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One Troika fits all? Job crash, pro-market structural reform and austerity-driven therapy in Portugal

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Abstract
This article assesses the effectiveness of the labour market reforms implemented in Portugal as part of the Troika's structural reform package. Using an ARDL-bounds test model to perform the econometric estimation, this investigation examines the long-run relationship between unemployment, capital accumulation and labour market variables for the 1985–2013 period. The econometric estimation suggests that capital accumulation has been the main driver of long-run unemployment, whilst labour market variables have played a minor explanatory role. These results suggest that Portuguese NAIRU is endogenous to capital accumulation and do not support the *Troika's* emphasis on labor market reforms as a strategy to reduce long-term unemployment.

Keywords NAIRU · Unemployment · Capital accumulation · Labour market institutions · ARDL · Bounds test

JEL Classification E11 · E12 · E15 · E22 · E24

1 Introduction

In 2011 Portugal signed a memorandum with *Troika*, an association of the IMF with European institutions, that committed the Portuguese government to follow a set of political, institutional and economic policies in exchange for the financing provided by those international institutions to the Portuguese state (IMF 2011).

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The *Troika* memorandum was based upon two policy blocks that were implemented simultaneously: a first one, designed to correct the macroeconomic imbalances of the Portuguese economy, namely the trade imbalance and the high public and private debt to GDP ratios; and a second one, designed to enhance the long-run output growth, based upon the so called structural reforms.

The structural reforms were mainly directed to the labour market and to the welfare state. They included measures as the freezing of nominal minimum wages, the decrease in the value of dismissal compensations and cuts in the scope and in the amount of unemployment benefits and other social subsidies.[1] We decided to focus on the labour market package of the structural reforms because it is one the most prevails until nowadays, since, unlike other measures, the majority of labour market reforms was not revoked by the following government.

The supporters of the economic virtues of the program argue that the structural reforms implemented have created a new institutional framework that will guarantee lower levels of unemployment in the future. However, given the extensive critical literature that has emerged in the past 20 years, such considerations are far from being obvious. That critical literature found evidence that labour market institutions may play a minor role in explaining long-run unemployment, whilst aggregate demand, in general, and capital accumulation, in particular, are important determinants.

Inspired by that line of research, this article studies the long-run relationship between unemployment, labour market institutions and capital accumulation, using an ARDL-bounds test model. This model has the advantage of assessing the existence of cointegration between variables with different integration orders. The period of time under investigation ranges from 1985 to 2013.

We explicitly chose to use a model (ARDL-bounds test) not directly derived from a general model of the economy, such as the DSGE models, commonly used by central banks and some international institutions to assess structural reforms. Despite not having the pretension to describe the functioning of the economy as a whole, we argue that our model has two important advantages over conventional DSGE models: first, it allows to contrast our results with other times series and panel data investigations under influence of the well-established research paradigm of NAIRU. Second, and more importantly, our model is less prone to give results strongly influenced by the a priori assumptions of the model. In fact, DSGE models have been criticized as a method to assess structural reforms because their assessment heavily depends on strong assumptions implied in their construction, such as rational expectations, the undervaluation of problems related with aggregation and the tendency to equilibrium in the absence of wage and price rigidities (Marchionatti et al. 2015).

The main contribution of this article is to study the adequacy of the labor market reforms implemented in Portugal during the *Troika's* adjustment program. To accomplish so, we unveil how important labour market reforms and capital accumulation have been in explaining the evolution of unemployment in Portugal over the last three decades. If the labour market reforms prove to be crucial to explain

[1] For an extensive analysis of the measures proposed by *Troika* and their social and economic implications see ILO (2013).

unemployment during that period, then we may assume that the structural reforms contained in the memorandum were correctly designed given the historical experience of the Portuguese labour market. On the other hand, if the labour market reforms prove to be irrelevant while capital accumulation proves to be a crucial explanatory variable, it is reasonable to conclude that the memorandum measures were not well designed. Actually, they may even have been harmful to the long-run unemployment rate, given the negative impact of the internal devaluation on the investment growth rate.

