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MASTER'S DISSERTATION

WAGE DIFFERENTIALS IN THE SERVICE AND INDUSTRY SECTOR IN ANGOLA

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ABSTRACT

The wage differential has been a very important issue in economics area, addressed in particular by labor economists, and has been the subject of many research studies in several countries.

This dissertation investigates empirically the relationship between international trade, foreign direct investment/ FDI, investment and wage differentials of two different sectors in Angola, the service and the industrial sectors. We examine the average monthly wage from July 2003 to December 2012.

The results suggest that in this period the average wages grew at decreasing rates, and that when we analyse the wage of each sector, foreign direct investment and investments have a positive effect on these wages, and imports have a negative effect in Angola. But when we examine the relative wage between the sectors, the results are the opposite, being that foreign direct investment has no effect on the wage differential.

***JEL Classification**: F16, F21, J31*

Keywords: Wage Differentials, International Trade, Investment.

RESUMO

O diferencial de salários tem sido uma questão muito importante na área de economia, com especial ênfase pelos economistas do trabalho, e tem sido objecto de estudo de muitas investigações em vários países.

Esta dissertação investiga empiricamente a relação entre comércio internacional, investimento direto estrangeiro, investimento e o diferencial salarial entre dois sectores diferentes, o sector dos serviços e o sector da indústria mineira, em Angola. Examinamos o salário médio mensal a partir de Julho de 2003 a Dezembro de 2012.

Os resultados sugerem que os salários médios cresceram a taxas decrescentes neste período e quando analisamos o salário de cada sector, o investimento direto estrangeiro e outros investimentos têm um efeito positivo sobre esses salários, bem como a importação tem um efeito negativo em Angola. Porém, quando analisamos o salário relativo entre os sectores, os resultados são o oposto, sendo que o investimento estrangeiro direto não tem qualquer efeito sobre o diferencial de salários

Classificação JEL**:** *F16, F21, J31*

Palavras-chaves: Diferencial Salarial, Comércio internacional, Investimento.

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1. INTRODUTION

The existence of wage differentials between sectors has been a continuous debate among economists (Ramos 1995). Some authors have found that there are substantial differences in wages paid by different sectors, differences that cannot be explained by the individual attributes of workers nor by the feature of employment in each sector (Kruguer and Summers, 1988; Arai *et al*, 1996; Du Caju *et al*, 2009).

Our initial focus is to determine how the wage differential has evolved along the period, from 2003 to 2012, in the services sector in Angola compared with the economy's industrial[1]. Many studies have looked into the inter-sectorial wage differential and yielded several conclusions about this difference (Gittleman and Wolff, 1993; Gannon *et al,* 2007). However, we do not know if these findings apply to economies such as Angola given that these studies covered in particular developed countries. Laurence (2008) confirms that there is a link between trade and wage inequalities, stressing how imports, even from nonindustrial countries, often involve technological advanced goods.

With these considerations as our starting point, this thesis aims to shed light on the relationships between wage differentials and international trade. In this case, we will see the impact of import, foreign direct investment and investment[2] on wage differentials in Angola. The theoretical framework for our analysis is built on the vast literature dealing with the multiple economic, demographic and institutional factors that affect wage differentials in the countries.

In this work, we focus on Angola and use data to estimate a log wage equation in

[1] In this case, we only consider the mining sector (diamond, oil, etc) because it is the most prominent sector that affects productivity and wages in Angola.

[2] We are considering public investment.

each sector. We intend to see whether the variables - FDI, Import and investment, affect the wage differential between the two sectors. Export will not be included in our model, because Angola is not a diversified export economy with oil sector contributing more than 90% of all exports.

The inexistence of literature on this issue in what concerns Angola is the motivation for this research study. Krueger and Summers (1988) used data from the CPS (Current Population Survey) for 1986, and examined the wage differential between skilled workers but also in different sectors. They found that employees who worked in the industry received on average higher wages, compared with the industries that paid lower wages had a fall in wages. Workers who did the opposite saw an increase in their wages to increase and this variation was proportional in inter-sectorial differential cross section. Hence, we can see that there is an inter-sectorial differential even when there are workers with the same qualities. In consequence, this paper aims to set wage differentials between Angola's service and industry sectors. Dickens and Katz (1987) obtained the same result of Kruguer and Summers (1988), while, Murphy and Topel (1987) obtained opposite results. According to Murphy and Topel (1987), switchers industry received between 27% and 36% of the inter-sectorial differential, concluding that nearly two-thirds of the inter-industry wage differential is caused by unobserved worker ability.

Most articles on this subject are merely descriptive of the main characteristics of the sector; and not one undertakes an empirical study. Thus, it is intended to turn our attention to Angola. Angola was ravaged by a civil war for nearly 30 years, from 1975 to 2002. After this period, there followed strong economic growth, the result of an improvement of macro-economic policies and high oil prices in the international

market. This in turn enabled the increase of salaries in various sectors, and it is our intention to study in detail the evolution of the wage differential, testing the wage gap.

This thesis is organized in five sections. Section Two, after Introduction, reviews the literature. The contextual analysis of Angola is made in Section Three, the methodology, data analysis and results is covered in Section Four, followed by the conclusion, in Section Five.

2. LITERATURE REVIEW

This section begins with a brief review of the factors most often considered to explain wage differentials in countries.

2.1 Wage Differentials

There is a wide range of literature examines the wage differentials. The empirical debate on the causes of earnings inequalities was reopened at end of the 1980s, by Krueger and Summers. One of the irregularities pointed out is that often in the salary structure of industries, there is tendency for the latter to pay higher wages, whereas the service sector tend to pay relatively low wages (Krueger and Summers, 1988).

