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Informal economy and graduate unemployment

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Abstract. The informal economy unfortunately is still without a clear and precise definition indeed, it represents a contradictory reflection of advantages and disadvantages. The phenomenon of informality emerges when the formal sector becomes unable to absorb the new entrants to the labor market. Graduate unemployment also seems to be a global issue today that arises in North African countries and in Tunisia in particular. Our empirical work, which explores the relationship between graduate unemployment and the informal economy in Tunisia, rejects the hypothesis of the existence of a causal effect between these two variables. However, the increase in informality remains dependent on economic institutional variables (the degree of Tunisia's economic freedom), political institutional variables such as political stability and government efficiency, and especially on public investment with the aim of improving the economy.

Keywords. informal economy, graduate unemployment

1- Introduction

The history of the concept of informal economy is linked to the economic theory of development. This sector emerges from the moment when the modern sector becomes unable to absorb new arrivals on the labor market. Through a logic of survival (Charmes, 2006), the workforce that cannot access a job in the official sector finds in this parallel sector more opportunities of income to survive. This sector, therefore develops, in parallel with the evolution of unemployment and underemployment. The notion of informality appeared for the first time with the first work undertaken by the ILO as part of a global employment program in the early 1970s (Charmes 1997). Following a study in Ghana published in 1973 (Pesqueux, 2010), Keith Hart introduced the term "informal" into the economic lexicon for the first time. Defining this concept is no longer an easy task. Thus, there is no perfect and universally accepted definition of "informal sector" (ILO, 2010). This concept has been the subject of several scientific disciplines such as: statistics, law, sociology, anthropology and economics.

To start with, classical theory sees in this sector an illustration of the market economy of pure and perfect competition but segmented and not directly linked to the official market. Moreover, structuralist theory defines the informal sector as "a reserve of labor from which the modern sector would draw the labor force it needs". This theory therefore finds in this sector a place of reproduction of labor force at a lower cost. Lastly, Keynesianism (legalistic approach) considers the informal sector as the consequence of an erroneous assessment of the level of

State intervention. For a long time, economic theories have thought that a combination of economic policies and resources helps developing and poor economies (DCs) to transform themselves into dynamic and modern economies. This process results in a transition from the traditional economy to another more dynamic and more developed economy capable of absorbing the surplus labor.

2-Theoretical consideration:

2-1 Informal economy and employment

The informal economy has now become a source of income for several individuals or families. In fact, It plays a very important role in production. However, informality exposes workers to a higher risk of vulnerability and precariousness. Indeed,It has a significant negative impact on income adequacy, occupational safety and health and working conditions in general. Informality remains a major concern the Decent Work Agenda and the 2030 Agenda for Sustainable Development (the informality rate is one of the indicators selected to measure progress towards the Sustainable Development Goals, as an indicator of SDG 8.3.1). Addressing informality is also essential for women's economic empowerment and gender equality.

In 2023, the 21st International Conference of Labour Statisticians (ICLS) adopted a resolution updating and improving the standards for measuring the informal economy, not only to reflect the latest developments in the world of work and better account for people's situation, but also to align them with recent standards for measuring all forms of work (not just employment) and employment relationships adopted by the 19th and 20th ICLS. Informality is a phenomenon that exists in all countries, regardless of their level of development or income. It is true that its percentage in GDP is too high in countries of low level of development compared to others, the weight of this sector is remarkable in the global economy.

2-2 Informality and unemployment in North African countries

Since its appearance, the informal economy has been the subject of a great debate that has been aroused by researchers and international organizations. A large advance has marked theoretical and empirical research that has attempted to define this notion, measure it and detect its relationship with the official economy. ILO statistics show that informality is too high in developing countries compared to developed countries in 2020. Indeed, Bolivia takes the first place in terms of informality with a percentage of 64.2% of GDP. However, this phenomenon is almost absent in several developed countries namely for example Switzerland and the United States, representing a low rate of 8.5%. The countries of North Africa are also damaged by this phenomenon like the rest of developing countries:

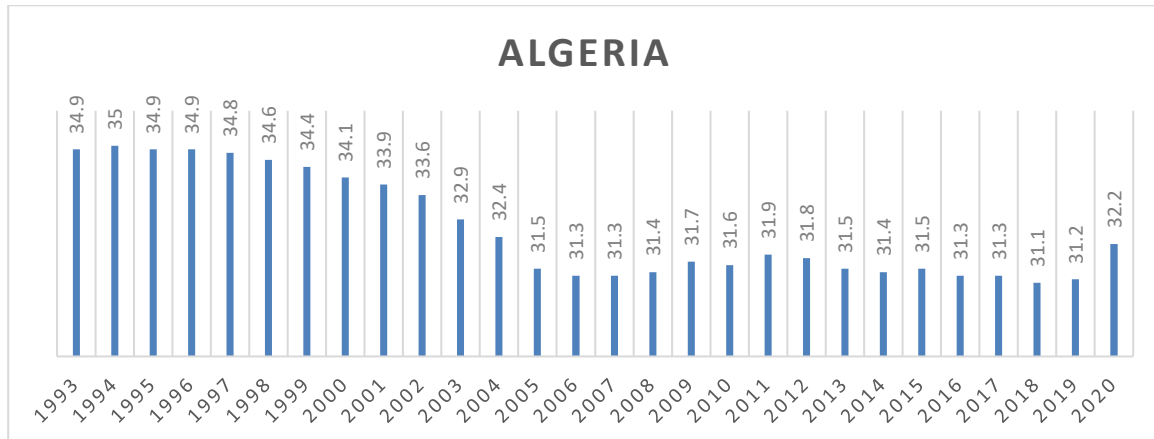


Figure 1:Percentage evolution of the informal economy in Algeria.
Source: World Bank (2024)

Informality in Algeria generally represents a kind of bureaucratic lock of the national economy. A slight decrease recorded over the period 1993-2019. In fact, the percentage went from 34.9% in 1993 to 32.2% in 2020. In Algeria the informal economy has become a real social phenomenon that occupies the daily lives of Algerians. The average over this period is 32.65% it is close to the world average which is equal to 32.7%. Unemployment is not the source of informality. Indeed, the spread of this phenomenon is strongly limited to the mentality of young people who dream of earning a lot of money without working. This is why informal employment in Algeria mainly affects young people, women, and the less educated (Ali Souagel all) 2017.