Portugal shares a set of common characteristics with other Southern European countries—like the high growth rate of real GDP, real wages and credit supply during the 90's—but has also another set of characteristics that make him unique, namely the stagnation of real GDP and the decline in investment and real estate prices from 2000 onwards, unlike countries like Spain and Greece, in which the growth trends of these variables remain broadly positive until the awake of the financial crisis (Barradas et al. 2018). This mixture of singularity and conformity comparing with other Southern European countries make the research on Portugal an interesting case for the broader research programmes about the European Crisis and the economics of *Troika*.

The article is organized as follows: the Sect. 1 briefly describes the NAIRU model; Sect. 2 presents a critical appraisal of the conventional NAIRU model and sets the foundations for an endogenous NAIRU theory; Sect. 3 briefly revises the existing empirical literature about this topic; finally, Sect. 4 reports the empirical assessment, including the variables definition, the econometric model and the discussion of the results.

2 The NAIRU model

The NAIRU model has an imperfect competition structure in which capitalists and workers hold some degree of market power. The payment of the production factors is not technologically determined; it depends on the bargaining power of each side of the market (Layard et al. 1991; Bozani and Drydakis 2011; Carlin and Soskice 2014). The model has its intellectual roots in the New Keynesian reaction to the more extreme hypothesis of Milton Friedman's natural rate of unemployment (Friedman 1977).

Capitalists set the price through a mark-up on the expected nominal wage. The mark-up sensibility to unemployment is assumed to be weak or even nonexistent. On the other hand, workers set their nominal wages through a mark-up on the expected price level. Workers market power is inversely dependent on the unemployment level. Expansionary periods are associated with low unemployment levels and, consequently, with workers' higher bargaining power and thus higher expected real wages. By contrast, recessions are associated with high unemployment levels and, consequently, with a weaker bargaining power and lower expected real wages.

The inflation rate is constant only if the expectations of the agents were fulfilled. There is just one level of unemployment that is able to ensure this condition—the non-accelerating inflation rate of unemployment (NAIRU)—determined exogenously by the structural conditions of the economy.

Demand shocks move unemployment away from its equilibrium level, causing inconsistent claims on output. A positive shock makes the sum of the expected shares of capitalists and workers bigger than the output value, triggering the rise of inflation to ensure the *expost* consistency of claims. Because the conventional negative relationship between inflation and output is assumed, unemployment will increase, causing a decrease in the workers' bargaining power. A negative shock creates the opposite process. The adjustment will continue until NAIRU has been restored (Layard et al. 1991).

Therefore, NAIRU works as a gravitational center to the effective level of unemployment and it is not influenced in the long run by demand shocks. Supply side shocks alone, such as a change in the price of raw materials or in the institutional structure of the labour market, are able to modify its value. NAIRU authors only acknowledge the hypothesis of hysteresis/endogeneity in the short-run, where events like an asymmetric bargaining power between insider and outsider workers may occur (Lindbeck and Snower 1988). In the long-run, however, it is assumed that those exceptional conditions cannot hold and NAIRU is given irrespective to aggregate demand dynamics (Nickell and Nunziata 2001).

Under this paradigm, involuntary unemployment is accepted but it is attributed to the labour market's inability to clear due to supply side frictions, such as the setting of efficiency wages (Shapiro and Stiglitz 1984), the bargaining power of unions and the mismatch between firms and workers at the educational and geographical level.

The NAIRU model was developed under the broader paradigm of New Keynesian Economics. Generally, this school of economic thought advocates that demand shocks only affect the economy in the short-run, while price and wage rigidities are in place and there is a trade-off between inflation and unemployment, illustrated by a negatively sloped Phillips curve. However, in the long run, the Walrasian features are restored and the economy shows a self-adjusting tendency to the NAIRU. The Phillips curve becomes vertical, meaning the absence of a trade-off between inflation and unemployment. Demand-led policies are thus useless in the long run, causing only increases in inflation with no impact on output (Mankiw 1992).

Therefore, the economic policy advice usually focuses on the correction of frictions in the supply side of the market, deemed to be an essential step towards a lower NAIRU. Two main types of policies are suggested to reach this goal; those aimed at decreasing the mismatch between workers and firms and those related to the weakening of the wage-push variables.