Krueger and Summers (1988), using data from the Current Population Survey (CPS) found that there was little correlation between sectorial wage differential using models without control, control for education, age, gender, race and other variables. With this information, compared with older data from the U.S. economy and also with data from other countries (Canada, France, Germany, Japan, Korea, Mexico, Norway, Poland, Sweden, the Soviet Union and the United Kingdom). Measuring the above mentioned correlation of inter-industry wage structure of the United States with other countries, they concluded that it remained constant over time; being similar in developed countries and different in developing countries. Furthermore, the differences in salary between sub-sectors were partly the result of the difference in the quality of workers with industries that pay higher wages, and which predominantly attracted better workers. Finally, they also noticed that the industry paid on average 20% more than the service sector, to workers of the same type. In Canada the results were similar, with a persistence of the wage gap and its stability over time, with the retail and wholesale sector receiving lower pay, almost 10% below (Gera and Geinder 1994). In this article Gera and Geinder even considered workers separated into two

categories: blue collar workers and white collar workers, and the standard sector wage differential did not change. Dikkens and Katz (1987) using micro-data, and Slichter (1950) using aggregate data reached the same conclusion. Since then, similar results have been obtained for numerous industrialized countries (Du Caju *et al* (2009), Gannon *et al* (2007).

Gibbons and Katz (1992), looking at the USA case, have shown that the magnitude of industry wage differences is almost undiminished when estimating wage equations in the first differences rather than in levels, and results indicate the workers sectorial affiliation. The wage differential varies from industry, thus, there is not one single plausible explanation, nor wage premiums. The mining, manufacturing and construction sectors remains large and statistically significant, even with a model with comparative advantage and learning (Gibbons *et al* 2005). *Prima facie*, wage disparities observed between sectors; support the efficiency wage theory, in that it shows that when the incentive conditions for effort vary between sectors, two workers with identical productive characteristic and working conditions are likely to earn different wages.

According to the effort version of the efficiency wage theory, large companies would find it in their interest to offer relatively higher wages to their employees because they face higher costs to monitor effort, (Du Caju *et al* (2012). However, this theory does not explain why the scale of wage differentials varies between countries and appears to be more compressed in the less developed countries, nor does it explain the motives for companies to pay efficiency wages.

In turn, studies of developing economies such as Brazil, studied by Gottschalk and Alves (2006) using the micro data Annual Survey of Services (PAS) 2002 in Brazil, and by Krueguer and Summers (1988) using an identical methodology,

identified the existence of positive and negative wage awards within the services sector. The positive wage premium was found in news agencies, and the worst in business of repairing shoes. They also saw that there is a positive relationship between average schooling and working time in the service sector.

Fregúglia, Menezes-Filho and Souza (2007) analyzed the wage differential between branches of the processing industry for the state of Minas Gerais, in Brazil. In this study they considered the observable and non-observables worker characteristics and concluded that the wage differential between regions decreases when unobservable characteristics, such as ability and motivation, are considered. Although in some studies of developed countries unobserved ability does not explain this difference, Martin (2004) tested and rejected the hypothesis that industries with high wages in Portugal have disproportionately workers with more skills.

The literature has showed that structures of inter-industry wage differentials are quite consistent and strongly correlated between countries, but that their scale varies considerably between industrialized countries[3].

2.2 Foreign Direct investment and wage differential

Foreign direct investment (FDI) has gained considerable attention as a channel of knowledge diffusion and sometimes as a source of accelerated growth in the economics literature. According to Figini and Görg (2011), while FDI may bring benefits to the economy in where it is locate, it is by no means clear whether everyone will benefit to the same extent or even if some will be better off while others will suffers from this. The authors attempted to investigate if FDI benefits everyone in the same way in terms of wages, or whether it helps to alleviate, or instead, it worsens

[3] Barth and Zweimuller (1992), Kahn (1998), Du Caju *et al* (2010)

wage differentials. The results were that the effect of FDI differs according to the level of development, because developing countries are robust, and they suggest the presence of a nonlinear effect, i.e., wage differentials increase with FDI inward stock, but this effect diminishes with further increases in FDI. As regards developed countries, wage differentials decrease with FDI inward stock, and there is no robust evidence to show that this effect is nonlinear. Following this approach, the studies by Feenstra and Hanson (1997), Figini and Görg (1999) and Taylor and Driffield (2005) used industry level data for Mexico, Ireland and the United Kingdom, respectively, and found that there is a link between FDI and relative wages[4]. But Figini and Görg (1999) and Taylor and Driffield (2005) found that this effect is nonlinear.

For Dunning (1977), in order for foreign firms to compete effectively with locally networked firms, they must possess certain special characteristics in the form of cost advantages, advanced technologies or product superiority that justify their investment in the foreign country. Thus, there is a strong potential FDI to impact wage patterns within the domestic economy.

According to neo-classical economic theory, the addition of new capital and the increases in knowledge brought about by the presence of foreign producers should lead to higher productivity of labor. This, in turn, should lead to higher wages since wages reflect the productivity of labor, Vijaya and Kaltani (2007). Their research presents a cross-country empirical investigation of the impact of FDI on the manufacturing sector and the results indicate that FDI has a negative impact on overall wages in the manufacturing sector. For the authors, the one possible explanation for such an impact is a decrease in the bargaining power of labor due to

[4] Girma and Görg (2007) also find that Foreign-Owned in United Kingdom pay higher wages than comparable domestic firms and that magnitude of the wage premia differ between skilled and unskilled workers, hence impacting on wage differentials

new labor market arrangements in a global economy where capital is free to move across countries in search of more favorable conditions. However, Bloningen and Slaugther (2001) fail to find any significant effects of FDI on wage differentials in the United States between skilled and unskilled workers. Also focusing on the United States, Chintrakarn *et al* (2011) find that FDI exerts a significant and robust negative effect on wage differentials, but with much heterogeneity across states, while Wei *et al* (2009) consider FDI as the cause for rising regional inequality in China. Basu and Guarilia (2007) use the panel data of about 80 countries to test a theoretical model linking FDI to growth and inequality in human capital and conclude that inward FDI promotes economic inequality.

2.3 Wage Differential and International trade.

Over the last several decades, international trade has increased between industrialized countries and between high-wage and low-wage countries. Today, international trade represents 70% in many countries. This had raised questions on how does international trade affect the labor market. Consequently, a vast literature scrutinizes trade mechanisms to better understand changes in both labor demand and wage structure (Slaughter 1999).