Algeria has recorded a remarkable decrease in the level of unemployment among graduates:

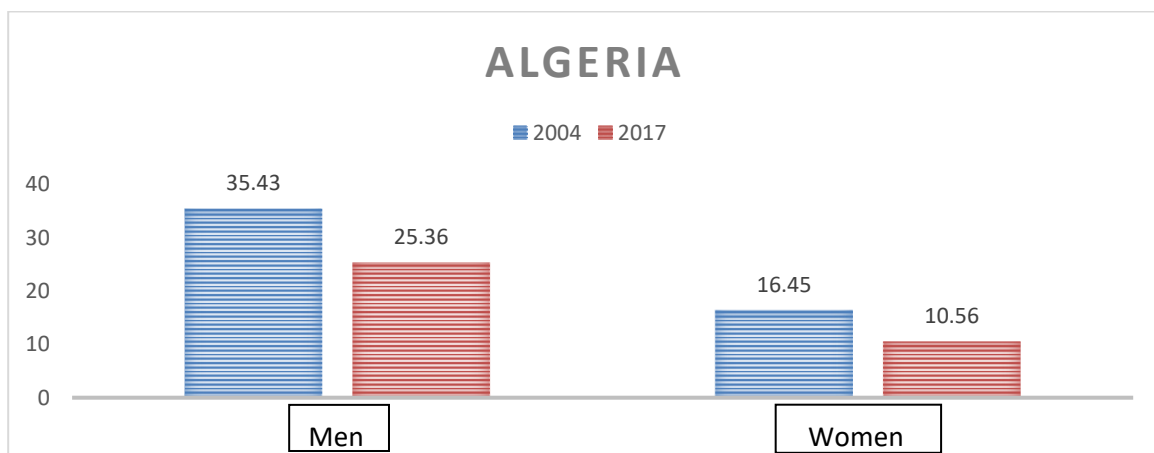


Figure 2:Evolution of the percentage of unemployment among graduates.
Source: World Bank (2024).

The graph above shows a decrease of about 10 percentage points in the higher-level of unemployment rate for men between the two years 2004 and 2017, and of about 6 percentage points in the unemployment rate for women with a university education compared to the total female population.

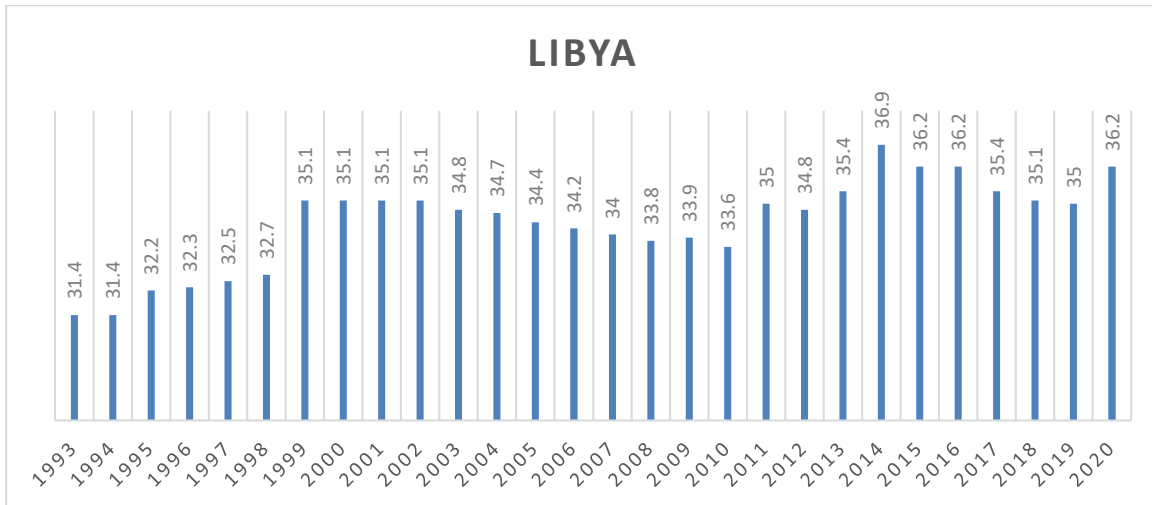


Figure 3:Percentage evolution of the informal economy in Libya.
Source: World Bank (2024).

Unlike Tunisia and Algeria, the informal economy in Libya has fluctuated over the period 1993-2020, but in general it has increased by 5 percentage points. In fact, the rate has gone from 31.4 in 1993 to 36.2 in 2020. Libya suffers from problems that are totally different from other African countries, peace in Libya remains fragile because the problems related to the elections are still unsolved. The labor market in this country is dominated by the public sector and informal employment.

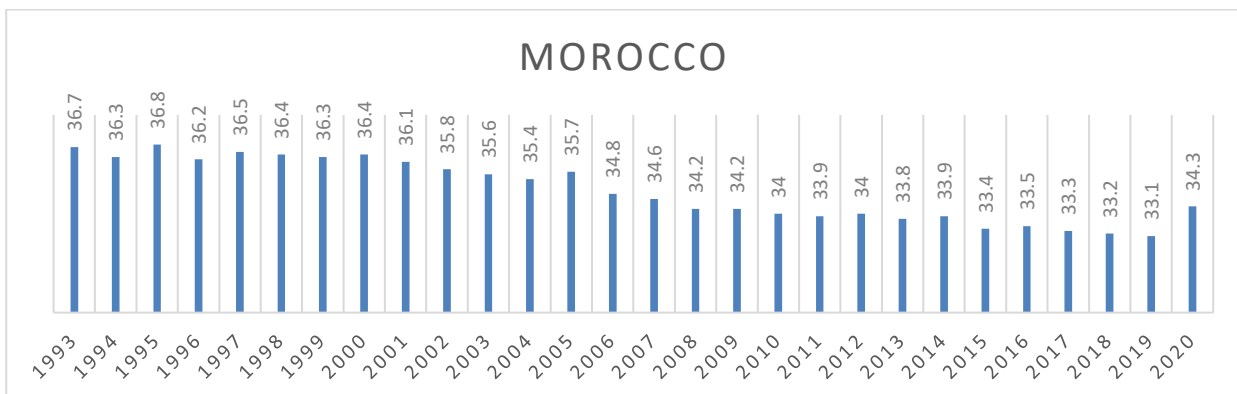


Figure 4:Percentage evolution of the informal economy in Morocco
Source: World Bank (2024).

A continuous decrease in the percentage of informality in Morocco. over the period 1993-2019 the rate goes from 36.7% to 33.1%. however, the average over this period is 34.94% which exceeds the world average by about 2 percentage points. A weak recovery from this increase was recorded in 2020 in fact the rate rises to 34.3%. The informal sector seems a solution to the inability of the modern sector to absorb the flow of labor of rural origin, the refuge of the latter in the informal sector to meet their needs is quite logical and obvious, MEZIOUNI Basma 2021. Unemployment in general represents a primary cause of development of the informal sector in Morocco, a remarkable evolution of the unemployment rate of graduates was recorded over the period 0982-2022:



Figure 5: Evolution of the percentage of unemployment among graduates.
 Source: World Bank (2024)

The graph above shows on the one hand, a sharp increase in the unemployment rate of female graduates in Morocco, the percentage of male graduates who are unemployed increases from 2.38% in 1982 to 19.38% in 2022 and that of women has recorded an increase of 30.1 percentage points, the rate increases from 5% to 35.1% over the same period. On the other hand, there is a large gap between the female and male percentage, with female unemployment almost twice or even more than that of men.

