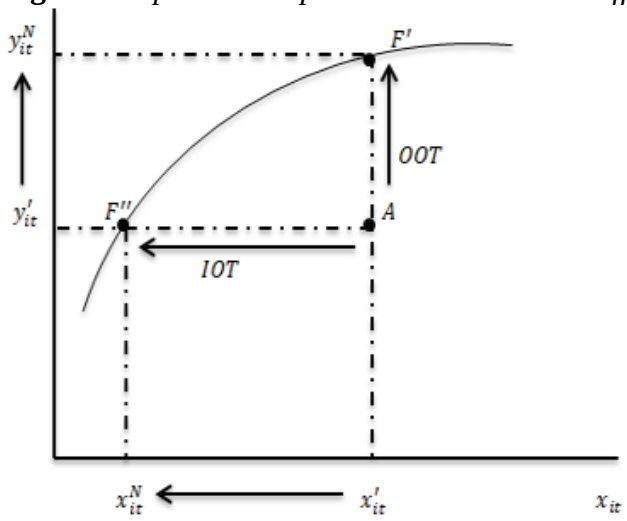
$$Y_{it} = \exp(x_{it}\beta + V_{it} - U_{it}) \ (1)$$
$$i = 1, \dots, N \quad t = 1, \dots, T$$

where $x$ is a vector of factors of production used to produce output $Y$, $\beta$ is a vector of unknown parameters to be estimated, subscripts $i$ and $t$ capture local municipality and time respectively, $V$ is an error term capturing random noise[1] and $U$ is a non-negative component capturing technical inefficiency. Technical inefficiency in this case measures the gap between observed output $Y_{it}$ and potential output $Y_{it}^{*}$.

$$TE = {Y_{it}}/{Y_{it}^{*}} = \frac{\exp(x_{it}\beta + \mathrm{V_{it}} - \mathrm{U_{it}})}{\exp(x_{it}\beta + \mathrm{V_{it}})} = \exp(-\mathrm{U_{it}}) \ (1.1)$$

Graphically from Figure 4, an inefficient municipality sitting at point **A** can reach the production possibility frontier by going upwards to point F' or leftwards to point F''. The upwards direction increases output from y' to $Y^N$ with fixed inputs x'. This is termed outward-oriented technical efficiency (OOT). Going leftwards reduces the amount of inputs used in production from x' to $x^N$ without compromising output level y'. This is termed input-oriented technical efficiency (IOT).

**Figure 4.** *Input and Output Oriented Technical Efficiency*




*Source:* Own illustration.

By definition, LED is essentially about getting more from existing resources and available technology and not cutting back on factors of production such as labour and capital. In other words, it would be self-defeating to celebrate reaching

[1]The random term $V_{it}$is assumed to be $\mathrm{N}(0, \sigma_V^2)$ and independent of the inefficiency term $U_{it}$ which is assumed to follow a truncated normal distribution with mean, $z_{it}\delta$ and variance $\sigma^2$. Vector $z$ here captures the level of education while $\delta$ is the correlate of education on technical efficiency.

economic potential through a process that sends people out of jobs (input-oriented technical efficiency). Based on this reasoning therefore, an output-oriented technical efficiency is assumed in this paper.

Intuitively, the paper assumes that inefficient municipalities fall short of their potential output partly due to the lack of knowhow. This is a reasonable assumption since the lack of knowhow often leads to a suboptimal use of resources. With this assumption, the hypothesis that education reduces technical inefficiency can be tested. An educated workforce is equipped with skills that make it more efficient with fixed resources. Therefore, the idea here is to test whether differences in education can explain the heterogeneity of output-oriented technical efficiency levels across municipalities.

Analytically, the usual starting point involves choosing the input variables and selecting the appropriate stochastic frontier model. Regarding the former, the standard practice uses conventional factors of production namely capital and labour where capital is measured by gross capital investment and labour by number of people employed. Regarding the latter, the common model particularly applied in panel data contexts is the Battese and Coelli (1995) which treats unobserved heterogeneity as part of technical inefficiency. These two conventional choices suffer important limitations. First in relation to the Battese and Coelli (1995) model, it is hard to intuitively explain how education reduces technical inefficiency that is arising from time-invariant factors such as geographical location. If a municipality is failing to produce at its best because of a geographical disadvantage, running a regression with schooling as a source of inefficiency would be unreasonable. uLundi local municipality of KwaZulu-Natal is naturally placed in an economically unproductive district. Mandeni on the other hand is geographically located in a district where manufacturing activities thrive. It is situated near 1) sea ports, 2) one of the country's largest airport – King Shaka international airport – and 3) a good road network. Such locational attributes do not change with time and if they are giving Mandeni the advantage to set the productive frontier, it is hard to explain how education in uLundi will help it close the productivity gap (i.e. reduce inefficiency) and catch up with the frontier set by Mandeni when the two are faced with the same level of technology and fixed capital stock. There are scenarios of course where unobserved heterogeneity is mostly your culture, norms, religious practices and so on which can change with education. However, such a change is not guaranteed in practice and the probability of that happening is miniscule at best. To improve this methodological weakness, the paper applies instead the true-fixed effects stochastic model by Greene (2005) which controls time-invariant factors that are specific to each municipality and generate technical inefficiency scores that are free from unobserved heterogeneity.

Secondly, in relation to the measurement of labour, using aggregate employment figures treats labour as a homogenous factor which is highly problematic. In practice, labour is not homogenous. Workers have different skills and it is important to accommodate such differences as skilled and unskilled workers for example may have different effects on frontier output. Thirdly, measuring education using average years of schooling as did Barro (2001) and

Arendt (2005) is limited in so far as it captures the time spent in school and not the quality of education. To accommodate these improvements, which this paper presents as its key contribution, consider the following production function.

$$Y_{it} = AK_{it}^{\alpha} L_{it}^{1-\alpha} e^{\varepsilon_{it}} \quad (2)$$

in which output $Y$ of municipality $i$ in year $t$ is a function of labour $L$, capital stock $K$, the technology parameter $A$ and an error term $\varepsilon$. Note here that $K_{it}^{\alpha} L_{it}^{1-\alpha}$ are part of vector $x$ in equation (1), $\beta$ would embed here $\alpha$ and $1-\alpha$ while $V_{it} - U_{it}$ would be $\varepsilon_{it}$. Parameters $\alpha$ and $1-\alpha$ represent capital and labour shares on output respectively and since the error term comprises two parts

$$\varepsilon_{it} = V_{it} - U_{it}$$

one can write the stochastic frontier production function as

$$Y_{it} = AK_{it}^{\alpha} L_{it}^{(1-\alpha)} e^{(V_{it} - U_{it})} \quad (3)$$

This production function implausibly assumes homogeneity of labour as indicated shortly above. In practice, workers are heterogenous in terms of skills. To accommodate this heterogeneity, the paper improves equation (3) by decomposing labour into three groups namely low-skilled, semi-skilled and skilled workers. Letting,

$$L_{it} = L_{it}^{\phi_j}, \quad j = 1,..,3$$

where j1, j2 and j3 represent low-skilled workers (LSW), semi-skilled workers (SSW) and skilled-workers (SW), equation (3) can be rewritten as,

$$Y_{it} = AK_{it}^{\alpha} (L_{it}^{\phi_1} L_{it}^{\phi_2} L_{it}^{\phi_3})^{(1-\alpha)} e^{(V_{it} - U_{it})} \quad (4)$$

Algebraically, one can re-specify equation (4) as

$$Y_{it} = AK_{it}^{\alpha} L_{it}^{(1-\alpha)\phi_1} L_{it}^{(1-\alpha)\phi_2} L_{it}^{(1-\alpha)\phi_3} e^{(V_{it} - U_{it})} \quad (5)$$