There is an ongoing debate on whether international trades in general, and imports from nonindustrial countries in particular, are affecting the within-country wage differentials between skilled and unskilled workers. This is particularly important given the remarkable increase in international trade that has been observed in recent years as a consequence of globalization.

Corsini (2013) states that there is an ongoing debate on whether international trade in general, and imports from nonindustrial countries in particular, is affecting

the within-country wage differentials between workers. For Corsini (2013), this descends from the Stolper–Samuelson theorem: the increasing competition from less-developed countries reduces the price of low-skill-intensive goods and generates a fall in the price of the factor used in their production process, unskilled labor in this case. Hence, as a consequence of the fall in prices, wage differentials should increase. The following sub-section also looks at some papers about import side and export side.

2.3.1 Import Side

Recently, several articles addressed link between international trade and wage differentials (Pavcnick *et al*, 2004; Hoekman and Winters, 2005; Corsini, 2012). Pavcnick *et al* (2004) argue that studies that do not take in account the industry's affiliation may neglect an important channel through which trade affects wages. Du Caju *et al* (2012) summarize three papers outlining the channels through which the trade pays differentials are affected, as follows. First, strong import growth or trade liberalization reforms may involve pro-competitive effects in the product market that may influence industry rents, and therefore the industry wage structure (Kramarz, 2008). Secondly, changes in trade may have an impact on industry or on firm-level productivity, thus changing industry-relative wages (Martins and Opromolla, 2009). Thirdly, growth in the import penetration level may be considered as shock wave to labor demand, that affects the industry wage structure in the presence of imperfect labor mobility across sectors (Dutta, 2007).

Borjas and Ramey (1995) state that in more concentrated industries, foreign competition has a greater impact on rents and therefore on wages. They show, for example, that wages are sensitive to net imports in an open-economy version of Abowd and Lemieux's (1993) rent-sharing model, in which market structures vary across sectors. Because trade induces more competition, it may impact on rents that

workers are extracting and reduce sectorial wage premia; and as a result industries with more foreign competition pay lower wages on average, Du Caju *et al* (2012).

Kramarz (2008) puts forward that imports can affect not only overall profits, but also the result of the wage bargaining between workers and employers. His example is that importers may pay more to their workers in order to neutralize hold-up opportunities when they purchase imported intermediate inputs in advance. Imports of finished goods may also have a negative impact on wages by decreasing the worker's external opportunities and consequently their bargaining position, Du Caju *et al* (2012). Nevertheless, Gaston and Trefler (1994) find that wage differentials are negatively related in a cross section to import penetration and tariffs, and positively related to exports.

Oliveira Martins (1994) suggests that import penetration may undermine differentials in industries with low product differentiation, whereas in industries with high product differentiation import penetration may increase them.

2.3.2 Export Side

As regards the export side, Lundin and Yun (2009) showed that exports increase profits and stimulate expansion. Consequently, this situation brings firms to compete more for the same workforce in the short run, as a result wages increase across the whole industry. To hold up opportunities for employees in the case of export firms having to make export-related to investments. Moreover, in a rent-sharing framework, the fact that the more productive exporters translated into higher wages (De Loecker 2007; Van Biesebroeck, 2005). Schank *et al* (2007) suggests another argument to explain why exporting industries pay higher wages. The authors argue said that high-export sectors offer high wages as the result of relatively favorable foreign demand

shocks. They also put forward that the wages premium in exporting sectors is compatible with the turnover version of efficiency wages theory.

Following this thought, high-exports sectors succeed thanks to their product quality advantage and to the associated highly qualified workforce. Since this type of workforce is relatively rare and that it involves higher turnover costs, it is argued that firms in these sectors pay wages above the market level to secure their competitive advantage in the global market, Du Caju *et al* (2012). They also found- based on the system generalized method of moment's estimator, a positive effect of exports on industry wage differentials in Belgium.

With another perspective, Chen and Hsu (2001) used time series to analyze Taiwan, a semi-developed economy, where the relative wage reveals a declining trend since the mid-1980s. They found that net exports to the OECD countries raise the relative wage of skilled workers, whereas net exports to non-OECD countries and China diminish the relative wage. Moreover, the impacts of net exports to China are much larger than those to OECD and other non-OECD countries.

2.4 Wage Differentials and Investments[5].

There is an increasing interest in the impact that skilled labor demand and returns to skills have had on distributive patterns in recent years. Since the 1990s, theoretical and empirical studies often focused on the United States, have highlighted the importance of research and development investment (Technological progress) determinants of trends in earnings inequality (Levy and Temin, 2007; Pianta, 2003; Levy; Katz and Murphy, 1992).

Acemoglu (1998 and 2005) and many other authors have explained why technological change has distributional implication, while Atkinson (2007) showed that, in a dynamic perspective, skill-biased technological change (SBTC)[6] may cause only a temporary shock on wage differentials, initially widen, but that in the long run, the "fanning out" of these differentials could vanish as the supply of skilled labor catches up with demand. According to the SBTC hypothesis, technological advances raise the relative demand for skilled labor, and thus skilled laborer's wages, in every task. However, this same line of thought in recent studies (Autor *et al*, 2003; Manning, 2004; Spitz-Oener, 2006) also suggests that technological progress actually favors non-routine jobs in both the high-skill sector and the low-skill sector, whereas it is detrimental to routine jobs in the medium-skill sector.

Perugini and Pompei (2009) provide empirical evidence of the link between technological change and overall income inequality in 14 EU countries. The analysis begins by testing the skill-biased technological change (SBTC) hypothesis in sectors with different levels of technology intensity. They found a non-linear relationship

[5] We are focusing in research and development investment, because technological progress is one of the factors of wage differentials

[6] Skill-Biased Technical Change is a shift in the production technology that favors skilled over unskilled labor by increasing its relative productivity and, therefore, its relative demand.

between SBTC and inequality in five of the eight sectors considered, suggesting an inverted U-shaped pattern that can be explained by stages in labor demand and supply adjustments over time. On the other hand, Corsini (2012) found a strong positive effect from research and development investment on wage differentials, and Esquivel and López (2003) found a large negative impact of technological progress on the real wage.