The first types of policies are widely accepted. They include the creation of new educational and professional programs provided to workers, which seek to adapt their qualifications to the needs of firms. They also contemplate pin-point targeting procedures, designed to take into account the heterogeneous characteristics of different regions. A better match between the labour supply and the vacancies provided by firms ensures a lower NAIRU in the long-run (Layard et al. 1991, Chapter 6).

On the other hand, wage-push variables are those which influence the bargaining power of workers. Examples include union coverage, unemployment benefits, minimum wages and dismissal compensations. Decreasing wage-push variables is a common policy recommendation to achieve a lower long-run NAIRU, since weaker bargaining power increases workers' willingness to work at lower expected

real wages, so that it is possible to accommodate a lower unemployment rate with steady inflation. Furthermore, it is claimed that it increases the speed of adjustment towards the equilibrium after a shock. Cuts in unemployment benefits and in minimum wages or new institutions that limit the power of unions are hence common policy recommendations (Layard et al. 1991, ch 10).

3 The endogenous NAIRU

Several authors have criticized the New Keynesian conclusions extracted from the NAIRU model. Stockhammer (2008) argues that the acceptance of the NAIRU concept, that is, the existence of an unemployment rate below which the conflicting claims on output lead to an increase in the inflation, does not imply the adherence to a theory or to a single set of economic policy prescriptions. In fact, NAIRU is compatible with New Keynesian, Post Keynesian or Marxist schools of economic thought, depending on the assumptions made about its determination and dynamics. The New Keynesian interpretation is seen just as a special case in which NAIRU is assumed to be exogenously determined and it is able to impose a self-adjusting trend to current unemployment. If these premises were not verified, then aggregate demand and capital accumulation, in particular, can play a determinant role in setting the long-run unemployment rate.

Critical appraisals of the NAIRU model challenge its three main assumptions: uniqueness, automatic tendency to equilibrium and invariance to demand shocks.

3.1 Must NAIRU be unique?

NAIRU uniqueness is implicitly related to the assumed Phillips curve shape. The Phillips curve relates the change in inflation rate—which in turn depends on the real target wage of workers—with the unemployment rate. If the Phillips curve is negatively sloped in the whole domain, as is usually assumed in the short-run, each level of unemployment corresponds to a different real target wage, so that there is only one level of unemployment compatible with a constant level of inflation. Moreover, if the Phillips Curve is vertical, as it is often assumed in the long-run, the trade-off between inflation and unemployment does not exist at all. Therefore, any attempt of exploring that trade-off by the government will be unfruitful.

However, there is profuse empirical evidence contrary to those Phillips curve shapes. Studies conducted in different countries have estimated that the Phillips curve has a horizontal shape for a wide range of unemployment rates (Barnes and Olivei 2003; Ball and Mazumder 2011; Kuttner and Robinson 2010). That means that NAIRU is not a single point but a range within which unemployment can decrease without increasing the actual target wage of the workers. Inside that horizontal segment it is possible for governments to delineate their economic policy to reduce unemployment without the fear of accelerating inflation.

3.1.1 Long-run path dependence

Keynesian economists argue that the long-run rates of growth of the economies are substantially explained by the past and present behavior of aggregate demand (AD). That is, the potential output path is dependent towards AD. The dependence can be exerted through different channels with impact on the supply side of the economy.

First, AD can interfere in the long-run capital to output ratio by changing capital utilization and the internal financing capacity of firms. Higher AD regimes increase capital utilization and internal financing, stimulating the incentives to investment, as classically stated by Kalecki (1971). In addition, capital accumulation triggered by high demand regimes is able to decrease the pressure on inflation for two reasons. The first is related to the hypothesis that productivity changes induced by an increase in capital stock are not fully reflected on real wages. When this hypothesis holds, the proportion of wage claims over total output becomes smaller (Rowthorn 1999). In second place, a similar process occurs on the capitalists side. The increasing capital stock increases spare capacity, which is assumed to have an inverse relationship with the mark-up set by firms (Rowthorn 1995). A smaller mark-up means a minor proportion of profit claims over total output. Both effects increase the level of real wages compatible with constant inflation, causing a decrease in the NAIRU.