Parameters $(1-\alpha)\phi_1$, $(1-\alpha)\phi_1$ and $(1-\alpha)\phi_1$ now capture shares of low-skilled, semi-skilled and skilled workers on output respectively. Replacing $L_{it}^{\phi_1}$, $L_{it}^{\phi_2}$ and $L_{it}^{\phi_3}$ with $LSW_{it}^{\phi_1}$, $SSW_{it}^{\phi_2}$ and $SW_{it}^{\phi_3}$ respectively yields

$$Y_{it} = AK_{it}^{\alpha} LSW_{it}^{(1-\alpha)\phi_1} SSW_{it}^{(1-\alpha)\phi_2} SW_{it}^{(1-\alpha)\phi_3} e^{(V_{it} - U_{it})} \quad (6)$$

Equation (6) shows that output is affected by capital stock, low-skilled, semi-skilled and skilled workers, random noise and technical inefficiency. As it is non-

linear in parameters, the linearization of parameters is possible through taking natural logs.

$$\ln Y_{it} = \ln A + \alpha \ln K_{it} + (1-\alpha)\phi_1 \ln LSW_{it} + (1-\alpha)\phi_2 \ln SSW_{it} + (1-\alpha)\phi_3 \ln SW_{it} + V_{it} - U_{it} \quad (7)$$

$$i = 1, \dots, N \quad t = 1, \dots, T$$

The technical inefficiency model will then be specified as,

$$U_{it} = \beta Z_{it} + W_{it} \quad (8)$$

where equation (8) captures improved measures of education. The study essentially advances and empirically tests the hypothesis that different education qualifications (i.e., primary, high school, diploma, bachelors, honours and masters and doctorate) can have different effects on technical inefficiency. This is novel.

## Data Description

The study relies on Quantec[2] municipality data stretching from 1995 to 2018. The panel dataset is balanced $i = 234$ and $t = 24$ yielding a total of 5616 observations $(234 \times 24)$. According to the constitution of South Africa, there are 278 municipalities in the country, comprising 8 metropolitans, 44 district and 226 local municipalities. In this study, focus is on metropolitans and local municipalities since district municipalities are essentially an aggregation of these two. The 8 metropolitans are Buffalo City (East London), City of Cape Town, Ekurhuleni Metropolitan Municipality (East Rand), City of eThekwini (Durban), City of Johannesburg, Mangaung Municipality (Bloemfontein), Nelson Mandela Metropolitan Municipality (Port Elizabeth) and the City of Tshwane (Pretoria). Due to the high number of local municipalities (226), their list is annexed in Table 1.

## Model Specification

Methodologically, there are four empirical issues that deserve attention. First, one needs to make a choice between a one-step and a two-step approach. In the two-step approach, a stochastic frontier model is firstly estimated, and the computed technical efficiency scores are then used as the dependent variable in the second step. This approach is biased as the model estimated in the first stage is misspecified (Wang and Schmidt 2002). Therefore, as a remedial measure, a one-step approach has been proposed in literature and it simultaneously estimates the

[2]Quantec data provider which is a local consultancy firm that gathers macro and micro data for South Africa.

stochastic frontier model along with the inefficiency specification. This is the approach used in this paper.

The second issue relates to the choice of an appropriate functional form. Two functional forms common in literature are the Cobb and Douglas (1928) and the Translog specification by Christensen et al. (1973) and Diewert (1971). These two approaches have their advantages and disadvantages. For example, the Cobb Douglas specification is convenient and easy to interpret but it is criticized for being overly restrictive. The Translog on the other hand is flexible but faces collinearity and curvature problems due to the addition of interactions and second order terms. Notwithstanding these pros and cons, the Cobb Douglas and Translog specification continue to be widely used in efficiency literature and statistical tests are generally conducted to determine the one that best fits the data.

The third issue relates to the distribution of the inefficiency component. Common distributions used in literature include the half-normal, exponential and the truncated normal[3] (see Aigner et al. 1977, Meeusen and van der Broeck, 1977, Jondrow et al. 1982, Greene 1990). Although there are no written rules for choosing one distribution over the other, Bhattacharyya et al. (1995) encourages an understanding of the data generating process. The half-normal and exponential distributions have a mode of zero which implies a high proportion of perfectly efficient decision-making units. In a developing world where market imperfections are the rule rather than the exception, this assumption is less appealing. A more appealing distribution is the truncated-normal which has a non-zero mode. In addition, it is the truncated-normal distribution that allows one to estimate the conditional mean inefficiency specification in a one-step approach. Based on these two considerations, the truncated-normal distribution was assumed in this paper.

The fourth aspect is the endogeneity of labour and capital inputs in the stochastic frontier specification. Theory does treat labour and capital as exogenous to output but in practice, they can be both causes and consequences of output growth since an increase in output can also spur investment and more employment. In order to partially address this potential endogeneity problem, all right-hand side variables are included with a lag.

The first step was to conduct a likelihood ratio test on functional form. This test preferred a stochastic frontier model based on a Cobb Douglas functional form as the additional interactions and polynomial terms were jointly insignificant. The estimated frontier equation therefore took the following form.

$$\ln(\mathrm{Y}_{it}) = \beta_1 \ln(\mathrm{K}_{it-1}) + \beta_2 \ln \mathrm{LSW}_{it-1} + \beta_3 \ln(\mathrm{SSW}_{it-1}) + \beta_4 \ln(\mathrm{SW}_{it-1}) + \sum_{t=1}^{T-1} \beta_t(\mathrm{Year}_t) + V_{it} - U_{it} \quad (9)$$

$$i = 1, \ldots, 234 \quad t = 1995, \ldots, 2018$$

[3]There is also a gamma distribution which is often computationally unfeasible.

where $\beta_0$ or $\ln A$ is eliminated through the within transformation to control for unobserved heterogeneity, $\alpha = \beta_1$, $\beta_2 = (1-\alpha)\phi_1$, $\beta_3 = (1-\alpha)\phi_2$ ,$\beta_4 = (1-\alpha)\phi_3$ and the remaining variables $Y$ , $K$ , $V_{it}$ and $U_{it}$ are as defined before. The new variables $LSW$, $SSW$ and $SW$ are empirically measured by the employment of workers classified at Quantec as low-skilled, semi-skilled and skilled respectively. Unlike the previous section, the technical inefficiency model here contains five different levels of education as explanatory variables.

$$\begin{aligned} \mathbf{U_{it}} = \delta_0 &+ \delta_1 \ln(\mathbf{PhD\_MSc}_{it-1}) + \delta_2 \ln(\mathbf{Hons}_{it-1}) + \delta_3 \ln(\mathbf{Bsc}_{it-1}) \\ &+ \delta_4 \ln(\mathbf{HighScDip}_{it-1}) + \delta_5 \ln(\mathbf{Prim}_{it-1}) \\ &+ W_{it} \qquad (10) \end{aligned}$$

where PhD_Msc is the total number of individuals with masters and doctorates in each municipality over time, Hons captures the total number of individuals with an honours degree, Bsc is the total number of individuals with a Bachelors degree, HighScDip captures the total number of individuals with high school and a diploma while Prim is the total number of individuals with less than high school level. The logic behind equation (10) is that education cannot be assumed to have a linear effect on technical inefficiency. There is no guarantee that a diploma holder is as efficient as a doctoral graduate even though both are educated. In practice, different education levels may have different effects on technical efficiency and exploring these potentially heterogeneous effects is a unique feature of this study. Notwithstanding these potentially heterogeneous effects, the general consensus in literature is that education increases efficiency and reduces wastage in production. Educated workers have better skills and improved decision making. They are productive and able to effectively execute managerial instructions. Therefore, $\delta_1 - \delta_5$ are expected to be negative implying that inefficiency decreases with education.