The most recent literature has opted for a new concept: technology based polarization. According to this view, there has been a shift in employment towards both the highest-skilled and lowest-skilled occupations with declining employment in the intermediate-skilled occupations, Hynninen *et al* (2013).

Goldin and Katz (1998) present a theoretical framework for the wage effects of a technological change where the production process is modeled in two stages. In the first stage of production, skilled labor and raw capital are used to produce workable capital. In this stage, skilled labor and raw capital strongly complement each other. In the second stage of production, the workable capital produced in the first stage and the unskilled workers are employed as inputs in a Cobb–Douglas production function for producing the final output. Technological change plays a role in the first stage of the process by increasing the capital intensity of production and the productivity of skilled labor.

Autor *et al*. (2003) unravel the effect of the new technology on different job tasks, which then affects the skills required for labor. They introduce a model where technological change is assumed to treat different job tasks non-monotonically by decreasing the demand for routine job tasks, which are typically located in the middle of the skill distribution. An increase in the demand for un- skilled labor in the manual

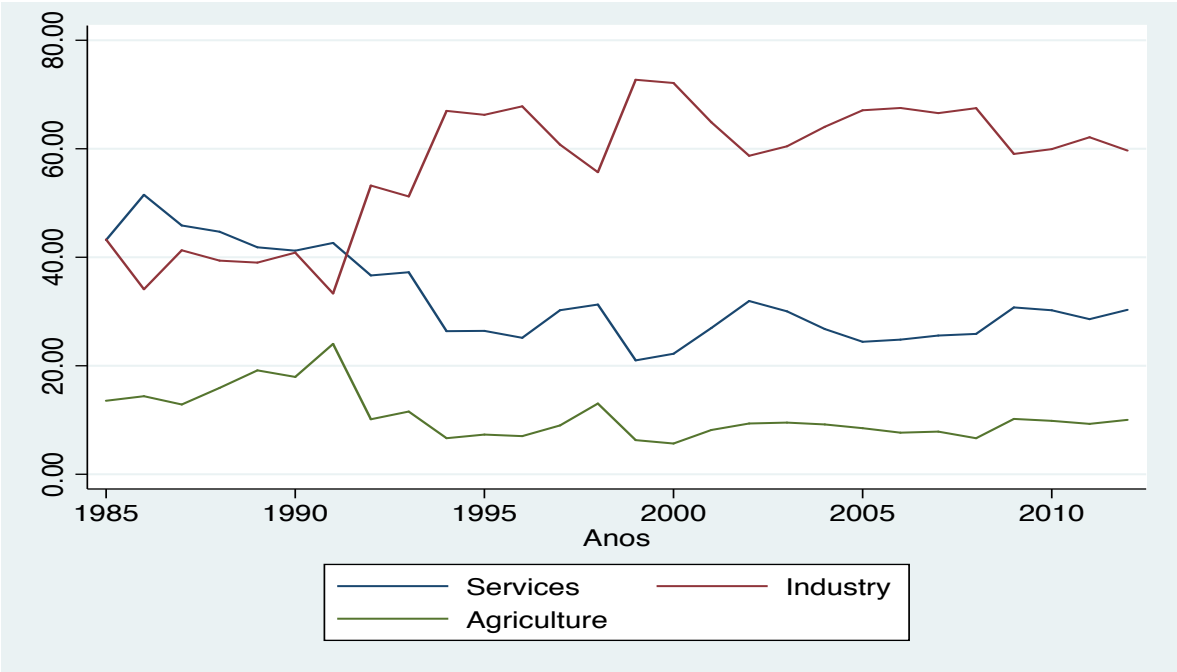
tasks and high-skilled labor in the abstract tasks combined with a decrease in the demand for moderately skilled labor in the routine tasks weakens the relative position of those in the middle of the skill distribution and polarizes the labor market.

3. CONTEXTUAL ANALYSIS

In most developed countries the service sector accounts for a very significant share in GDP and a similar proportion in the number of employees. In the Angolan case, and despite it not being a developed country case, the services sector contributed 30.1% of GDP in 2012. In the same year extractive Industries were a major contribution to GDP (47%), especially when compared to the Manufacturing Industry (6%), which contributed very little, and Services (30.1%), were substantially contributors, even more so when compared with agriculture (11%).

The Services sector in Angola has always contributed to the growth of the economy, been one of the most important sectors. In figure 1 we can see the behavior of the three main sectors in Angola from 1985 to 2012. During the 1980s, services reached 51.51% in contribution to GDP, but in 1992, it was surpassed by industry. 1999 was its darkest, with contribution to the GDP of only 20.99%.

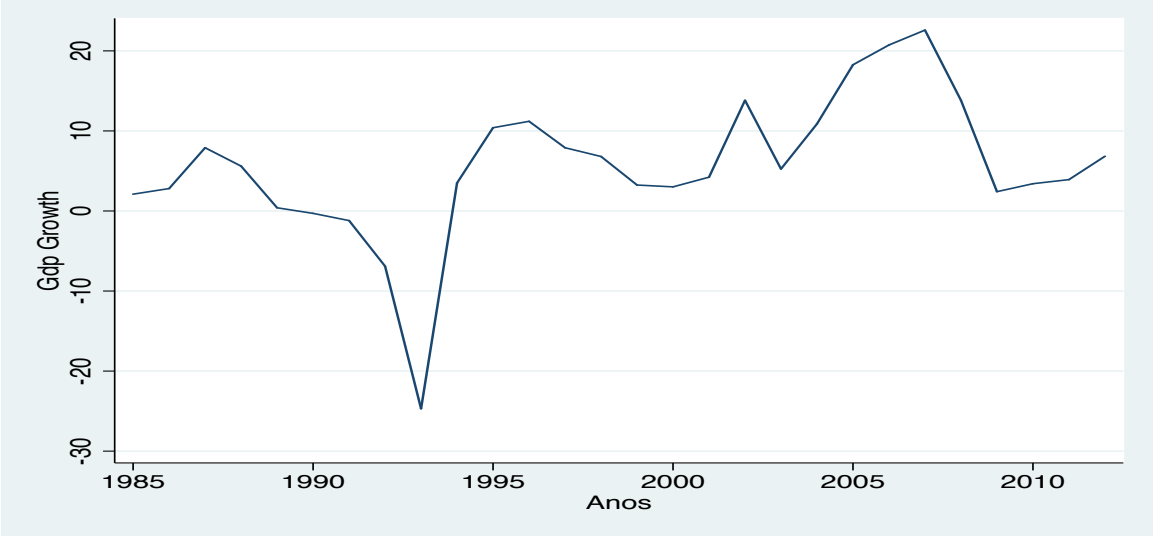
The figure also shows that the Agricultural sector has always been surpassed by the services, and in 1992 the industry sector became the largest contributor to economic growth in Angola, a position that it has kept until the present.