AD also interferes with the labour force rate of growth. When demand shocks are long and severe, causing high levels of unemployment during several years, they can lead to significant migration of workers who leave their home countries in search of work abroad. As most of these workers are adults of childbearing age, the birth rate tends to lower in the countries of origin, causing a decrease in the potential labour force growth rate and, consequently, in the potential output (Fontana and Palacio-Vera 2007). Finally, AD can positively interfere in the technological progress by intensifying the effects of learning by doing and also by creating the need for companies to seek technological innovations that make them more efficient to meet the increasing production volume despite their limited level of resources (Robinson 1956).

Stock Flow Consistent Modelling—a modelling strategy based on the seminal work of Godley and Lavoie (2016)—has been one of the most important instruments to address the long-run impacts of aggregate demand. These models possess conditions more aligned with the Keynesian paradigm, namely the endogeneity of money and the possibility of disequilibrium in the long-run. Several investigations have pointed out to the possibility of long-run effects of AD on boosting investment, by improving the internal financing capacity of firms (Chatelain 2010) and its positive on long-run productivity (Carnevali 2018). Recently, Sousa et al. (2015) constructed a SFC benchmark model for Portugal. Despite the refuse to derive definitive conclusions out of the model, the author concludes that the shrinking of public demand had a contractionary effect on the Portuguese GDP.

The above arguments have been received with skepticism for many years by neoclassical economists. That reaction is not surprising as the long-run invariance of output to demand shocks has been assumed as one of the cornerstones of neoclassical economics (Solow 1997).

However, upon the appearance of the Great Recession, an increasing number of economists have become more open to accepting the path dependence hypothesis. Assessing the impact of the global financial crisis in a sample of 23 countries, Ball (2014) concluded that "(...) shortfalls of actual output from pre-recession trends have reduced potential output almost one-for one"; and, in the same vein, Blanchard et al. (2015) found evidence from a sample of over 120 recessions that about two-thirds of them have led to a permanent gap between the previously estimated potential output and the after-recession estimate. They present this evidence under the concept of "super hysteresis" which, in practice, corresponds to the acceptance of long-run effects of AD on potential output.

These findings severely impact on NAIRU theory propositions: if we take as valid the long-run path dependence of potential output to AD, that would mean that there is no such thing as a single and exogenous NAIRU. Given that NAIRU is a fundamental element for the potential output computation and this output is determined by past behaviour of AD, NAIRU is fully endogenous and its values heavily depend on the way as AD was managed in the past.

3.2 NAIRU as a weak attractor

Neoclassical economists perspective NAIRU as a strong attractor to the contemporary unemployment rate. The root for this result rests in the adjustment mechanism in the goods market implicit in the AD shape.

3.2.1 AD in the inflation-output space

The representation of AD on the inflation-output space was initiated by New Keynesian authors and was later embraced by the New Consensus Macroeconomics (NCM) (Romer, 2000). Inside the NCM framework, the Central Bank (CB) adjusts its interest rate depending on the inflation target. Whenever expectations of a growing aggregate demand threaten the inflation goal set by the central bank, it should raise the short-run interest rate in order to depress the evolution of demand and inflation expectations. Therefore, it is the CB reaction function that imposes a downward slope to AD.

However, CB's action is not always effective. In the current context of the Great Recession, central banks face the so-called zero lower bond problem (Eggertsson and Krugman 2012) and despite seeking to use alternative instruments of monetary policy (e.g. quantitative easing), their power to influence aggregate demand has been shown to be limited. In a scenario of central bank's difficulty/inability to influence aggregate demand (as is happening now in the Eurozone) there is no plausible mechanism that makes the AD have a negative slope.

Ultimately, it is not possible to give a conclusive answer regarding the shape of AD curve. During normal times, with a CB able to influence output and a low level of public/private debt, it is probable that AD shows a negative slope. However, during times such as what we are living in, characterized by high indebtedness and a powerless CB, there is no reason for the AD curve to present that shape

(Stockhammer 2011), undermining the macroeconomic foundation for a NAIRU that works as a gravitational center to economic activity.