## Empirical Results

Results from the estimated stochastic frontier model are presented in Table 1a variant (1). They confirm that the positive effect of labour on output only comes from semi-skilled and skilled workers. According to the results in Table 1a, a percentage increase in semi-skilled and skilled workers is associated with a subsequent increase in output within the 0.374 – 0.40 and 0.307 – 0.336 percent range, respectively. Low-skilled workers, which from descriptive statistics account for a third of total employment on average, have a negative effect on frontier output which is highly significant across all the variants. Based on Table 1, a percentage increase in low-skilled workers correlates with a subsequent decrease in output within the 0.278-0.34 percent range. This result is self-explanatory.

Secondly, Table 1 shows that education has a positive effect on efficiency, but the effect is only significant for masters and doctorates. In other words, honours, bachelors, diplomas and primary cohorts do not have any effect on technical inefficiency. There are two possible explanations for this. The first is that

lower levels of education do not significantly enhance an effective utilization of existing technology. In other words, there may be a structural mismatch between the skills and academic content embedded in honours level and the demands of the economy. If students are schooled with content that is economically redundant, having a large stock of such may not significantly help municipalities reach their economic potential.

A second possible explanation could be attributed to unemployment that disproportionately affects those with lower level qualifications (see Altbeker and Storme 2013). It is easier for a postgraduate to get a job that an undergraduate in the labour market hence the significant effect of masters and PhD on technical efficiency may be simply reflecting their improved chances of getting formal employment unlike people with honours degree and below. In other words, the cohorts with honours degree and below may be entering insignificantly because they are marginalised from productive jobs.

For robustness check, the insignificant levels of education were dropped in variant (2) and the total number of individuals with masters and doctorates entered as the only explanatory variable. As variant (2) shows, the association between technical inefficiency and the MscPhD variable remains highly negative demonstrating that the exclusion of other levels of education does not alter the way postgraduates correlate with technical inefficiency. To check whether the association is stable over time, two separate regressions were estimated. Variant (3) is estimated based on the true-fixed effects model but the sample is limited to 1995 – 2008. Variant (4) comprises the 2000 – 2018 sampling period. Clearly, the negative association between postgraduates and technical inefficiency is robust to the exclusion of other levels of education as well as the decomposition of the total sampling period into different sub-periods.

In terms of diagnostic tests, lambda is above 1 across all the four variants. This shows that the technical inefficiency component highly dominates the noise term which is an indication that a stochastic frontier model is appropriate over the average production function with normal errors. In other words, the value of lambda provides justification for examining sources of technical inefficiency among these municipalities. The marginal effects associated with coefficients in variant (4) are reported in Table 1b. They are observation specification hence the paper presents them in purely descriptive sense.

**Table 1a.** *Education and Technical Efficiency*

| | Variant (1) | Variant (2) | Variant (3) | Variant (4) |
|---|---|---|---|---|
| VARIABLES | (1995-2018) | (1995-2018) | (1995-2008) | (2009-2018) |
| | TFE | TFE | TFE | TFE |
| | | | | |
| L.lnCapital | 0.174*** | 0.196*** | 0.112*** | 0.0731*** |
| | (0.0188) | (0.0133) | (0.0186) | (0.0184) |
| L.lnSkilled | 0.307*** | 0.324*** | 0.325*** | 0.336*** |
| | (0.0330) | (0.0314) | (0.0334) | (0.0330) |
| L.lnLowskilled | -0.278*** | -0.263*** | -0.319*** | -0.340*** |
| | (0.0230) | (0.0211) | (0.0230) | (0.0228) |
| L.lnSemiskilled | 0.399*** | 0.374*** | 0.391*** | 0.404*** |

| | | | | |
|---|---|---|---|---|
| | (0.0287) | (0.0255) | (0.0288) | (0.0284) |
| Time dummies | -------- | ------- | ------- | ------- |
| | | | | |
| Mu | | | | |
| L.lnMscPhD | -3.439** | -3.863*** | -3.390** | -3.269** |
| | (1.424) | (1.314) | (1.426) | (1.443) |
| L.lnHons | 1.320 | | 1.334 | 0.491 |
| | (1.971) | | (2.075) | (1.913) |
| L.lnBsc | -3.378 | | -3.197 | -2.830 |
| | (3.272) | | (3.329) | (3.266) |
| L.lnHighScDip | 0.0883 | | -0.0641 | 0.374 |
| | (3.306) | | (3.397) | (3.330) |
| L.lnPrim | -0.768 | | -0.895 | -0.960 |
| | (1.409) | | (1.466) | (1.462) |
| Constant | -18.42** | -15.85** | -17.68** | -18.76** |
| | (8.569) | (8.336) | (8.754) | (8.597) |
| Usigma constant | 1.706*** | 1.811*** | 1.695*** | 1.699*** |
| | (0.0345) | (0.0217) | (0.0346) | (0.0343) |
| Vsigma_constant | -5.378*** | -2.879*** | -5.452*** | -5.476*** |
| | (0.0476) | (0.0336) | (0.0485) | (0.0493) |
| Sigma_u | 2.346*** (0.040) | 1.128*** (0.021) | 2.333*** (0.040) | 2.338*** (0.040) |
| Sigma_v | 0.067*** (0.001) | 0.043*** (0.033) | 0.065*** (0.001) | 0.064*** (0.001) |
| Lambda | 34.542*** (0.040) | 26.232*** (0.033) | 35.637*** (0.040) | 36.151*** (0.040) |
| Observations | 5,382 | 5,382 | 3,042 | 3,042 |
| Number of id | 234 | 234 | 234 | 234 |
| Prob > chi2 | 0.000 | 0.000 | 0.000 | 0.00 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

**Table 1b.** *Marginal Effects*

| **Variable** | **Mean** | **Std Dev** | **Min** | **Max** |
|---|---|---|---|---|
| lnMscPhD | -0.007 | 0.0026 | -0.0735 | -0.0024 |
| lnHons | 0.002 | 0.0010 | 0.0009 | 0.0282 |
| lnBsc | -0.007 | 0.0026 | -0.0722 | -0.0023 |
| lnDip | 0.0001 | 0.0001 | 0.0001 | 0.001 |
| lnPrim | 0.0017 | 0.0005 | -0.0164 | -0.0005 |

From Table 1a, a potential criticism of the results is that the model does not include control variables. It is almost implausible to view education as the only source of inefficiency in these municipalities. In practice, there are many other factors that can significantly influence technical inefficiency and if correlated with education, the association between education and technical inefficiency presented in Table 1b will be biased. In light of this potential criticism, the paper considered additional control variables. Based on literature, the analysis particularly selected variables that are commonly cited in literature as relevant sources of technical inefficiency. These variables include health proxied by life expectancy, trade and

shares of agriculture, manufacturing and services on total output to capture how technical inefficiency correlates with the economic structure.