Source: Own elaboration with data of World Bank

Figure 1 - Behavior of sectors (% GDP)

Figure 2 also shows that GDP growth in the same period also has varied, and that having; fell -24.7% in 1993, there follows a period when there is a transition from communist economic system to capitalism.



Source: Own elaboration with data of World Bank

Figure 2 - GDP Growth

It should be noted that the weight of the oil sector in GDP decreased from 2008 to 2011. This behavior of GDP is in line with the government's objective of increasingly diversifying Angolan economy, that is, to increase the weight of non-oil GDP in Global GDP. As regards the rate of growth of the Non-oil sector, and despite a slight slowdown of 0,64 percentage points compared to 2011, this sector has shown a favorable performance in the last four years. The growth of Non-Oil sector in 2012 was driven primarily by Non-oil sectors Mineral, Energy, Agriculture and Services.

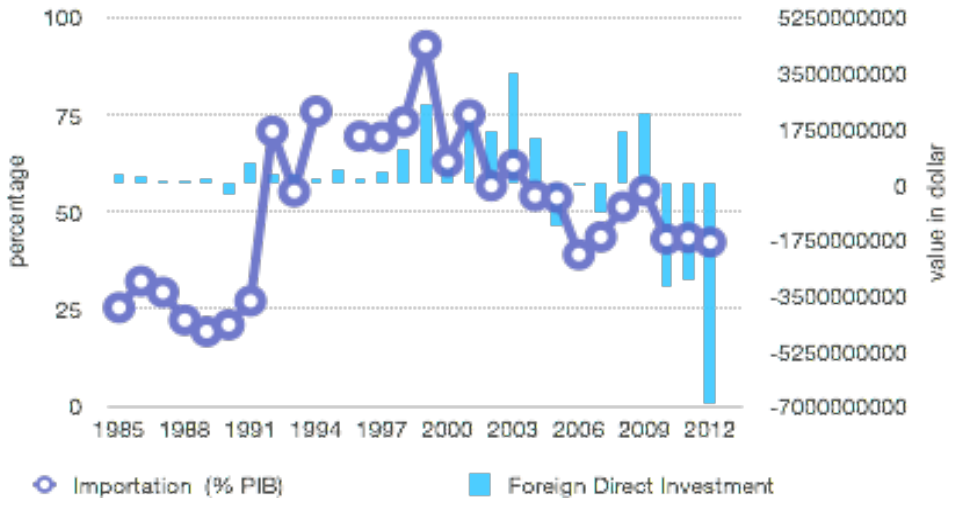
In term of the percentage of GDP structure, the sectors of Agriculture and Merchant Services, which in recent years have increased their share in the composition of Non-Oil GDP, have been the engines of national economic growth rates with 21.68% and 10.50%, respectively. Table I illustrates the evolution of the Angolan GDP for the Oil and Non-Oil sector since 2008.

Table I: Non-Oil GDP and Oil GDP Growth

YEAR	GDP GROWTH	OIL GDP GROWTH	NON-OIL GDP GROWTH
2008	13.82	12.29	15.04
2009	2.39	-5.09	8.31
2010	3.45	-2.87	7.80
2011	3.86	-5.57	9.74
2012	7,.5	4.30	9.10

Source: Banco Nacional de Angola

Import have fluctuated greatly in the past 20 years, with a highlight in 1999 when it reached 92.7 as a percentage of GDP, but in 2006 fell in 38.97 percent of GDP. As to foreign direct investment, and despite is not being very different from import, it has been negative in the last 3 years. The figure below shows the movements of these two variables from 1985 to 2012. The increase in imports of goods and services is associated with a weak domestic production insufficient to meet demand and, secondly, with the need to equip economics with capital goods, aiming at investments in the industry, infrastructure, energy and water sectors, and also in the oil sector.



Source: Own elaboration with data of World Bank

Figure 3 – Importation and foreign direct investment behavior

The wages of both sectors have had the same behavior in last eleven years, and in the early years it was almost the same. Figure IV shows these behaviors; and also shows that the Industry sector has had higher wage since 2005.

Source: Own elaboration with data of MAPTESS

Figure 4: Average wage growth

4. DATA ANALYSIS, METHODOLOGY AND RESULTS

4.1 Data

The data used in this analysis are monthly observations from July 2003 to December 2012 and come from several sources. The variables were chosen based on the review of the literature. The data of wages were provided by the Ministério da Administração Pública Trabalho e Segurança Social (MPTESS) and are related to the public enterprise sector. For the workers with more than ten years of working experience and graduate, the values are in kwanza. Which means that the data confines the analysis of longtime, older workers. Other data such as Net foreign direct investment in millions of USD, which is a stock, imports and investment at constant prices was provided by the Banco Nacional de Angola (BNA). The trend and square trend was inserted on the data to see if wages increase or decrease over time, and if they grow at what rates. The table below provides a descriptive statistics about the variables considered for this study.