3.3 Summary

The previous section described a critical appraisal of the conventional NAIRU theory. Furthermore, arguments were presented for the adoption of an alternative theoretical framework, which can be labeled as the endogenous NAIRU theory or, in the terminology of Arestis and Sawyer (2005), structuralist view of inflation. It has the following stylized characteristics: (1) NAIRU is not unique—there are a range of unemployment rates within which the inflation rate may stay constant; (2) the major supply side factors that influence the inflation frontier are the conflict over income shares and productive capacity—labour market institutions play a minor role; (3) supply side factors are not independent of the aggregate demand behaviour. Capital accumulation can influence the income shares conflict and productive capacity, meaning that aggregate demand can influence NAIRU in the long-run (Arestis and Sawyer 2005).

In conclusion, inside this new framework governments no longer need to accept high levels of unemployment to prevent rising inflation. Alternatively, they may choose appropriate demand policies to stimulate investment and underpin full employment.

4 A review of the empirical literature

4.1 The NAIRU model

To explore the differences in unemployment between countries, Layard et al. (1991) estimated a cross-sectional equation including 20 countries during the 1983–1988 period. The group of independent variables included benefit duration, replacement ratio, spending on active labour market policies, coverage of collective bargaining and the change in the inflation rate. All variables proved to be statistically significant. Benefit duration, replacement ratio and coverage of collective bargaining had a positive impact on unemployment while active labour market spending had a negative one. Furthermore, it was claimed that this regression structure was able to explain over 90% of the cross-country differences in unemployment. As policy recommendations, they suggest measures such as decreasing the duration of unconditional unemployment benefits, diminishing of employment protection legislation, reforming the bargaining systems and designing better training programs to overcome the mismatch between workers and firms.

Siebert (1997) made an analysis on the evolution of unemployment in several European countries, concluding that the faster decrease of unemployment in United Kingdom and Netherlands was due to their adherence to flexible labour market measures.

By the end of the decade, Nickell (1998) conducted an econometric study covering all the OECD countries between 1964 and 1992. He sought to explain the behaviour of unemployment through seven explanatory variables: industrial turbulence, replacement ratio, terms of trade, skills mismatch, union mark-up, tax wedge and real interest rate. He found a strong long run relationship between unemployment and skills mismatch, union density and tax wedge. These results are consistent with the NAIRU model predictions.

The conclusions of this research agenda were quickly absorbed by international organizations with a significant influence over policy making. The policy recommendations of the OECD Job Study, published in 1994, were entirely in agreement with the NAIRU literature published in the preceding years (OECD 1994). This study was an important legitimacy source for the labour market deregulatory reforms implemented by most countries during that decade. The same sort of policy recommendations regarding labour market reforms can be found in subsequent institutional reports, like IMF (2003) or EC (2003).

This intellectual influence remains in the main international institutions to date, which explains the content of programs implemented in countries such as Portugal. In a recent study evaluating labor market reforms in European countries, an article in the economic bulletin of the ECB concludes: "Labour market reforms, to the extent that they reduce the wage mark-up or the reservation wage, should have a wage-moderating effect, which is reflected in improved competitiveness and/or higher profit margins for firms and an increased demand for labour, which can lead to higher employment and, all other things being equal, lower structural unemployment" (ECB 2015).

4.2 Critical response

Although the NAIRU model has become the dominant script for the interpretation of unemployment in developed economies, its theoretical and empirical foundations have been repeatedly challenged. The theoretical counterpoint was widely explored in Sect. 2, so will not be discussed again.

On the empirical level, the refutation attempt follows, roughly, two main lines of research. There is a first set of authors who investigates the robustness of the institutional variables used by advocates of the NAIRU model, assessing whether slight modifications in the specification of equations or new choices in the period of analysis have an impact on the significance of the explanatory variables. They also seek to assess whether monetary policy generates long-term effects on unemployment, opposing the conventional notion that their effect would be limited to the short-term. The other line of research introduces capital accumulation in the econometric specifications in an attempt to assess whether the lack of capital and/or the lack of investment are the main causes of unemployment in the long term.