The informal economy is a problem in Egypt and affects daily life as is the case in all other countries in Africa Rehab Sakr (2018), it has increased since the 1990s due to unemployment and the contraction of jobs. And since then, it has been in remarkable fluctuation as the graph above shows us. It is important to mention that Egypt recorded the lowest rate in 2020 compared to other countries in Africa. The rate in 2020 is the lowest over the entire period. The average for the entire period is 34.5%, which is higher than the world average which is 32.7%.

Unemployment in Egypt is a causal factor of informality:

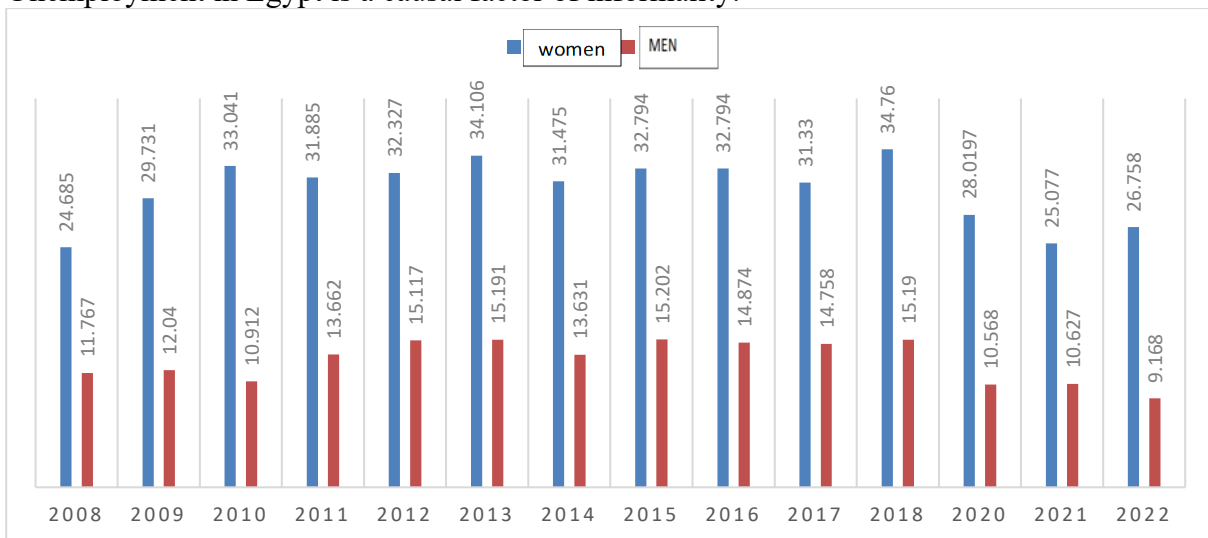


Figure 6: Evolution of the percentage of unemployment among graduates.
 Source: World Bank (2024)

Unemployment among female graduates has seen a remarkable increase over the period 2008-2018 regardless of men or women, whose rates increased from 11,767% to 15.19% and from 24,685% to 34.76% respectively. As in the case of Morocco, the percentage of female graduates who are unemployed is almost twice that of men. A remarkable decrease was recorded in 2020, 2021 and 2022 of approximately 6 percentage points in the male rate and 8 percentage points in the female rate.

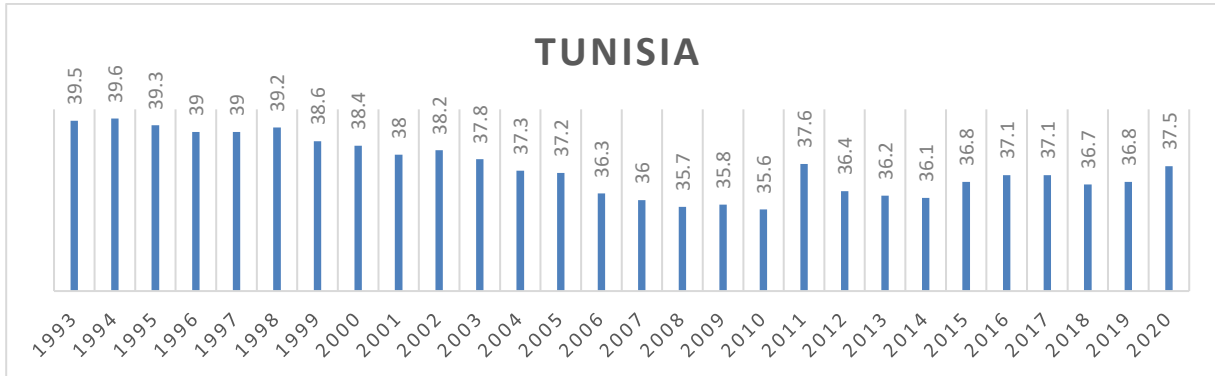


Figure 7:Percentage evolution of the informal economy in Tunisia
Source: World Bank (2024).

Informality in Tunisia has experienced a slight recession over the period 1993-2010. In fact, the percentage went from 39.5% to 35.6% a decrease of almost 4 percentage points, however, in 2011 the rate increased again in a year to reach 37.6% and it remained stable until 2020. The average of informality in Tunisia is 37.45 which is higher than the world average by about 5 percentage points and it also represents the highest average compared to other countries in North Africa.

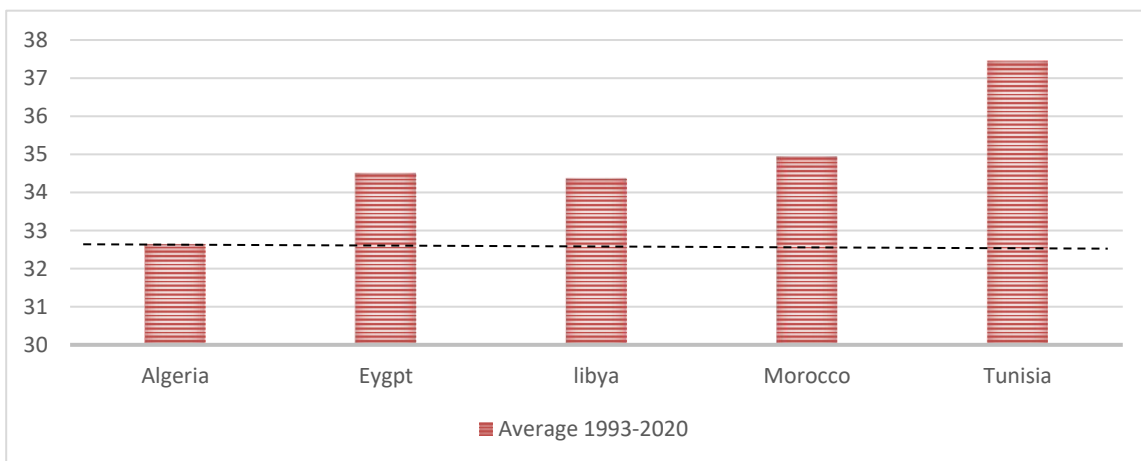


Figure 8:the average of the informal economy in Africa compared to the world average
source: Our calculations