Table II: Data Descriptive Statistics

Variable	Description	Mean	Std. Dev	Min	Max
LnWs	Log wage in service sector in constant prices (Dez2010 =100)	18.587	6.750	10.275	38.265
LnWi	Log wage in industry sector in constant prices (Dez2010=100)	18.804	6.683	10.458	38.265
FDI	Foreign Direct Investment (millions USD) in constant prices (Dez 2010=100)	66903.37	212170,5	- 35787.53	1019706
Imp	Volume of import of goods and services (millions USD) in constant prices (Dez 2010 =100)	63764.25	18940.49	37327.05	142478.7
Invest	Volume of investment (millions USD) in constant prices (Dez 2010 =100)	16793.06	5561.81	9353.959	36534.9

Monaco *et al* (2006), in order to test the existence of unit-roots, have used the Augmented Dickey Fuller (ADF). Dickey and Fuller (1979) developed a procedure to testing whether a variable has a unit root or, equivalently, if the variable follows a random walk. The majority of the commonly-used unit-root tests displayed in the literature -such as in Dickey and Fuller, (1979); Phillips and Perron, (1988); the alternative in Kwiatkowski *et al*., (1992), have been developed in autoregressive (AR) models of form:

$$(1-\rho L)\, x_t = u_t, \qquad t=1,2,..., \qquad (1)$$

Where L is the lag-operator (i.e. $Lx_t = x_{t-1}$) and u_t is an I(0)[7] process, defined as a covariance stationary process with spectral density function[8] that is positive and finite at the zero frequency. Therefore, the unit root null corresponds to:

$$H_0 : \rho = 1. \qquad (2)$$

Conspicuous features of these methods for testing unit roots are the non-standard nature of the null asymptotic distributions, which are involved. However, these properties are not automatic, rather depending on what might be called a degree of "smoothness" in the model across the parameters of interest, in the sense that the limit distribution does not change in an abrupt way with small changes in the parameters.

This is associated with the radically variable long run properties of AR processes around the unit root. Under (1), for $|\rho| > 1$, x_t is explosive, for $|\rho| < 1$, x_t is covariance stationary, and for $\rho = 1$ it is non-stationary but non-explosive, Gil-Alana (2004). Robinson (1994) developed a test for unit roots, that unlike these previous procedures, was not embedded in AR structures, and instead based on fractional alternatives of form:

$$(1-L)^d x_t = u_t, \qquad t=1,2,..., \qquad (3)$$

Where d can be any real number, u_t is I(0), and where the unit root null corresponds to the null:

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[7] If a non-stationary series, y_t must be differenced d times before it becomes stationary, then it is said to be integrated of order d. So: An I(0) series is a stationary series and an I(1) series contains one unit root.

[8] A value of a function (or the entire function) whose integral over any frequency interval represents the contribution to the variance from that frequency interval.

$$H_0 : d=1. \quad (4)$$

Fractional and AR departures from (1) and (3) have very different long-run implications. In (3), x_t is non-stationary but non-explosive for all $d \geq 0.5$. As d increases beyond 0.5 and through 1, x_t can be viewed as becoming "more non-stationary" (in the sense, for example, that the variance of partial sums increases in magnitude). Our data in time series is important for the series to be co-integrated, which is a good reason for using the Robinson unit root test.

Table III: Results of Robinson fractional Unit Roots test

Variable	*D*	T-statistic	P>|t|[a]
LnWs	0.792	9.539	0.000
LnWi	0.791	9.533	0.000
LnFdi	0.693	8.347	0.000
LnImp	0.662	7.970	0.000
LnInvest	0.951	11.455	0.000

Notes:
a. All values were significant.

The results show that all the variables are significant and non-stationary. All *d* values are higher than 0.5, indicating a high level of persistence and for that reason we reject null hypotheses. A second step, after the unit root test, is to investigate the existence of a common trend among the variables signifying co-integration. Co-integration analysis provides a framework for estimation, inference and interpretation when the variables are not co-variance stationary. The Johansen multivariate co-integration procedure was employed using the same set of variables defined in table II, and the results indicated that the variables are co-integrated with two trends among

them, promoting their co-integration along the period[9] we reject the null hypothesis that there is not a co-integration and estimate in level.

4.2 Methodology

Our model was inspired by the Chen and Hsu (2001) model- using wage differentials with time series data, they use a linear static model. The model to be estimated was the following, based on the unit root and joint co-integration identified in the series[10]:

$$\ln W_s = \beta_1 + \beta_2 TREND + \beta_3 SQTREND + \beta_4 FDI_t + \beta_5 Imp + \beta_6 Invest + \varepsilon_t \quad (5)$$

And equation for the industry sector is as follow:

$$\ln W_i = \beta_1 + \beta_2 TREND + \beta_3 SQTREND + \beta_4 FDI_t + \beta_5 Imp_t + \beta_6 Invest_t + \varepsilon_t \quad (6)$$

Where W_s is wage in service sector, W_i wage in industry sector, FDI is foreign direct investment, Imp is Importation, invest is investment. We will use the same equation to estimate wage in both sectors - we first intended to see the behavior and then the impact of these variables on the wages of each sector. This done, we then follow the model of Chen and Hsu (2001) to estimate the relative wage – our objective is to specifically study the effect of international trade and investment on wage dispersion between service and industry workers:

$$\ln (W_s / W_i) = \beta_1 + \beta_2 TREND + \beta_3 SQTREND + \beta_4 FDI_t + \beta_5 Imp_t + \beta_6 Invest_t + \varepsilon_t \quad (7)$$

However, time series estimation techniques are used to examine trends in wages between the industries with comparable workers. Typically, wage equations for these workers are estimated based on a structural model of labor supply and demand using

[9] See APPENDIX 1

[10] That is, we used variables that were most used by other authors which theoretically are related with wage differentials.

cross-sectional data. The dependent variable, most often the hourly wage, is assumed to be a function of demographic characteristics (gender, race, ethnicity, region of residence) as well as human capital (age, education, union membership), Monaco *et al* (2006).

If truthful, panel data were available a wage equation could be estimated for the entire sample of service and industry workers. An equation that covered worker characteristics as well as macroeconomic conditions and other dynamic changes. The differences between the two groups of workers could be captured by dummy variables, which would capture the differences between the groups that are not explained by demographics and human capital differences.