In the dual economy model by Lewis (1954), productivity is low in agriculture and high in the manufacturing sector. Based on this model therefore, it can be hypothesized that municipalities can reduce inefficiency and reach their economic frontier if they move away from agriculture to manufacturing and other high productivity sectors. Trade is expected to increase technical efficiency through external competition that forces domestic producers to rationalise their operations and give up inefficient production practices that are not consistent with the output maximization objective. Health on the other hand is viewed as an important dimension of human capital. A healthy workforce is productive and records less absenteeism from work which collectively increases the chances of municipalities reaching their maximum output level. I therefore report results based on the following specification.

$$\begin{aligned} \mathrm{U_{it}} = {} & \delta_0 + \delta_1 \ln(\mathrm{PhD\_MSc}_{it-1}) + \delta_2 \ln(\mathrm{Lifeexp}_{it-1}) + \delta_3(\mathrm{Trade}_{it-1}) \\ & + \delta_4(\mathrm{Agric}_{it-1}) + \delta_5(\mathrm{Manuf}_{it-1}) + \delta_6(\mathrm{Servi}_{it-1}) \\ & + W_{it} \qquad (11) \end{aligned}$$

where Trade is measured by the sum of exports and imports as a percentage of total output for each municipality, Lifeexp is life expectancy at birth, Agric, Manuf and Servi are percentage shares of agriculture, manufacturing and the service sector respectively. These controls vary across municipalities and over time. Agric is specifically agriculture, forestry and fishing. Servi covers wholesale and retail trade, catering and accommodation, transport, storage and communication, finance, insurance, real estate and business services, general government and community, social and personal services. Essentially comprises financial intermediary, retail and tourism. Data on these control variables are sourced from Quantec.

Again, the right-hand side variables are lagged to circumvent the potential reverse causality. As customary in literature, the study includes the control variables in a stepwise fashion. Across all the four regression variants, the postgraduate category remains negative, sizeable and statistically significant at 5 percent. The negative causal effect of postgraduates on technical inefficiency therefore exists in data even after controlling for other significant sources of technical inefficiency. In terms of the control variables themselves, life expectancy enters with an expected negative sign across all the regression variants. The negative sand significant sign on life expectancy validates the hypothesis that health increases productive efficiency and reduces inefficiency. Similarly, the negative and significant sign on trade is consistent with the discipline hypothesis which predicts an inverse relationship between trade exposure and technical inefficiency. It is widely accepted in literature that trade exposes local economies to immense competition from the global economy and increased competition eliminates lax in production which consequently raises efficiency levels. This is confirmed in Table 2 in which an increase in trade intensity is associated with a decline in technical inefficiency on impact.

In terms of the economic structure, evidence in Table 2 shows no evidence that agriculture and services correlate significantly with technical inefficiency. It is only the manufacturing sector that enters with a negative effect that is sizeable and statistically significant at 1 percent level across all the four variants. This is indirectly confirmatory to the Lewis (1954) dual economy model in which expansion of manufacturing activities on economic output is an important source of productivity gains and economic catch up. Diagnostic tests still support the use of a stochastic frontier model as opposed to a standard production function with normal errors since the lambda value exceeds one in all cases.

**Table 2.** *Education and Technical Efficiency*

| | Variant (1) | Variant (2) | Variant (3) | Variant (4) |
|---|---|---|---|---|
| VARIABLES | (1995-2018) | (1995-2018) | (1995-2008) | (2009-2018) |
| | TFE | TFE | TFE | TFE |
| L.lnCapital | 0.106*** | 0.150*** | 0.173*** | 0.0801*** |
| | (0.0184) | (0.0189) | (0.0193) | (0.0188) |
| L.lnSkilled | 0.386*** | 0.313*** | 0.305*** | 0.334*** |
| | (0.0303) | (0.0335) | (0.0339) | (0.0337) |
| L.lnLowskilled | -0.426*** | -0.293*** | -0.282*** | -0.339*** |
| | (0.0225) | (0.0234) | (0.0237) | (0.0233) |
| L.lnSemiskilled | 0.508*** | 0.411*** | 0.403*** | 0.404*** |
| | (0.0269) | (0.0291) | (0.0295) | (0.0291) |
| Time dummies | -------- | ------- | ------- | ------- |
| Mu | | | | |
| L.lnMscPhD | -3.321** | -3.486** | -3.451** | -3.554** |
| | (1.416) | (1.448) | (1.461) | (1.471) |
| L.lnLifeexp | -0.759*** | -0.168*** | -0.117*** | -0.327*** |
| | (0.033) | (0.0422) | (0.0430) | (0.0391) |
| L.Trade | -1.066*** | -0.179*** | -0.0941*** | -0.302*** |
| | (0.133) | (0.0395) | (0.0362) | (0.0373) |
| L.Agric | | -0.601 | -0.0304 | -0.069 |
| | | (0.543) | (0.0364) | (0.0553) |
| L.Manuf | | | -1.447*** | -0.164*** |
| | | | (0.312) | (0.0344) |
| L.Servi | | | | -0.566 |
| | | | | (0.893) |
| Constant | -18.93** | -17.97** | -19.12** | -19.53** |
| | (8.272) | (8.706) | (8.890) | (9.110) |
| Usigma constant | 1.757*** | 1.763*** | 1.778*** | 1.766*** |
| | (0.0328) | (0.0341) | (0.0343) | (0.0343) |
| Vsigma_constant | -5.555*** | -5.336*** | -5.307*** | -5.421*** |
| | (0.0611) | (0.0475) | (0.0475) | (0.0491) |
| Sigma_u | 2.407*** (0.039) | 2.414*** (0.041) | 2.432*** (0.041) | 2.418*** (0.041) |
| Sigma_v | 0.062*** (0.001) | 0.069*** (0.001) | 0.0704*** (0.001) | 0.066*** (0.001) |
| Lambda | 38.697*** (0.039) | 34.784*** (0.041) | 34.546*** (0.041) | 36.367*** (0.041) |
| Observations | 5,382 | 5,382 | 5,382 | 5,382 |
| Number of id | 234 | 234 | 234 | 234 |
| Prob > chi2 | 0.000 | 0.000 | 0.000 | 0.00 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The analysis proceeds to ask the question, does the effect of postgraduates depend on some of the significant correlates of technical inefficiency? In practice it makes sense to assume an interactive effect between education, health, trade and the economic structure. For example, it is generally plausible to assume that an educated and healthy workforce is more productive than an educated but unhealthy workforce. The intuition is that an educated but unhealthy workforce may be less productive due to frequent sick leaves unlike an educated and healthy workforce. On the other hand, the interactive effect between education and trade is well documented in literature. Miller and Upadhyay (2000) for example argue that trade openness increases productivity and the effect is more sizeable in countries that have educated labour. The explanation is that an educated workforce is better able to learn, adopt and efficiently utilise technology facilitated by global trade. Interacting education with the economic structure on the other hand helps us determine whether the effect of postgraduates increases or decreases with an expansion of the manufacturing sector. The estimated model capturing these potential interactive effects can be specified as

$$\begin{aligned} \mathrm{U_{it}} = {} & \delta_0 + \delta_1 \ln(\mathrm{PhD\_MSc}_{it-1}) + \delta_2 \ln(\mathrm{Lifeexp}_{it-1}) + \delta_3(\mathrm{Trade}_{it-1}) \\ & + \delta_4(\mathrm{Manuf}_{it-1}) + \delta_5 \ln(\mathrm{PhD\_MSc}_{it-1}) \times \ln(\mathrm{Lifeexp}_{it-1}) \\ & + \delta_6 \ln(\mathrm{PhD\_MSc}_{it-1}) \times (\mathrm{Trade}_{it-1}) + \delta_7 \ln(\mathrm{PhD\_MSc}_{it-1}) \\ & \times (\mathrm{Manuf}_{it-1}) + W_{it} \qquad (12) \end{aligned}$$

For trade from equation (12) the effect of postgraduates will be $\delta_1$ plus $\delta_6$ which depends on the level of trade. For life expectancy, the effect of postgraduates will be $\delta_1$ plus $\delta_5$ which depends on life expectancy. The study included only the manufacturing sector and dropped agriculture and services to avoid unnecessary model overfitting as the latter entered insignificantly in Table 2. The total effect of postgraduates is therefore $\delta_1$ plus $\delta_7$ which depends on the share of manufacturing on total output. From Table 3, the analysis finds postgraduate education reducing inefficiency and the effect increases with life expectancy (although the interactive effect is significant in one out of three cases), the share of manufacturing and trade. The results suggest that postgraduate education is more effective in reducing technical inefficiency in municipalities that 1) have a higher life expectancy, 2) participate more in global trade and 3) that have high shares of manufacturing activities on total output.