The world average and that of the countries of North Africa is too far compared to the average percentage of the informal economy in Switzerland which represents the country with the lowest percentage of informality on a global scale, a minimum of 8.64%, a difference of 24.06 percentage points and compared to Tunisia a difference of about 28.81 percentage points. Most

studies have shown the strong correlation between unemployment and informality; however, many others find that there is no relationship between these two phenomena and that the increase in the number of unemployed people does not necessarily justify the growth of informality.

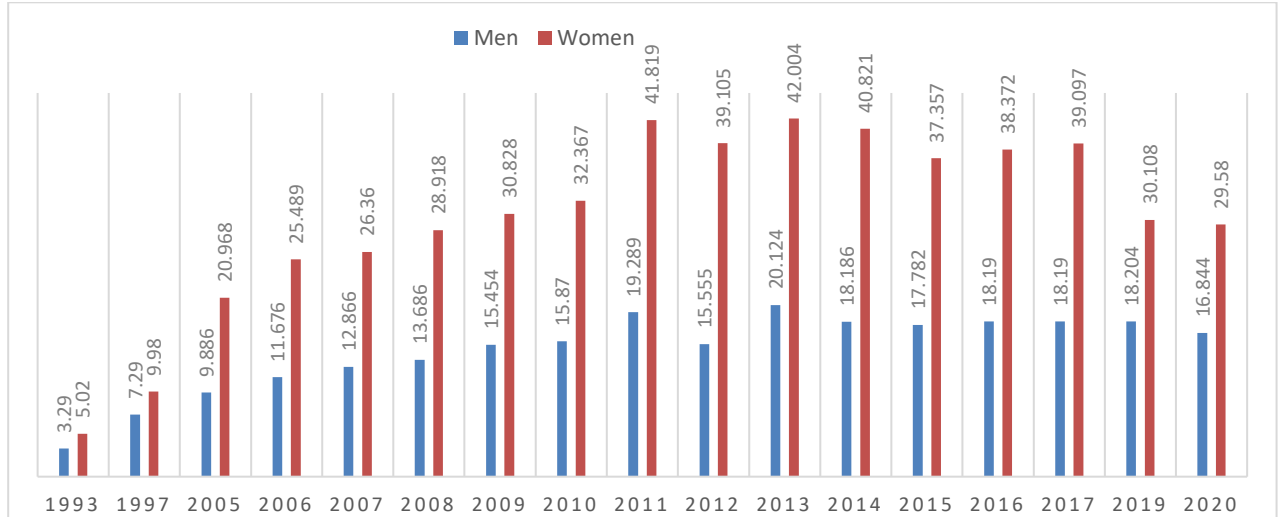


Figure 9: Evolution of the percentage of unemployment among graduates.

Source: World Bank (2024)

The graph above shows the evolution of unemployment of graduates by gender over the period 1993-2020, unemployment rates regardless of men or women are increasing remarkably from the year 2005, the percentage of men goes from 9.886% to 20.124% in 2013 and that of women goes from 20.968% in 2005 to 42.004% in 2013. A slight recession was noted over the period 2015-2020 on the part of women, the rate goes from 37.357% to 29.58% while that of men is almost stable over the entire period. The informal sector represents a source of remuneration for people who are unemployed or without job opportunities.

Table 1: Employment in the informal sector in 2021:

| | % of unemployed people working in the informal sector | Percentage of unemployed |
|--------------|-------------------------------------------------------|--------------------------|
| Men | 11,347 | 18.201 |
| Women | 14,219 | 30.108 |

Source ILOSTAT

In 2021, statistics show that the percentage of unemployed men is 18,201%, of which 11,347% work in the informal sector. The percentage of unemployment among women is 30,108% of the total number of women who have a university degree, 14,219% of whom work in the informal sector.

2- Empirical investigation

Graduate unemployment seems today to be a global issue that arises in all regions of the world, but with even more acuity than elsewhere in North Africa and Tunisia more precisely. Informal

employment remains the leading employer, ahead of public employment and formal private employment in many developing countries, it constitutes a source of remuneration for a well-defined number of unemployed graduates, the ILO for its part in several reports shows the importance of this informal sector in job creation for young graduates.

The existence or not of such a causal relationship between these two phenomena is the objective of our research work.

3-1 Empirical model

- *Analysis sample:*

Tunisia is a North African country with the highest average in terms of informality over the period 1993-2020, this country is the subject of our analysis sample. Our empirical work will help us know the effect of unemployment of graduates by gender on informality; so, the informal economy represents the endogenous variable and unemployment of graduates is the subject of the endogenous variable. The analysis period is 15 years from 2005 to 2020.

- *Analysis variables :*

| Variables | Definitions |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inf-Eco | Informal economy: the size of the informal economy as a percentage of real GDP per capita. |
| Unem-Men | Unemployment in the population with higher education, men (% of the male working population in this category) |
| UNem-Women | Unemployment in the population with higher education, women (% of the female labor force in this category) |
| Corrup | Control of Corruption: According to the definition published by the World Bank, "Control of Corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as state capture by elites and private interests. The estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5." |
| Gov-Effec | Governorate effectiveness: According to the World Bank, this variable "reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to these policies. The estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5." |
| Poli-Stab | Political stability: The definition published by the World Bank "Political stability and absence of violence/terrorism measures the perceived likelihood of political instability and/or politically motivated violence, including terrorism. The estimate gives the country's score on the aggregate |

| | |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5." |
| Reg-Qualit | Regulatory Quality: "Regulatory quality reflects the perception of the government's ability to formulate and implement sound policies and regulations that enable and promote private sector development. The estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5." |
| Rul-Law | Rule of law: "the quality of contract enforcement, property rights, police and courts, and the likelihood of crime and violence. The estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from about -2.5 to 2.5." |
| Free-Eco | The Index of Economic Freedom is an unweighted average of 12 sub-indicators that ranges from 0 to 100. A score of zero indicates a complete absence of economic freedom, while 100 indicates complete freedom. Similarly, levels of freedom are determined based on the score obtained: the closer the score is to 100, the higher the country rises on the freedom scale. Thus, a score that is higher than 80 classifies countries in the category of "Free" economies, a score of 70 to 80 refers to the class of "Mostly Free" countries, a score between 60 and 70 relates to the category of "Moderately Free", a score between 50 and 60 qualifies countries as "Mostly Unfree" and the last category, with a score lower than 50, is that of "Repressed" economies. |
| Inv | Gross fixed capital formation (formerly called gross fixed domestic investment) includes land improvements (fences, ditches, drains, etc.), factories, machinery and equipment purchases, construction of roads, railways, etc. including schools, offices, hospitals, private residential units and commercial and industrial buildings. According to the 1993 System of National Accounts, net acquisitions of high-value assets are also part of capital formation. |

- *Analysis hypothesis:*

H: Unemployment of graduates, whether men or women, increases the level of informality in Tunisia.