However, truthful panel data are not available for the period in question. We therefore used time series techniques which allow the effects of macroeconomic changes to be controlled, but not the human capital and demographic differences between the groups. The selected independent variables were most used by other authors and are theoretically are related with wage differentials[11].

[11] Some papers use almost all the independent while others use only one, but always in the same subject.

4.3 Results and Discussion

In order to analyze the wage differentials we used the classical regression model, using the average wage per month as the as endogenous variable. The table below shows the results obtained:

Table IV: Results

Equation	(5)	(6)	(7)
Dependent variables	lnW_s	lnW_i	ln (W_s/W_i)
Trend	0.0146***	0.0203***	-0.00047***
	(0.0009)	(0.0014)	(0.00006)
Sqtrend	-0.00002***	-0.0001 ***	0.00003***
	(7.42e-06)	(0.00001)	(6.92e-06)
FDI	5.89e-06***	5.91e-06***	-3.10e-09
	(4.24e-07)	(4.21e-07)	(2.14e-09)
Import	-0.0021***	-0.0042 ***	1.62e-07***
	(0.0007)	(0.001)	(2.76e-08)
Invest	0.0103***	0.0197 ***	-5.91e-03***
	(0.0024)	(0.0035)	(0.0023)
Observations	114	114	114
R-squared	0.9758	0.9658	0.8461
Adjust-R^2	0.9745	0.9639	0.8389
Breusch–Godfrey test	59,35	57,38	71,11

Note: Standard deviations are in parentheses. ***, **, And *, respectively, statistical significance at the 1%, 5% and 10% levels

In order to see the autocorrelation instead of the Durbin-Watson test, the Breusch-Godfrey test was used to test the serial correlation beyond the first order, and is valid in the presence of lagged dependent variables. The Durbin–Watson test is a

test statistic used to detect the presence of autocorrelation - a relationship between values separated from each other by a given time lag - in the residuals (prediction errors) from a regression analysis. In general, an AR process only requires that ε_t be independent and identically distributed. However, the Durbin-Watson test requires ε_t normally distributed for the statistic to have an exact distribution. The null hypothesis of the test is that there is no first-order autocorrelation.

The null hypothesis of the Breusch-Godfrey test is that there is no serial correlation up to the specified number of lags. The Breusch-Godfrey test regresses the residuals on the original regressors and lagged residuals up to the specified lag order. The number of observations multiplied by R^2 is the Breusch-Godfrey test statistic. According to the results of statistical value and p-value[12] of the table above was detected autocorrelation, that is, reject the null hypothesis.

These overall results lead us to correct the error using the Newey-West standard error. The Newey–West (1987) variance estimator is an extension that produces consistent estimates when there is autocorrelation in addition to possible heteroskedasticity. The table below shows the results of the estimator Newey-west, standard deviation values assumed smaller than Table V.

[12] See APPENDIX 2

Table V: Newey-west Standard Error Results

Equation	(5)	(6)	(7)
Dependent variables	lnW_s	lnW_i	ln (W_s/W_i)
Trend	0.0146***	0.0203***	-0.00047***
	(0,0327)	(0.0327)	(0.00006)
Sqtrend	-0.00002***	-0.0001 ***	0.00003***
	(0.0002)	(0.0002)	(6.92e-06)
FDI	5.89e-06***	5.91e-06***	-3.10e-09
	(9.76e-07)	(9.77e-07)	(2.14e-09)
Import	-0.0021***	-0.0042	1.62e-07***
	(9.12e-06)	(0.0000)	(2.76e-08)
Invest	0.0103***	0.0197 ***	-5.91e-07***
	(0.000037)	(0.00004)	(0.0023)
Observations	114	114	114

Note: Newey-West Standard deviations are in parentheses. ***, **, And *, respectively, statistical significance at the 1%, 5% and 10% levels.

The results in Table V show that for both sectors the sqtrend is negative, and indicates that average wages grew at decreasing rates in period of 2003-2012. In any case, the effect of foreign direct investment is significantly positive on wages, although the coefficient is extremely small, in other words, when foreign direct investment in Angola increases, both wages in the service sector and the industry sectors improve. Investment has also a positive effect and is significant, which is consistent with economic theory- investment leads to the increase of productivity of the country or sector, which in turn, causes higher wages. These results suggest that

investment is inducing polarization[13] in wages.

We find that the Import has a negative effect on average wages in sectors, which is compatible with Du Caju *et al* (2012), Gaston and Trefler (1994), possibly because in Angola the importers of goods and services pay better salaries than exporters. Nevertheless, the Stolper–Samuelson theorem states increasing competition from less-developed countries reduces the price of goods and generates a fall in the price of the factor used in their production process, unskilled and skilled labor in this case. Then, as a consequence of the fall in prices, wage should increase.

However, in equation 7, when we analyze the wage differential between sectors, the effects are opposite. The sqtrend is positive, which tells us that the wage differentials has increased at an increasing rate between 2003 to 2012, although the coefficient is virtually zero but it is significant. For foreign direct investment, the coefficient is not significant, and is extremely small having, no effect on the wage differential between sectors in Angola.

As Figini and Görg (2011) found, the effect of FDI differs according to the level of development because developing countries are robust, and suggest the presence of a nonlinear effect, whereas in developed countries there is no evidence of a nonlinear effect, which means that it does have effect on wage differentials. Bloningen and Slaugther (2001) also fail to find any significant effects of FDI on wage differentials in the United States.

Nevertheless, for a country such as Angola, there is a strong potential for FDI to impact income patterns within the domestic economy. As already mentioned, the

[13] Economists refer to the polarization of the labor force when middle-class jobs (requiring a moderate level of skills, such as autoworkers' jobs) appear to disappear relative to those at the bottom, requiring few skills, and those at the top, requiring greater skill levels.

addition of new capital and the increases in knowledge generated by the presence of foreign producers should lead to a higher productivity in labor. This in turn should lead to higher wages, taken that wages reflect the productivity in labor. Moreover, with labor mobility, workers move from foreign to domestic firms and carry with them the knowledge acquired and which is now embodied in themselves. Therefore, labor productivity can increase in the entire economy, and consequently, there is a potential for wage increases to spillover to other sectors of the economy. Even if technology is not directly embodied in the workers, the spread of disembodied ideas regarding new organizational and production methods and the higher levels of capital in the economy should increase the productivity of labor, and therefore of wages throughout the economy.