4.2.1 Do time and specification matter?

Ball et al. (1999) analyzed a sample of two groups of countries: a smaller group, consisting of six of the seven G-7 countries and a larger sample consisting of 17

OECD countries. Both groups have in common the fact they went through recessions in the early 80's. They noted that the monetary policy strategy after the recession was decisive for the degree of hysteresis, that is, the degree to which short-term unemployment affects long-term unemployment (NAIRU). Countries conducting an easier monetary policy, such as US and Canada, had fast and sustained decreases in their rate of unemployment without the occurrence of large increases in their inflation rates. In contrast, most European countries chose to maintain a tight monetary policy, a decision that caused higher and more persistent levels of unemployment. Thus, they concluded: "(...) demand expansions helped reduce the NAIRU, but the permanent reduction in the NAIRU does not require a permanent rise in inflation". They also report that "he role of labour market reforms in the success stories is exaggerated" Opposing the conclusions of Siebert (1997), they suggest that the case of Netherlands and UK are just particular cases unable to validate the success of labour market reforms. In fact, there are a large number of other countries that have also made these reforms without achieving the same success. In support of their argument, they allude to Blanchard and Jimeno (1995), where it is claimed that the evolution of unemployment in Portugal and Spain is very different, even though the type and timing of labour market reforms are similar.

Ball et al. (1999) set themselves apart from other mainstream analysis on the impact of monetary policy on the unemployment rate by suggesting that monetary policy has long-term effects. Blanchard and Wolfers (2000), for instance, concede that the influence of labour market reforms has been overemphasized and that monetary policy may influence the short-term unemployment. However, retain the assumption that long-term unemployment remains invariant to the effect of monetary policy on aggregate demand.

Howell et al. (2007) criticize the construction criteria of the institutional variables for being too subjective and for hiding the lack of homogeneity among the several countries analyzed. The gross replacement rate (GRR), for example, often used as an indicator of the generosity of unemployment compensations, fails to capture the existing asymmetries in the unemployment benefit eligibility criteria in each country. It is possible that countries with a high GRR have low coverage rates and vice versa. The same criticism can be directed at the Union Density (UD), since this indicator does not capture the collective bargaining coverage, that is, the share of employees whose wages and employment conditions are set through collective bargaining. There are several examples of countries with low UD and very high levels of collective bargaining coverage, whereby the interpretation of the indicator can be misleading.

They also dispute the causal relationship usually presented. By applying Granger-causality tests, they found that in 4 countries it is the change in unemployment that causes the variation of the GRR and not the opposite way around, as usually assumed. This causal relationship is probably explained by the increase in unemployment benefits during times of recession, representing an attempt to diminish the associated social costs.

In addition, empirical studies performed by OECD and IMF seem to be extremely sensitive to small changes in the equations specification. Baker et al. (2004) perform minor changes in the three main specifications of IMF (2003), including new

variables and interactions between variables generally used in previous researches on the subject. Statistical evidence changes dramatically: from all previously significant institutional variables, only the tax wedge remains significant at 10% level.

Baccaro and Rei (2005) summarize a set of arguments supporting an alternative view with regard to the impact of the labour market institutional variables. In particular, they argue that a longer and generous GRR can increase the likelihood of matching workers and job offers and that employment protection legislation necessarily has an ambiguous effect, since it reduces both flows from unemployment into employment and flows from employment into unemployment. Additionally, they test the robustness of the methods used in Nickell and Nunziata (2001) and in IMF (2003). They apply a wide range of alternative specifications, using static and dynamic models, annual and average data as well as a long list of estimation techniques. Like Baker et al. (2004), they find that the results largely depend on the model specification and on the estimator used. They conclude that this evidence suggests that most of these studies are skewed to confirm the starting assumptions of the theory defended by their authors.

4.2.2 Capital stock and capital accumulation

4.2.3 Capital stock

Arestis and Biefang-Frisancho Mariscal (2000) test the influence of capital stock on long run unemployment for UK and Germany. They make a regression of unemployment on expected real wages, union militancy, tax and import costs, nominal price inertia and capital stock. They find that the impact of capital stock on unemployment prevails above any other factor. Arestis et al. (2007) apply the same regression to a panel of nine EMU countries, reaching similar conclusions.

Using the Fully Modified Ordinary Least Squares (FMOLS) estimator, Palacio-Vera et al. (2011) performed a similar study for Canada, trying to relate unemployment to the generosity of unemployment benefits, the interest rate, the mark-up and the capital-output ratio. All variables, except for the mark-up, were statistically significant.