- *Equation to be estimated:*

The general form of the equation to be estimated is as follows:

$$Y = X_i \beta_i + e_i$$

Of which $i=1 \dots 9$

Y: Informal economy

t= 2005...2020

- X₁ :Unemployment Men
- X₂ :Unemployment Women
- X₃ : Corruption
- X₄:Governorate effectiveness
- X₅:Political stability
- X₆ :Regulatory Quality
- X₇ :Rule of law
- X₈ :Economic Freedom
- X₉ :Investment

3-2 Estimation

3-2-1 Teste de post-estimation

- Test d'autocorrélation des résidus

. correlate chohom chofem corrup effecgov stabpoli qualitreg regleloi liberteco inv
(obs=16)

| | chohom | chofem | corrup | effecgov | stabpoli | qualit-g | regleloi | libert-o | inv |
|-----------|---------|---------|---------|----------|----------|----------|----------|----------|--------|
| chohom | 1.0000 | | | | | | | | |
| chofem | 0.8627 | 1.0000 | | | | | | | |
| corrup | 0.7142 | 0.7526 | 1.0000 | | | | | | |
| effecgov | -0.8278 | -0.7156 | -0.7176 | 1.0000 | | | | | |
| stabpoli | -0.7970 | -0.7387 | -0.7227 | 0.9184 | 1.0000 | | | | |
| qualitreg | -0.7736 | -0.6931 | -0.6950 | 0.8996 | 0.9592 | 1.0000 | | | |
| regleloi | -0.3986 | -0.5925 | -0.6535 | 0.4068 | 0.3868 | 0.3190 | 1.0000 | | |
| liberteco | -0.2910 | -0.1869 | -0.2175 | 0.5932 | 0.6974 | 0.6958 | -0.0262 | 1.0000 | |
| inv | -0.2408 | -0.0308 | -0.3128 | 0.5176 | 0.5100 | 0.6146 | -0.2767 | 0.5627 | 1.0000 |

Source: output stat

- Stationarity test of residuals:

| Variables | p_value |
|-------------------|---------|
| Inf-Eco | 0.107 |
| Unem-Men | 0.087 |
| Unem-Women | 0.207 |
| Corrp | 0.318 |
| Gov-Effec | 0.782 |
| Poli-Stab | 0.733 |
| Reg-Quali | 0.766 |
| Rul-Law | 0.682 |

| | |
|-----------------|-------|
| Free-Eco | 0.196 |
| Inv | 0.981 |

- Source : output stata

The Dickey-Fuller stationarity test shows that our variables are stationary, P-value greater than 5% we accept the null hypothesis (H0).

- Residualnormalitytest:

| Test | Prob> chi2 |
|-----------------------|------------|
| Doosnik_Hansen | 0.2838 |

Source : output stata

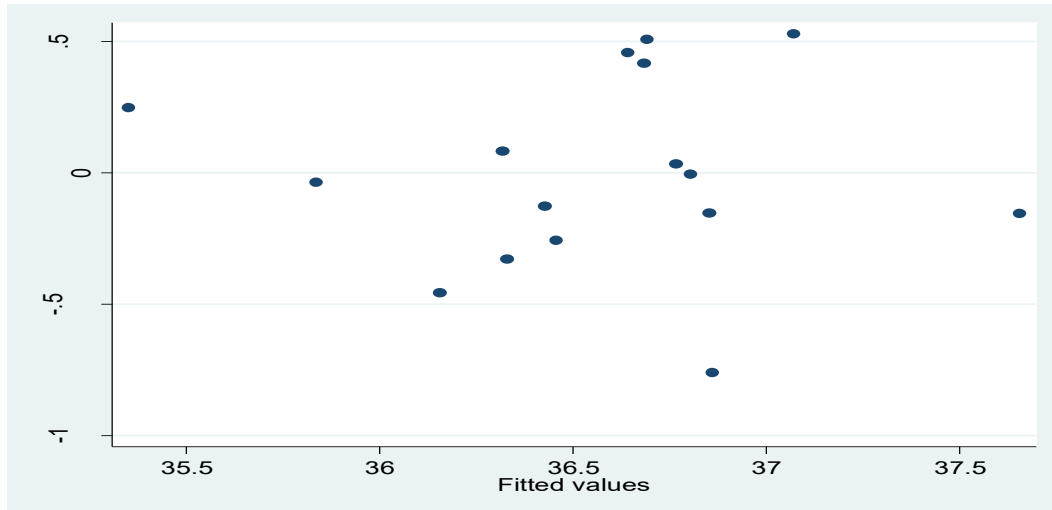
Le teste de Doonik-Hansen montre que les variables suivent un loi normal probabilité supérieur à 5%

- Heteroscedasticity test of errors:

| test | Prob> chi2 |
|----------------------|------------|
| breusch-pagam | 0.5141 |

Source : output stata

P-value greater than 5% of the Breusch-Pagam test, the variances of the residuals of the variables examined are constant, we accept the null hypothesis, H0: constant variance
Le graphique ci-dessus nous confirme le résultat de teste d'homoscédasticité :



Source : output stata

Almost all points are within the interval "-5.5" the variances of the residuals of the variables examined are constant we accept the null hypothesis, H0: constant variance

- 3-2-2 Empirical results

- Overall significance

| | |
|------------------------------|--------------|
| Prob F | 0.000 |
| R² | 0.9993 |
| R²adjusted | 0.9990 |

Source : output stata

We can judge that our model is globally significant, P-value is 0.000 less than 1% we reject the null hypothesis of filing which justifies the non-significance of the model, Moreover, the R2 shows that 99.9% of the variability of our endogenous variable is explained by the exogenous variables.

- Unemployment Men estimations :

| Variables | Coefficients P-value |
|------------------|---------------------------------------|
| UNem_men | 0.152 (0.196) |
| rul_law | -0.811 (0.812) |
| freed_eco | 6.477 (0.000) |
| inv | -0.357 (0.043) |

Source : output stata

Our empirical results show that the unemployment variable of graduates does not have a significant effect on the informal economy, p-value greater than 10% so we accept the null hypothesis of the student test. We can; therefore, conclude that unemployment of men with a higher level of education cannot be considered as one of the causes of the diffusion of informality.