The negative interactive effect between manufacturing and postgraduate education might be explained by two things. Firstly, the manufacturing is labour intensive and therefore creates more opportunities for postgraduates. Secondly, it is a high productivity sector which pays relatively high levels of wages. An educated worker earning a relatively high wage is more motivated and more efficient which is crucial for raising overall technical efficiency level. Life expectancy captures health and healthy workers spend more time at workplace rather than hospitals. A combination of good health and high education is therefore expected to improve the efficiency of workers. The interactive effect of postgraduate education and trade on the other hand might be explained by the fact

that trade creates competition and educated workers are better able to adapt to competition by working harder than uneducated workers.

**Table 3.** *Education and Technical Efficiency*

| | Variant (1) | Variant (2) | Variant (3) | Variant (4) |
|---|---|---|---|---|
| | (1995-2018) | (1995-2018) | (1995-2008) | (2009-2018) |
| | TFE | TFE | TFE | TFE |
| L.lnCapital | 0.155*** | 0.135*** | 0.188*** | 0.137*** |
| | (0.0183) | (0.0142) | (0.0133) | (0.0142) |
| L.lnSkilled | 0.262*** | 0.369*** | 0.336*** | 0.414*** |
| | (0.031) | (0.0322) | (0.0314) | (0.0381) |
| L.lnLowskilled | -0.316*** | -0.308*** | -0.277*** | -0.234*** |
| | (0.0211) | (0.0213) | (0.0233) | (0.0213) |
| L.lnSemiskilled | 0.548*** | 0.432*** | 0.426*** | 0.422*** |
| | (0.0231) | (0.0252) | (0.0251) | (0.0241) |
| Time dummies | -------- | ------- | ------- | ------- |
| Mu | | | | |
| L.lnMscPhD | -1.393*** | -2.821** | -1.151** | -1.813** |
| | (0.336) | (0.638) | (0.391) | (0.221) |
| L.lnLifeexp | -0.247*** | -0.144*** | -0.228*** | -0.214*** |
| | (0.041) | (0.041) | (0.0310) | (0.0331) |
| L.Trade | -1.338*** | -0.9713*** | -0.189*** | -0.152*** |
| | (0.026) | (0.022) | (0.0331) | (0.0351) |
| L.Manuf | -0.693*** | -0.781*** | -0.891*** | -0.133*** |
| | (0.221) | (0.167) | (0.171) | (0.0381) |
| L.lnMscPhD#L.lnLifeexp | | -0.134*** | -0.088 | -0.0433 |
| | | (0.0325) | (0.0811) | (0.0391) |
| L.lnMscPhD#L.Trade | | | -0.108*** | -0.0387*** |
| | | | (0.0303) | (0.0131) |
| L.lnMscPhD#L.Manuf | | | | -0.103*** |
| | | | | (0.0277) |
| Constant | -17.63** | -17.33** | -15.32** | -19.53** |
| | (4.232) | (4.746) | (5.330) | (9.110) |
| Usigma constant | 1.667*** | 1.773*** | 1.838*** | 1.766*** |
| | (0.0301) | (0.0321) | (0.0331) | (0.0343) |
| Vsigma_constant | -5.417*** | -5.136*** | -5.366*** | -5.421*** |
| | (0.0363) | (0.0375) | (0.0425) | (0.0491) |
| Sigma_u | 2.408*** (0.033) | 2.335*** (0.031) | 2.431*** (0.040) | 2.418*** (0.041) |
| Sigma_v | 0.061*** (0.001) | 0.068*** (0.001) | 0.0702*** (0.001) | 0.066*** (0.001) |
| Lambda | 38.699*** (0.035) | 34.783*** (0.042) | 34.549*** (0.041) | 36.367*** (0.041) |
| Observations | 5,382 | 5,382 | 5,382 | 5,382 |
| Number of id | 234 | 234 | 234 | 234 |
| Prob > chi2 | 0.000 | 0.000 | 0.000 | 0.00 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Next, the study sought to compute the contribution of postgraduates on technical efficiency during the sampling period. This was achieved by estimating two separate regressions. In the first regression, postgraduates enter as an

explanatory variable in the technical inefficiency specification. Technical efficiency is then calculated as

$$TE_{it} = \exp(-U)$$

The average technical efficiency score is then,

$$\overline{TE} = \frac{\sum TE_{it}}{n}, \qquad n = 1, \ldots, 5616$$

These technical efficiency scores net out the effect of education and therefore they are called net technical efficiency. In the second regression, the stochastic frontier model is estimated without the postgraduate variable in the technical inefficiency specification. Technical efficiency scores are calculated again using the formula above. These technical efficiency scores are called gross technical efficiency as the postgraduate variable is excluded. The difference between these two efficiency scores therefore reflects the percentage contribution of postgraduates on technical efficiency.

$$\text{cont}_J = \frac{\overline{TE}_G - \overline{TE}_N}{\overline{TE}_N} \times 100, \quad J = 1, .., 4$$

where $\text{cont}_J$ is the percentage contribution of variable $j$ on technical efficiency and j includes four variables were found to have a significant effect on technical efficiency i.e. postgraduates, trade, life expectancy and the size of manufacturing sector. Table 4 reports these computations. When all explanatory variables are excluded from the technical inefficiency specification i.e. when the analysis estimates,

$$\text{U}_{\text{it}} = \delta_0 + W_{it} \qquad (13)$$

gross average technical efficiency (TE) is 0.87. This value means that on average, these municipalities are only producing 87 percent of their potential output. Put differently, they are operating 13 percent below their maximum possible output level. Since this is an output-oriented measure of technical efficiency, it means that the municipalities had, during the sampling period, scope to increase output by 13 percent with the same level of inputs and technology. The average observed output during the sampling period was 20.6 billion Rands in constant prices. A 13 percent output shortfall therefore translates to approximately 2,6 billion[4] output which is more than the 2.5 billion Rands allocated to small businesses in the country's 2020/2021 national budget.

[4] x-20 653 000 000/20 653 000 000 = 0,13
x-20 653 000 000 = 0,13*20 653 000 000
x-20 653 000 000 = 2 684 890 000

When the postgraduate variable is included in the specification,

$$U_{it} = \delta_0 + \delta_1 \ln(\text{PhD\_MSc}_{it-1}) + W_{it} \qquad (14)$$

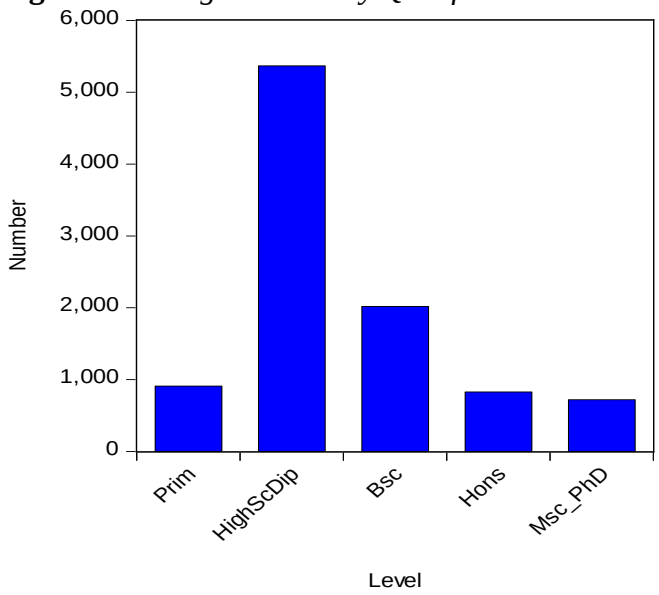
the net average technical efficiency increases to 0.938 indicating a contribution of 7.79 percent. When the exercise is repeated for all the four variables, postgraduate education is found to have the largest contribution on technical efficiency (7.69%) followed by expansion of the manufacturing sector (3.56%). The contribution of trade is miniscule (0.69%) while life expectancy contributes only 1.38%.