4.2.4 Capital accumulation

Some studies directly attempt to test the Keynesian assumption according to which the dynamic of investment is the main determinant of the unemployment rate. They include the growth rate of investment as a regressor, in addition to the usual variables representing the labour market and the welfare state structures. Unlike the ones presented in the previous section, these studies focus on the impact of the growth rate of capital accumulation rather than on the capital stock.

Stockhammer (2004) uses the seemingly unrelated regressions (SUR) method to study the evolution of the labour market in the United States and four European countries. He chooses to perform two estimations with different dependent variables: the unemployment rate and the growth rate of employment. Capital accumulation is

consistently significant in all countries in both specifications. On the contrary, out of all the labour market variables, only the replacement rate is consistently significant with the signal predicted by the NAIRU hypothesis.

Studying the evolution of unemployment on a panel of 20 OECD countries, Stockhammer and Klär (2010) use as explanatory variables the capital stock growth rate and a set of institutional variables, such as employment protection legislation (EPL), replacement ratio, benefit duration, union density and tax wedge. They also use controls for several macroeconomic shocks, namely the real interest rate, terms of trade and the deviation of the total productivity from its trend factor. The data is structured in 5-year averages to eliminate business cycle fluctuations. Out of all the institutional variables, only UD coefficient is statistically significant with the expected signal. EPL coefficient is statistically significant but has a sign contrary to what one would expect—increasing EPL has a negative impact on unemployment. The capital stock growth rate is again statistically significant at 1% level.

On a more recent research, Stockhammer et al. (2014) analyze the evolution of unemployment during the period of the Great Recession (2007–2011). Econometric specifications are similar to the ones used in Stockhammer and Klär (2010) but include a new variable, Housebub, defined as the deviation of the employment ratio in the construction sector from the global rate of employment, to assess the impact of the housing bubble in the evolution of unemployment. Again, the only statistically significant institutional variable is UD. Capital accumulation and Housebub are consistently significant in all specifications.

5 Empirical assessment

5.1 Data description

The data consists of quarterly time-series ranging from the first quarter of 1985 (1985Q1) to the fourth quarter of 2013 (2013Q4).[2] The model will include six variables: Unemployment rate (*U*), capital accumulation (*GK*), government led employment protection legislation (*GEPL*), gross replacement rate (*GRR*), Union Density (*UD*) and an external macroeconomic shock (*EMS*).

The unemployment rate was directly taken from the Bank of Portugal Economic Bulletin (2015). Following Stockhammer (2004), *GK* is defined as the logarithm of gross fixed capital formation. The series was also taken from the Bank of Portugal Economic Bulletin (Bank of of Portugal 2015)

GEPL is a composite variable computed as the logarithm of the product of the real minimum wage (*RMW*) with the weighted average of the employment protection legislation indicators published by OECD (EPL) $-$ $GEPL = LOG(RMW \times EPL)$.

[2] Some series are not published on a quarterly basis. In these situations, we used the interpolation methods calculated by Eviews 9 software. For each case, the chosen interpolation method was the one that better preserved the original series behavior. We used linear interpolation for *SEPR*, *SEPT* and *UD* and quadratic interpolation for *GRR* and *TOT*.

To construct *RMW*, data was extracted from the nominal minimum wage and divided by the quarterly Consumer Price Index (CPI). Both variables were taken from INE—Statistics of Portugal. *EPL* was built from two variables published by the OECD, strict employment protection legislation of regular workers (*SEPR*) and strict employment protection legislation of temporary workers (*SEPT*). The weights utilized were taken from PORDATA. They are respectively the proportion of regular workers in the employed population (*REGPROP*) and the proportion of temporary workers in the employed population (*TEMPROP*) − $EPL = SEPR \times REGPROP + SEPT \times TEMPROP$. We decided to build a variable that would aggregate the impact of employment protection legislation and the minimum wage, since these are the two institutional variables under the direct influence of government action.

GRR represents the gross unemployment benefit level as a percentage of previous gross earnings. It is an indicator that intends to measure the generosity of the unemployment benefits in each country. *UD* corresponds to the ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners. It represents a proxy for the bargaining power of the workers. Both variables are computed by OECD.