However, the variable of economic freedom has a positive effect on informality, a positive and significant coefficient at the 1% threshold. Tunisia has been ranked among the countries with a predominantly unfree economy since the 2000s to the present day. The Heritage Foundation has published the 29th edition of its annual report on the Economic Freedom Index (EFI in

2023, in which Tunisia ranks 132nd out of 184 countries with a score of 52.9, so, we are talking about an unfree economy which necessarily represents an obstacle to minimizing informality; because, these measures aim to assess the attractiveness of countries, particularly through the easing of constraints on entrepreneurship.

Gross fixed capital formation has a negative effect on the phenomenon of informality negative coefficient is significant at the 5% threshold. Infrastructure is one of the variables that discourages informality and improves regional attractiveness. Minimizing informality remains dependent on expanding state investment and its ability to implement a favorable business climate.

We can also deduce that the rule of law as a political institutional variable is neutral and it does not exert a direct effect on informality. P-value (0.812) non-significant effect, In other words, the degree of respect of people for the rules of society, the quality of contract execution and the probability of crime and violence do not exert a direct effect on informality in Tunisia. This result is in line with that of our previous empirical work Hedhli (2024) where we showed that the Rule of Law variable does not exert either a direct effect on the informal economy or a simultaneous effect on economic growth.

- Unemployment women estimations:

| Variables | Coefficients P-value |
|------------------|---------------------------------------|
| unemp-men | -0.062 (0.253) |
| rul-law | -0.264 (0.945) |
| freed-eco | 6.649 (0.000) |
| inv | -0.393 (0.025) |

Source : output stata

Unemployment of graduates does not really represent a source of informality other than unemployment of men, that of women also does not exert a direct effect on informality coefficient not significant, P-value 0.253 greater than 10% so we accept the null hypothesis of student test of non-significance. We also note the robustness of the positive effect of economic freedom, significance threshold of 1% and the negative effect of investment at the threshold of 5%.

Still the rule of law variable does not exert an effect on informality (non-significant coefficient).

- Corruption

| Variables | Coefficients P-value |
|------------------|---------------------------------|
| corrup | 2.744 (0.492) |
| Free-eco | 6.951 (0.000) |
| inv | -0.365 (0.032) |

Source : output stata

Corruption in turn as a political institutional variable does not represent a generator of informality a non-significant coefficient P-value of 0.492. We can notice both the robustness of the positive effect of the variable of economic freedom and the significance of the coefficient at the threshold of 1%, as well as the negative effect of investment on these kinds of informal practices.

- Political stability

| Variables | Coefficients P-value |
|------------------|---------------------------------|
| POL-stab | -1.818 (0.002) |
| free-eco | 6.328 (0.000) |
| inv | -0.240 (0.042) |

Source : output Stata

The political stability variable exerts a significant effect, probability of 0.002 greater than 1% we reject the null hypothesis of student test of the non-significance of the variable, Political stability in Tunisia exerts a negative effect on informality. Is it measured by the frequency of politically motivated violence, the degree of terrorism etc.

We still confirm the robustness of the two variables of investment and economic freedom, a negative effect of the first variable and positive of the second.

- **Government effectiveness**

| Variables | Coefficients P-value |
|------------------|---------------------------------|
| GOV-effec | -2.944 (0.015) |
| free-eco | 6.545 (0.000) |
| inv | -0.251 (0.072) |

Source : output Stata

Among the political institutional variables our empirical results show the significant effect of government effectiveness on the recession of informality, a negative coefficient and significant at the 5% level. We are still talking about the robust effect of the two variables of economic freedom and investment.

- **Rule of law**

| Variables | Coefficients P-value |
|------------------|---------------------------------|
| Rul-law | -2.967 (0.347) |
| free-eco | 7.145 (0.000) |
| inv | -0.440 (0.012) |

Source : output Stata

The student test shows the robustness of the significance of the variables of economic freedom and investment, the respectively positive and negative effects, and the non-significance of the variable political intention (Rule of law).

Conclusion

We can finally conclude that graduate unemployment does not necessarily cause informality, we reject the analysis hypothesis which states that: "Graduate unemployment regardless of men or women increases the level of informality in Tunisia". This result has already been shown at the level of our old empirical work where we tested the effect of unemployment on the informal economy and the simultaneous effect of these two variables on growth. We confirmed that unemployment in general including that of graduates does not have an effect on informality which neutralized its effect on growth. 'informal economy in Tunisia' Hedhli (2024).

The expansion of the informal sector mainly and first degree comes back to the problem of economic freedom. These measures mainly aim to restart investment and determine the degree of attractiveness of Tunisia, by easing constraints on entrepreneurship. Heritage Foundation shows that the score and rank of Tunisia in remarkable recession over the period 2009-2023. Indeed Tunisia has moved from the groups of countries with a "Moderately free" economy to countries with "Mostly unfree" economies. Among the 12 sub-indicators explaining the difficulties of economic freedom, Tunisia suffers from the problems of judicial efficiency, government integrity, budgetary health (an increase in the deficit and the debt burden whose score is 13.7/100 in 2023) and the opening of the market, precisely, freedom of investment such as bureaucracy and political uncertainty, and financial freedom. Tunisia, in terms of these indicators, is classified in the "Repressed" category. whose scores are below 50. This study serves to provide an overview of the state of economic freedom in Tunisia and to analyze its "liberal" positioning in order to assess the strengths to be consolidated and the weaknesses that it should remedy. which will subsequently generate minimization of informality.

Still within the framework of creating a favorable business climate and improving the attractiveness of Tunisia in order to manage informality, our results show the significant effect of public investment in order to improve infrastructure. In additions the essential role of political stability such as the absence of violence and terrorism and finally the improvement of the quality of government. In other words, the improvement of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of the formulation and implementation of policies and the credibility of the government's commitment to these policies.