**Table 4.** *Contribution on Technical Efficiency*

| Variable | Gross TE | Net TE | Contribution (%) |
|---|---|---|---|
| MscPhD | 0.871 | 0.938 | 7.69 |
| Life expectancy | 0.871 | 0.883 | 1.38 |
| Trade | 0.871 | 0.877 | 0.69 |
| Manufacturing | 0.871 | 0.902 | 3.56 |

Overall, the results observed in this study support the hypothesis that higher education increases technical efficiency and that life expectancy, trade and the manufacturing sector strengthen this relationship. This finding can be equivalently used to suggests that local economies in South Africa could be failing to reach their economic potential due to a disproportionately high stock of undergraduate degrees, diplomas and high school qualifications relative to postgraduate education. Figure 5 substantiates this generalization. Each municipality in the sample has a disproportionately high number of primary, diploma and bachelors which do not significantly contribute towards moving local economies closer to their potential output level. The masters and PhD level which provides a significant productivity lift has the least number.

**Figure 5.** *Average Number by Qualification*



In some municipalities such as Cederberg of North-West, Ikwezi of Eastern Cape and Moretele of North-West, the number of people with masters and doctorate is less than 100. Therefore, there is room for productivity gains if the country's stock of graduates with honours level and below is supported to reach masters and PhD level.

## Discussion of Findings

In this section, the paper discusses and reconciles two key findings with previous literature and South Africa's socio-economic fabric.

*Key Result One - Post Graduation Training Matters More to Development*

One of the important insights stemming from the results is that education levels have different effects on the ability of South Africa's local economies to reach their full potential and what appears to have a relevant and significant effect are postgraduate qualifications. This result to a larger extent agrees with Bloom et al. (2006) who emphasize the need for shifting focus from overly supporting lower level of schooling to equally considering higher level qualifications as a vital source of economic development. Intuitively, there are several reasons why postgraduate training may have a more significant effect on economic development than lower-level qualifications. The first possibility is that high-end qualifications are likely to earn higher salaries than workers with lower-level qualifications. With higher earnings serving as an important source of motivation that is in turn linked to productivity as argued in Casey (2009), one expects Masters, and PhD holders to have a more contribution to the productivity-catch up process relative to lower-level qualified workers. In addition, conventional economic theory teaches that wages reflect marginal productivity. The relatively higher wages paid to postgraduates is therefore likely to reflect their relatively higher productivity levels.

It is also important to note that the progression from one level of education to another in the main comes with improvements in intellectual, abstract, and analytical thinking which is now central in modern days given the increasingly becoming complex working environments. Industries are now faced with complex situations with technological progress and increased competition almost demanding the employment of workers with high-end problem-solving abilities. While one can plausibly have good problem-solving techniques at honours, chances are that a PhD graduate is more likely to be a critical thinker relative to an average bachelor's degree graduate. Postgraduate training also increases one ability to adopt modern technologies which is key to raising output with limited resources. Supportive of this idea, Bloom et al. (2006) supports the idea that expanding post graduate training fosters technological catch-up and improves a country's ability to maximize its economic output. From finding Sub-Saharan Africa's current production level about 23 per cent below its production possibility frontier, they find a one-year increase in post-graduate training raising the region's

long-run per capita income by 12.2%. Results presented in this paper are consistent with this conclusion.

There is also a case that unlike undergraduate qualifications, postgraduate training may generate more tax revenue, increase savings and investment, and lead to a more entrepreneurial and civic society. This is particularly relevant for a country like South Africa with a progress tax system (which taxes higher earners more) and an entrepreneurship-oriented government that has designed various entities meant to support people with innovative and entrepreneurial mindsets. While one might argue that entrepreneurship can equally even without schooling, evidence suggests that businesses established and run by highly qualified personnel are likely to be more sustainable and well-run.

Postgraduate training can also have an indirect effect on an economy's ability to produce at full capacity. This includes the likelihood of Masters, and PhD holders being relatively better teachers than those with undergraduate qualifications. This in turn means teachers with postgraduate qualifications are more likely to produce skilled engineers, efficient bankers, physicians, skilled medical doctors, and other critical professions which ultimately helps a region raise its productivity level.

*Key Result Two – Lower-level Qualifications Do Not Have a Discernible Effect on Productivity Growth*

The insignificant effect of lower-level qualifications can have two interpretations. One is that lower-level qualifications do not have a meaningful contribution on productivity growth when one is controlling for postgraduate training. In other words, this would mean that lower-level qualifications complemented postgraduate training so that the former seizes to have a statistically significant effect once the latter is held constant. While there is some plausibility to this possibility in methodological sense, South Africa's education system and dynamics in the labour market suggest that the insignificance of lower-level qualifications could be telling a story that is more than just an issue of model specification. South Africa primary and secondary education which provide the foundation for tertiary learning have been criticised over the years for being far from international standards. Modisaotsile (2012) described this as a crisis in basic education that is driven by a myriad of factors ranging from poor exam marks, poorly designed curriculum (Mseleku 2022), drug abuse and a lack of adequate infrastructure. In addition to these factors, the 30% pass mark for example and the existence of maths literacy means majority of primary and secondary school students at best end with undergraduate degrees as progression to Masters, and PhD requires high analytical skills especially in quantitative disciplines such as engineering, information and technology, maths, and science. The few that succeed to earn postgraduate qualification are those that would have been exceptional at lower levels, a characteristic which makes it plausible to have a significant productivity effect of postgraduate training in the paper. There is also a possibility that labour market demands are outpacing the level of knowledge provided at undergraduate level heading into the fourth industrial revolution.

It is important to note however that our key findings disagree with the results observed in Baharin et al. (2020). Studying the impact of human capital on productivity of labor in Indonesia in a dynamic model framework, they find primary and secondary qualifications having a significant positive influence on labor productivity while tertiary education variables are found to have a significant negative effect. The difference in findings can be explained by at least three factors. Firstly, their analysis was based on a dynamic specification which makes it difficult to compare with results from a statistic specification. Secondly, their analysis was based on a partial productivity indicator that disregards the presence of inefficiency. Third, the difference in results could simply be explained by the stark heterogeneity in country circumstances.

## Limitations of the Study

While the study yields important findings, it is not without limitations. One area of weakness relates to the handling of endogeneity in the frontier specification. Addressing endogeneity in a production function framework within a stochastic frontier framework remains at infancy. Efforts to exogenize variation in factors of production are undermined by the lack of appropriate and relevant instruments as majority of factors that affect factors of production also tend to have an independent effect on output. To ameliorate this methodological challenge, the study made us of lags hoping that the elasticities attached to lagged terms would crudely serve as causal effects of changes in inputs on output. While this is a reasonable and plausible, the analysis cannot definitively and conclusively argue that lagging guarantees exogeneity as there remains a real possibility that decisions to employ workers and investment in capital for example could be based on expectations of future output. It is important to note that the paper separated the education component from the health component. In practice, it may be argued that the pair are better analysed as an aggregate index of human capital with appropriate weights.