Import is significant and has a positive effect, manifested in its role in determining the wage differentials. These results are compatible with Corsini (2012)[14], because Angola imports most goods and services, and growth in the import may be considered as a shock to labor demand that affects the industry wage structure, and the wage differentials in the presence of imperfect labor mobility between sectors. Some papers argue that the effect of the imports penetration on industry wage premia depends on the country of origin of these imports. Sectors that face higher import competition from low-income countries have lower wage premia. This should occur through the downward pressure of the lower prices of import goods on firm domestic revenue and, consequently, on their profits.

Even though there are no data available for this research as concerns Angola, we expected a negative effect of import on wage differentials once the Angola import

[14] See literature review

from both country (Higher Income and Low Income) but the majority from higher income country. Finally, investment has a negative effect on the wage differential, i.e., when it increases the differential between the sectors tends to decrease, causing a decrease wage inequality.

5. CONCLUSIONS AND FUTURE RESEARCH

This dissertation examined the impact of international trade, foreign direct investment and investment in wage differentials between two sectors, the industry and the service sectors. For the purpose of this study we only consider the mining sector and not the sector of transformation, whereas the latter has had little contribution on the GDP, during the period covered by this review, and therefore did not justify its inclusion in our model.

Many studies have analyzed the inter-sectorial wage differential and several conclusions have been made about this difference. However, it should be reminded that the findings of these studies apply in their majority to cases of developed countries, and therefore one of the challenges that we faced was to understand how such results could be applied to economies such as Angola. This thesis is a contribution to the literature on wage differentials in Angola using time series.

The empirical results suggest that when we consider only wages, the average wages grew at decreasing rates in the period of 2003-2012; that foreign direct investment and investment has a positive effect, but that import has the opposite effect. The conclusion that there is a positive association between wages and the flow of FDI emphasizes the importance of questioning the distributional consequences of FDI. As the emphasis on offering incentives to attract FDI increases in Angola and FDI becomes an increasingly important component of economies, the potential changes to institutional structures within economies can be expected to argument. This analysis shows that FDI has had an impact on the wage setting process in the industry and service sector.

However, when we analysed the impact of the variables on the wage differential,

the effects were different and in the opposite direction. Indeed, foreign direct investment, besides not being significant, has coefficient that is extremely small and which has no effect on the wage differential between sectors in Angola, a result that was not surprising given that it is compatible with some of the current literature findings. A positive public policy aiming at reducing wage inequality and to help workers, will keep this effect. Likewise, our results show that import is significant and has a positive effect in sectors wages differentials. Nevertheless, given the rise in international trade that we are currently observing, we believe that international trade is going to be one of the driving forces behind wage inequalities.

Therefore, investment has a negative effect on wages, taken that when it increases, the differential between the sectors decrease, causing a decrease wage inequality.

The work that we now present faced several difficulties, and undoubtedly the most serious is related to the collection and availability of data about the private sector wages in Angola. Most of the data available concerns the public sector, which undermined our initial objective, limiting the findings presented in this thesis.

In Angola, data that express exactly the level of education, wages, age, gender of each employee, by years, are not available. Consequently, I only considered and used the average wage per month.

Despite this, it is my hope that this work be used as a motivation to carry out new research in labor economics fields. For future research, we suggest a few topics.

Considering the results obtained regarding the effect on wages, further research should aim at understanding the role of some macroeconomics variables on wages setting. Also relevant, future investigations should try to use panel data since it

enables us to verify how the demographic and human capital characteristics of employee can affect wages differentials. The studies should also consider a larger number of sectors, taken that currently in Angola the both sector of our study and other sectors, such as transformation industry, construction, and transport, among others, have grown considerably. Finally, and if possible, future investigation should consider a longer period, thus further contributing to the study of the economy of Angola.

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APPENDIX

1. Co-integration test results

Co-integrations test results for service sector

Johansen tests for co-integration					
Trend: Constant				Number of obs = 114	
Sample: March 2003 – Dec 2012				Lags = 2	
Maximum rank	Parms	LL	eigenvalue	trace statistic	5% critical value
0	7	437.75	.	748.60	124.24
1	20	759.29	0.10	105.52	94.15
2	31	790.11	0.41	43.89*	68.52
3	40	800.10	0.16	23.91	47.21
4	47	808.26	0.13	7.58	29.68
5	52	811.30	0.05	1.50	15.41
6	55	812.05	0.01	0.00	3.76
7	56	812.05	0.00		

***p<0.01, **p<0.05, *p<0.1

Co-integrations test results for Industry Sector

Johansen tests for co-integration					
Trend: Constant				Number of obs = 114	
Sample: March 2003 – Dec 2012				Lags = 2	
Maximum rank	Parms	LL	eigenvalue	trace statistic	5% critical value
0	7	397.10	.	655.50	124.24
1	20	672.71	0.99	106.01	94.15
2	31	703.55	0.42	44.33*	68.52
3	40	714.29	0.17	22.86	47.21
4	47	722.23	0.13	6.96	29.68
5	52	725.00	0.05	1.42	15.41
6	55	725.72	0.01	0.00	3.76

7	56	725.73

2. Breusch-Godfrey test results

Breusch-Godfrey LM test for autocorrelation for first regression

Lags (p)	F	df	Prob > F
1	59.350	(1, 107)	0.0000

Breusch-Godfrey LM test for autocorrelation for second regression

Lags (p)	F	df	Prob > F
1	57.367	(1, 107)	0.0000

Breusch-Godfrey LM test for autocorrelation for third regression

Lags (p)	F	df	Prob > F
1	71.114	(1, 107)	0.0000