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Annexes

Teste d'autocorrélation des résidus

```
. correlate chohom chofem corrup effecgov stabpoli qualitreg regleloi liberteco inv
(obs=16)
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| | chohom | chofem | corrup | effecgov | stabpoli | qualit-g | regleloi | libert-o | inv |
|-----------|---------|---------|---------|----------|----------|----------|----------|----------|--------|
| chohom | 1.0000 | | | | | | | | |
| chofem | 0.8627 | 1.0000 | | | | | | | |
| corrup | 0.7142 | 0.7526 | 1.0000 | | | | | | |
| effecgov | -0.8278 | -0.7156 | -0.7176 | 1.0000 | | | | | |
| stabpoli | -0.7970 | -0.7387 | -0.7227 | 0.9184 | 1.0000 | | | | |
| qualitreg | -0.7736 | -0.6931 | -0.6950 | 0.8996 | 0.9592 | 1.0000 | | | |
| regleloi | -0.3986 | -0.5925 | -0.6535 | 0.4068 | 0.3868 | 0.3190 | 1.0000 | | |
| liberteco | -0.2910 | -0.1869 | -0.2175 | 0.5932 | 0.6974 | 0.6958 | -0.0262 | 1.0000 | |
| inv | -0.2408 | -0.0308 | -0.3128 | 0.5176 | 0.5100 | 0.6146 | -0.2767 | 0.5627 | 1.0000 |

Test de stationnarité des variables

```
. dfuller ecoinf, lags(0)
```

Dickey-Fuller test for unit root Number of obs = 15

| Test | Interpolated Dickey-Fuller | | |
|------|----------------------------|-------------------|--------------------|
| | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| Z(t) | -2.533 | -3.750 | -3.000 |

MacKinnon approximate p-value for Z(t) = 0.1076

```
. dfuller chofem, lags(0)
```

Dickey-Fuller test for unit root Number of obs = 15

| Test | Interpolated Dickey-Fuller | | |
|------|----------------------------|-------------------|--------------------|
| | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| Z(t) | -2.196 | -3.750 | -3.000 |

MacKinnon approximate p-value for Z(t) = 0.2077

```
. dfuller corr, lags(0)
```

Dickey-Fuller test for unit root Number of obs = 15

| Test | Interpolated Dickey-Fuller | | |
|------|----------------------------|-------------------|--------------------|
| | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| Z(t) | -1.930 | -3.750 | -3.000 |

MacKinnon approximate p-value for Z(t) = 0.3183

. dfuller stab, lags(0)

Dickey-Fuller test for unit root Number of obs = 15

| Test Statistic | Interpolated Dickey-Fuller | | | |
|-------------------|----------------------------|----------------------|-----------------------|--------|
| | 1% Critical Value | 5% Critical Value | 10% Critical Value | |
| Z(t) | -1.054 | -3.750 | -3.000 | -2.630 |

MacKinnon approximate p-value for Z(t) = 0.7332

. dfuller qual, lags(0)

Dickey-Fuller test for unit root Number of obs = 15

| Test Statistic | Interpolated Dickey-Fuller | | | |
|-------------------|----------------------------|----------------------|-----------------------|--------|
| | 1% Critical Value | 5% Critical Value | 10% Critical Value | |
| Z(t) | -0.962 | -3.750 | -3.000 | -2.630 |

MacKinnon approximate p-value for Z(t) = 0.7668

. dfuller regl, lags(0)

Dickey-Fuller test for unit root Number of obs = 15

| Test Statistic | Interpolated Dickey-Fuller | | | |
|-------------------|----------------------------|----------------------|-----------------------|--------|
| | 1% Critical Value | 5% Critical Value | 10% Critical Value | |
| Z(t) | -1.179 | -3.750 | -3.000 | -2.630 |

MacKinnon approximate p-value for Z(t) = 0.6825

. dfuller eff, lags(0)

Dickey-Fuller test for unit root Number of obs = 15

| Test Statistic | Interpolated Dickey-Fuller | | | |
|-------------------|----------------------------|----------------------|-----------------------|--------|
| | 1% Critical Value | 5% Critical Value | 10% Critical Value | |
| Z(t) | -0.915 | -3.750 | -3.000 | -2.630 |

MacKinnon approximate p-value for Z(t) = 0.7829

```
. dfuller libert, lags(0)
```

```
Dickey-Fuller test for unit root          Number of obs =      15
```

| Test Statistic | Interpolated Dickey-Fuller | | |
|-------------------|----------------------------|----------------------|-----------------------|
| | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| Z(t) | -2.227 | -3.750 | -3.000 |

MacKinnon approximate p-value for Z(t) = 0.1964

```
. dfuller inv, lags(0)
```

```
Dickey-Fuller test for unit root          Number of obs =      15
```

| Test Statistic | Interpolated Dickey-Fuller | | |
|-------------------|----------------------------|----------------------|-----------------------|
| | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| Z(t) | 0.410 | -3.750 | -3.000 |

MacKinnon approximate p-value for Z(t) = 0.9819

Teste de normalité des résidus

Test for multivariate normality

Doornik-Hansen $\chi^2(2) = 2.519$ Prob> $\chi^2 = 0.2838$