## Concluding Remarks and Policy Implications

This paper has provided evidence that postgraduate education is the only relevant stock of education that significantly pushes local economies towards their economic frontier and the effect is strong in municipalities where the manufacturing sector, trade and life expectancy are high. Other levels of education such as high school, diploma and undergraduate degrees do not significantly contribute to economic productivity. While this conclusion holds a considerable degree of plausibility, it needs to be interpreted with caution as the possibility of endogeneity cannot be ruled out. Assuming that the use of lags in the methodology partly addressed this estimation challenge, these findings, which we find consistent with South Africa's social fabric and education system, have two policy implications. First, local economic development strategies in South Africa may

need to support the accumulation of postgraduate qualifications reinforced by increased participation in global trade, improved life expectancy coupled with a structural transformation that expands the manufacturing sector. Second, the government may continue supporting high school, diplomas and undergraduate degrees but improvements in economic efficiency required by municipalities to reach their economic potential will not be guaranteed. This latter implication therefore calls for interventions that enable students to acquire education at least up to a postgraduate level. With data from the department of higher education, further studies can benefit from checking the specific postgraduate qualifications that matter for these local economies as far as reaching economic potential is concerned.

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## Appendix

**Table 5.** *List of Municipalities in the Analysis*

| | | |
|---|---|---|
| P1D01M01: City of Cape Town (CPT) | P2D02M07: Nkonkobe (EC127) | P3D03M06: Thembelihle (NC076) |
| P1D02M01: Matzikama (WC011) | P2D02M08: Nxuba (EC128) | P3D03M07: Siyathemba (NC077) |
| P1D02M02: Cederberg (WC012) | P2D03M01: Inxuba Yethemba (EC131) | P3D03M08: Siyancuma (NC078) |
| P1D02M03: Bergrivier (WC013) | P2D03M02: Tsolwana (EC132) | P3D04M01: Mier (NC081) |
| P1D02M04: Saldanha Bay (WC014) | P2D03M03: Inkwanca (EC133) | P3D04M02: Kai! Garib (NC082) |
| P1D02M05: Swartland (WC015) | P2D03M04: Lukanji (EC134) | P3D04M03: //Khara Hais (NC083) |
| P1D03M01: Witzenberg (WC022) | P2D03M05: Intsika Yethu (EC135) | P3D04M04: !Kheis (NC084) |
| P1D03M02: Drakenstein (WC023) | P2D03M06: Emalahleni (EC136) | P3D04M05: Tsantsabane (NC085) |
| P1D03M03: Stellenbosch (WC024) | P2D03M07: Engcobo (EC137) | P3D04M06: Kgatelopele (NC086) |
| P1D03M04: Breede Valley (WC025) | P2D03M08: Sakhisizwe (EC138) | P3D05M01: Sol Plaatjie (NC091) |
| P1D03M05: Langeberg (WC026) | P2D04M01: Elundini (EC141) | P3D05M02: Dikgatlong (NC092) |
| P1D04M01: Theewaterskloof (WC031) | P2D04M02: Senqu (EC142) | P3D05M03: Magareng (NC093) |
| P1D04M02: Overstrand (WC032) | P2D04M03: Maletswai (EC143) | P3D05M04: Phokwane (NC094) |
| P1D04M03: Cape Agulhas (WC033) | P2D04M04: Gariep (EC144) | P4D01M01: Letsemeng (FS161) |
| P1D04M04: Swellendam (WC034) | P2D05M03: Ngquza Hill (EC153) | P4D01M02: Kopanong (FS162) |
| P1D05M01: Kannaland (WC041) | P2D05M04: Port St Johns (EC154) | P4D01M03: Mohokare (FS163) |
| P1D05M02: Hessequa (WC042) | P2D05M05: Nyandeni (EC155) | P4D01M04: Naledi (FS164) |
| P1D05M03: Mossel Bay (WC043) | P2D05M06: Mhlontlo (EC156) | P4D03M01: Masilonyana (FS181) |
| P1D05M04: George (WC044) | P2D05M07: King Sabata Dalindyebo (EC157 | P4D03M02: Tokologo (FS182) |
| P1D05M05: Oudtshoorn (WC045) | P2D06M01: Umzimvubu (EC442) | P4D03M03: Tswelopele (FS183) |
| P1D05M06: Bitou (WC047) | P2D06M02: Matatiele (EC441) | P4D03M04: Matjhabeng (FS184) |
| P1D05M07: Knysna (WC048) | P2D06M03: Mbizana (EC443) | P4D03M05: Nala (FS185) |
| P1D06M01: Laingsburg (WC051) | P2D06M04: Ntabankulu (EC444) | P4D04M01: Setsoto (FS191) |
| P1D06M02: Prince Albert (WC052) | P2D07M01: Nelson Mandela Bay (NMA) | P4D04M02: Dihlabeng (FS192) |
| P1D06M03: Beaufort West (WC053) | P2D08M01: Buffalo City (BUF) | P4D04M03: Nketoana (FS193) |
| P2D01M01: Camdeboo (EC101) | P3D01M01: Joe Morolong (NC451) | P4D04M04: Maluti a Phofung (FS194) |
| P2D01M02: Blue Crane Route (EC102) | P3D01M02: Ga-Segonyana (NC452) | P4D04M05: Phumelela (FS195) |
| P2D01M03: Ikwezi (EC103) | P3D01M03: Gamagara (NC453) | P4D04M07: Mantsopa (FS196) |
| P2D01M04: Makana (EC104) | P3D02M01: Richtersveld (NC061) | P4D05M01: Moqhaka (FS201) |
| P2D01M05: Ndlambe (EC105) | P3D02M02: Nama Khoi (NC062) | P4D05M02: Ngwathe (FS203) |
| P2D01M06: Sundays River Valley (EC106) | P3D02M03: Kamiesberg (NC064) | P4D05M03: Metsimaholo (FS204) |
| P2D01M07: Baviaans (EC107) | P3D02M04: Hantam (NC065) | P4D05M04: Mafube (FS205) |
| P2D01M08: Kouga (EC108) | P3D02M05: Karoo Hoogland (NC066) | P4D06M01: Mangaung (MAN) |
| P2D01M09: Kou-Kamma (EC109) | P3D02M06: Khâi-Ma (NC067) | P5D01M01: Vulamehlo (KZN211) |
| P2D02M01: Mbhashe (EC121) | P3D03M01: Ubuntu (NC071) | P5D01M02: Umdoni (KZN212) |
| P2D02M02: Mnquma (EC122) | P3D03M02: Umsobomvu (NC072) | P5D01M03: Umzumbe (KZN213) |
| P2D02M03: Great Kei (EC123) | P3D03M03: Emthanjeni (NC073) | P5D01M04: UMuziwabantu (KZN214) |
| P2D02M04: Amahlathi (EC124) | P3D03M04: Kareeberg (NC074) | P5D01M05: Ezingoleni (KZN215) |
| P2D02M06: Ngqushwa (EC126) | P3D03M05: Renosterberg (NC075) | P5D01M06: Hibiscus Coast (KZN216) |
| P5D02M01:E3:H31 uMshwathi (KZN221) | P5D10M01: Ingwe (KZN431) | P8D01M05: Lekwa (MP305) |
| P5D02M02: uMngeni (KZN222) | P5D10M02: Kwa Sani (KZN432) | P8D01M06: Dipaleseng (MP306) |
| P5D02M03: Mpofana (KZN223) | P5D10M03: Greater Kokstad (KZN433) | P8D01M07: Govan Mbeki (MP307) |
| P5D02M04: Impendle (KZN224) | P5D10M04: Ubuhlebezwe (KZN434) | P8D02M01: Victor Khanye (MP311) |
| P5D02M05: The Msunduzi (KZN225) | P5D10M05: Umzimkhulu (KZN435) | P8D02M02: Emalahleni (MP312) |

| | | |
|---|---|---|
| P5D02M06: Mkhambathini (KZN226) | P5D11M01: eThekwini (ETH) | P8D02M03: Steve Tshwete (MP313) |
| P5D02M07: Richmond (KZN227) | P6D01M01: Moretele (NW371) | P8D02M04: Emakhazeni (MP314) |
| P5D03M01: Emnambithi/Ladysmith (KZN232) | P6D01M02: Madibeng (NW372) | P8D02M05: Thembisile (MP315) |
| P5D03M02: Indaka (KZN233) | P6D01M03: Rustenburg (NW373) | P8D02M06: Dr JS Moroka (MP316) |
| P5D03M03: Umtshezi (KZN234) | P6D01M04: Kgetlengrivier (NW374) | P8D03M01: Thaba Chweu (MP321) |
| P5D03M04: Okhahlamba (KZN235) | P6D01M05: Moses Kotane (NW375) | P8D03M02: Mbombela (MP322) |
| P5D03M05: Imbabazane (KZN236) | P6D02M01: Ratlou (NW381) | P8D03M03: Umjindi (MP323) |
| P5D04M01: Endumeni (KZN241) | P6D02M02: Tswaing (NW382) | P8D03M04: Nkomazi (MP324) |
| P5D04M02: Nqutu (KZN242) | P6D02M03: Mafikeng (NW383) | P8D03M05: Bushbuckridge (MP325) |
| P5D04M03: Msinga (KZN244) | P6D02M04: Ditsobotla (NW384) | P9D01M01: Greater Giyani (LIM331) |
| P5D04M04: Umvoti (KZN245) | P6D02M05: Ramotshere Moiloa (NW385) | P9D01M02: Greater Letaba (LIM332) |
| P5D05M01: Newcastle (KZN252) | P6D03M01: Kagisano/Molopo (NW397) | P9D01M03: Greater Tzaneen (LIM333) |
| P5D05M02: Emadlangeni (KZN253) | P6D03M02: Naledi (NW392) | P9D01M04: Ba-Phalaborwa (LIM334) |
| P5D05M03: Dannhauser (KZN254) | P6D03M03: Mamusa (NW393) | P9D01M05: Maruleng (LIM335) |
| P5D06M01: eDumbe (KZN261) | P6D03M04: Greater Taung (NW394) | P9D02M01: Musina (LIM341) |
| P5D06M02: UPhongolo (KZN262) | P6D03M06: Lekwa-Teemane (NW396) | P9D02M02: Mutale (LIM342) |
| P5D06M03: Abaqulusi (KZN263) | P6D04M01: Ventersdorp (NW401) | P9D02M03: Thulamela (LIM343) |
| P5D06M04: Nongoma (KZN265) | P6D04M02: Tlokwe City Council (NW402) | P9D02M04: Makhado (LIM344) |
| P5D06M05: Ulundi (KZN266) | P6D04M03: City of Matlosana (NW403) | P9D03M01: Blouberg (LIM351) |
| P5D07M01: Umhlabuyalingana (KZN271) | P6D04M04: Maquassi Hills (NW404) | P9D03M02: Aganang (LIM352) |
| P5D07M02: Jozini (KZN272) | P7D01M01: Emfuleni (GT421) | P9D03M03: Molemole (LIM353) |
| P5D07M03: The Big 5 False Bay (KZN273) | P7D01M02: Midvaal (GT422) | P9D03M04: Polokwane (LIM354) |
| P5D07M04: Hlabisa (KZN274) | P7D01M03: Lesedi (GT423) | P9D03M05: Lepele-Nkumpi (LIM355) |
| P5D07M05: Mtubatuba (KZN275) | P7D03M01: Mogale City (GT481) | P9D04M01: Thabazimbi (LIM361) |
| P5D08M01: Mfolozi (KZN281) | P7D03M02: Randfontein (GT482) | P9D04M02: Lephalale (LIM362) |
| P5D08M02: uMhlathuze (KZN282) | P7D03M03: Westonaria (GT483) | P9D04M03: Mookgopong (LIM364) |
| P5D08M03: Ntambanana (KZN283) | P7D03M04: Merafong City (GT484) | P9D04M04: Modimolle (LIM365) |
| P5D08M04: uMlalazi (KZN284) | P7D04M01: Ekurhuleni (EKU) | P9D04M05: Bela-Bela (LIM366) |
| P5D08M05: Mthonjaneni (KZN285) | P7D05M01: City of Johannesburg (JHB) | P9D04M06: Mogalakwena (LIM367) |
| P5D08M06: Nkandla (KZN286) | P7D06M01: City of Tshwane (TSH) | P9D05M01: Makhuduthamaga (LIM473) |
| P5D09M01: Mandeni (KZN291) | P8D01M01: Albert Luthuli (MP301) | P9D05M02: Fetakgomo (LIM474) |
| P5D09M02: KwaDukuza (KZN292) | P8D01M02: Msukaligwa (MP302) | P9D05M03: Ephraim Mogale (LIM471) |
| P5D09M03: Ndwedwe (KZN293) | P8D01M03: Mkhondo (MP303) | P9D05M04: Elias Motsoaledi (LIM472) |
| P5D09M04: Maphumulo (KZN294) | P8D01M04: Pixley Ka Seme (MP304) | P9D05M05: Greater Tubatse (LIM475) |

**Table 6.** *Variable Description and Data Source*

| Variable | Description | Data Source |
|---|---|---|
| Output | Total output deflated using 2010 prices | Quantec |
| Labour | Number of formally and informally employed workers | Quantec |
| Capital | Capital stock computed using the perpetual inventory method | Quantec |
| Agriculture share | Agricultural output as a percentage of total output | Quantec |
| Manufacturing share | Manufacturing output as a percentage of total output | Quantec |
| Mining share | Mining output as a percentage of total output | Quantec |
| Schooling | Average number of years of schooling | Quantec |
| Masters and Doctorates | Number of masters and doctoral graduates | Quantec |
| Honours | Number of honours degree graduates | Quantec |
| Diploma and Matric | Number of individuals with matric and a diploma | Quantec |
| Primary | Individuals with less than matric | Quantec |
| Skilled workers | managerial/ professional, artisans, technicians, welders | Quantec |
| Semi-skilled workers | Machinery operators | Quantec |
| Low-skilled | Labourers, security guards | Quantec |
| Life expectancy | Number of years a newly born child is expected to live under current mortality levels | Quantec |
| Trade | Exports plus imports as a percentage of total output | Quantec |

**Table 7.** *Descriptive Statistics*

| Variable | Description | Mean | Std Dev | Min | Max |
|---|---|---|---|---|---|
| Output | Real output at 2010 prices (million Rands) | 20653.02 | 72795.45 | 137.23 | 847244.5 |
| Capital formation | Real gross fixed capital formation (million Rands) | 1846.841 | 7318.541 | 3.938 | 111648.8 |
| Low-skilled workers | Employment of unskilled workers | 13111 | 33520 | 378 | 338029 |
| Semi-skilled workers | Employment of semi-workers | 21058 | 69236 | 422 | 771722 |
| Skilled workers | Employment of skilled workers | 10685 | 41603 | 136 | 483513 |
| Masters and doctorates | Number of people with Masters and doctorates | 719 | 3797 | 0 | 63027 |
| Honours | Number of people with honours degree | 829 | 4307 | 2 | 80480 |
| Bachelors | Number of people with bachelors | 2020 | 9068 | 13 | 142372 |
| High School | Number of people with a diploma and high school | 5368 | 20190 | 65 | 298469 |
| Primary | Number of people with less than high school | 910 | 3122 | 5 | 44031 |