```
. tabstat ecoinf chohom chofem corrup effecgov stabpoli qualitreg regleloi liberteco inv , stat (skewness kurtosis) col (stat)
```

| variable | skewness | kurtosis |
|-----------|-----------|----------|
| ecoinf | .088129 | 1.816085 |
| chohom | -.7958529 | 2.638117 |
| chofem | -.2870186 | 1.85547 |
| corrup | -.2376863 | 1.737242 |
| effecgov | .6774542 | 2.157637 |
| stabpoli | .2334815 | 1.383785 |
| qualitreg | .2337905 | 1.567996 |
| regleloi | -.6040739 | 1.957362 |
| liberteco | 1.052139 | 3.246549 |
| inv | -.6505578 | 3.476207 |

Hétéroscédasticité des résidus

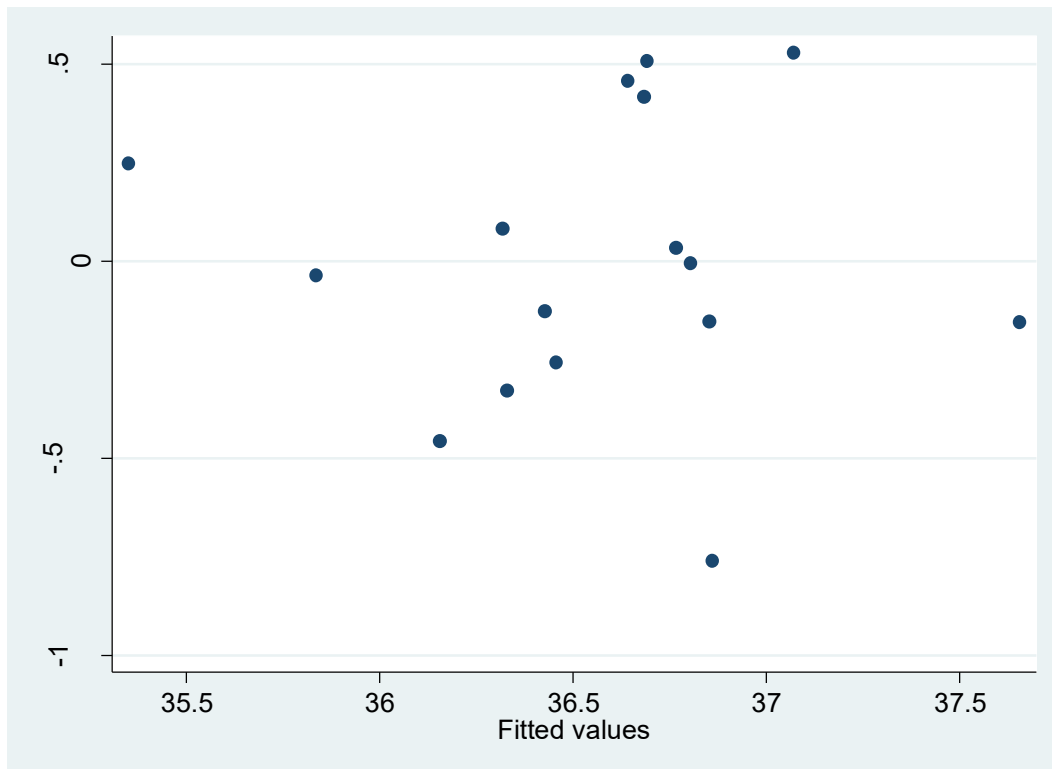
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

H0: Constant variance

Variables: fitted values of ecoinf

chi2(1) = 0.43

Prob > chi2 = 0.5141



Investigations empiriques

. regress ecoinf chofem regleloi liberteco inv, noconstant

| Source | SS | df | MS | Number of obs = 16 | | |
|----------|------------|----|------------|------------------------|--|--|
| Model | 21371.5031 | 4 | 5342.87577 | F(4, 12) = 3927.03 | | |
| Residual | 16.3264667 | 12 | 1.36053889 | Prob > F = 0.0000 | | |
| Total | 21387.8296 | 16 | 1336.73935 | R-squared = 0.9992 | | |
| | | | | Adj R-squared = 0.9990 | | |
| | | | | Root MSE = 1.1664 | | |

| ecoinf | Coef. | Std. Err. | t | P> t | [95% Conf. Interval] | |
|-----------|-----------|-----------|-------|-------|----------------------|-----------|
| chofem | .0629018 | .0523325 | 1.20 | 0.253 | -.0511209 | .1769245 |
| regleloi | -.2642015 | 3.739652 | -0.07 | 0.945 | -8.412203 | 7.8838 |
| liberteco | 6.64993 | .6528141 | 10.19 | 0.000 | 5.227571 | 8.07229 |
| inv | -.3939063 | .1536248 | -2.56 | 0.025 | -.728626 | -.0591866 |

. regress ecoinf corrup liberteco inv, noconstant

| Source | SS | df | MS | Number of obs = 16 |
|----------|------------|----|------------|------------------------|
| Model | 21368.9231 | 3 | 7122.97435 | F(3, 13) = 4897.72 |
| Residual | 18.9065004 | 13 | 1.45434618 | Prob > F = 0.0000 |
| Total | 21387.8296 | 16 | 1336.73935 | R-squared = 0.9991 |
| | | | | Adj R-squared = 0.9989 |
| | | | | Root MSE = 1.206 |

| ecoinf | Coef. | Std. Err. | t | P> t | [95% Conf. Interval] |
|-----------|-----------|-----------|-------|-------|----------------------|
| corrup | 2.74466 | 3.879542 | 0.71 | 0.492 | -5.636581 11.1259 |
| liberteco | 6.951623 | .4983047 | 13.95 | 0.000 | 5.875101 8.028145 |
| inv | -.3656588 | .1518589 | -2.41 | 0.032 | -.69373 -.0375876 |

. regress ecoinf chohom regleloi liberteco inv, noconstant

| Source | SS | df | MS | Number of obs = 16 |
|----------|------------|----|------------|------------------------|
| Model | 21372.0046 | 4 | 5343.00115 | F(4, 12) = 4051.58 |
| Residual | 15.8249533 | 12 | 1.31874611 | Prob > F = 0.0000 |
| Total | 21387.8296 | 16 | 1336.73935 | R-squared = 0.9993 |
| | | | | Adj R-squared = 0.9990 |
| | | | | Root MSE = 1.1484 |

| ecoinf | Coef. | Std. Err. | t | P> t | [95% Conf. Interval] |
|-----------|-----------|-----------|-------|-------|----------------------|
| chohom | .1526753 | .1116234 | 1.37 | 0.196 | -.0905312 .3958817 |
| regleloi | -.8118412 | 3.337093 | -0.24 | 0.812 | -8.082743 6.45906 |
| liberteco | 6.477984 | .6974737 | 9.29 | 0.000 | 4.958319 7.997648 |
| inv | -.3578009 | .1583621 | -2.26 | 0.043 | -.7028422 -.0127596 |

. regress ecoinf stabpoli liberteco inv, noconstant

| Source | SS | df | MS | Number of obs = 16 |
|----------|------------|----|------------|------------------------|
| Model | 21379.0306 | 3 | 7126.34352 | F(3, 13) = 10528.77 |
| Residual | 8.79898669 | 13 | .67684513 | Prob > F = 0.0000 |
| Total | 21387.8296 | 16 | 1336.73935 | R-squared = 0.9996 |
| | | | | Adj R-squared = 0.9995 |
| | | | | Root MSE = .82271 |

| ecoinf | Coef. | Std. Err. | t | P> t | [95% Conf. Interval] |
|-----------|-----------|-----------|-------|-------|----------------------|
| stabpoli | -1.818564 | .454517 | -4.00 | 0.002 | -2.800488 -.8366399 |
| liberteco | 6.32855 | .3760836 | 16.83 | 0.000 | 5.516071 7.14103 |
| inv | -.2404534 | .1068933 | -2.25 | 0.042 | -.4713822 -.0095245 |

. regress ecoinf effecgov liberteco inv, noconstant

| Source | SS | df | MS | Number of obs = 16 |
|----------|------------|----|------------|------------------------|
| Model | 21375.5642 | 3 | 7125.18806 | F(3, 13) = 7551.94 |
| Residual | 12.2653784 | 13 | .943490649 | Prob > F = 0.0000 |
| Total | 21387.8296 | 16 | 1336.73935 | R-squared = 0.9994 |
| | | | | Adj R-squared = 0.9993 |
| | | | | Root MSE = .97133 |

| ecoinf | Coef. | Std. Err. | t | P> t | [95% Conf. Interval] |
|-----------|-----------|-----------|-------|-------|----------------------|
| effecgov | -2.944189 | 1.053486 | -2.79 | 0.015 | -5.220108 - .6682699 |
| liberteco | 6.545871 | .4293324 | 15.25 | 0.000 | 5.618355 7.473388 |
| inv | -.2511865 | .1284338 | -1.96 | 0.072 | -.5286509 .0262779 |