EMS is calculated as the logarithm of the product of trade openness (*TO*) with terms of trade (*TOT*) − $EMS = LOG(TO \times TOT)$. This specification of the external macroeconomic shock follows the past literature on the subject, in line with Baccaro and Rei (2005). *TO* is defined as the ratio between the sum of exports (*EX*) with imports (*IM*) divided by the gross domestic product (*GDP*)—$TO = (EX + IM)/GDP$. The values of *EX*, *IM* and *GDP* are taken from the Bank of Portugal Economic Bulletin (2015). *TOT* is defined as the ratio between the index of export prices and the index of import prices and it can be interpreted as the amount of import goods an economy can purchase per unit of export goods. The variable was taken from the OECD.

GK is a measure of capital accumulation and is included to test for the Keynesian hypothesis. *GEPL*, *GRR* and *UD* are institutional variables and are included to test for the exogenous NAIRU hypothesis. *EMS* is a control variable. For a synthesis, see Tables 5 and 6 in the "Appendix".

According to the NAIRU hypothesis *GEPL*, *GRR* and *UD* are expected to have a positive long-run impact on the unemployment rate; *GK* can influence unemployment negatively but only in the short-run. In contrast, the Keynesian hypothesis postulates that *GK* is the main determinant of unemployment, having a negative influence both in the short and in the long-run; it also predicts that *GEPL*, *GRR* and *UD* should not play a major role in explaining long-run unemployment.

5.2 Methodology and results

5.2.1 ARDL approach to cointegration

To assess the long run relationship between unemployment, capital accumulation and the institutional variables, we will employ the Auto Regressive Distributed Lag

(ARDL)—bounds test approach to cointegration analysis developed by Pesaran and Shin (1998) and Pesaran et al. (2001).

The notion of cointegration arose out of the concern about spurious or nonsense regressions in time series. When a set of variables are integrated of some order, the traditional estimation techniques applied to stationary data are commonly not valid. They generate misleading results as highly significant coefficients, low values of Durbin-Watson statistic and R squared values that behave like random variables (Granger and Newbold 1974). However, it is possible to extract valid conclusions out of models with non-stationary variables as long as there is cointegration between them. Two sets of non-stationary $I(d)$ and $I(p)$ variables are cointegrated when exists at least one linear combination between them which is integrated of order $I(d-p)$, with $d > p$. When that is the case, it is possible to conclude the existence of a long-run relationship between the cointegrated variables.

The traditional cointegration approaches such as Engle and Granger (1987) and Johansen and Juselius (1990) had the disadvantage of requiring that all the variables employed had the same order of integration. The approach of Pesaran and Shin (1998) overcomes that methodological limitation by allowing for the use of a mixture of $I(1)$ and $I(0)$ variables in the regression. The model just imposes that the dependent variable must be $I(1)$ and that none of variables may have an order of integration higher than one.

Consequently, the first step is to determine the order of integration of the variables using the Augmented Dickey-Fuller test proposed by Said and Dickey (1984). The test provides evidence for the dependent variable (U) being integrated of order 1, as well as *GK*, *GRR* and *GEPL*. In contrast, *GEPL* and *UD* appear to be stationary. The order of integration of the dependent variable and the mixture of I(1) and I(0) regressors are supportive findings for the use of the ARDL approach. The test results are summarized in the Table 4 in the "Appendix".

5.2.2 Model selection

The ARDL model has the following general form:

$$y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \beta_i L^i y_t + \sum_{j=0}^{q} \gamma_j L^j x_t + \varepsilon_t \tag{1}$$

where α_0 is a constant, t is a linear deterministic time trend, y_t is a dependent variable, x_t is a vector of independent variables, L represents the lag operator and ε_t is a white noise error term.

To determine the optimal lag length of the model, we will employ four different information criteria: Akaike Information Criterion (AIC), Schwarz Criterion (SC), Hannan-Quinn Criterion (HQ) and Adjusted R-squared (R2). The best model specifications according to each information criteria are displayed in the following list of equations:

$$AIC: \; U_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \sum_{p=1}^{3} \beta_i U_{t-p} + \sum_{j=1}^{q1} \sum_{q1=0}^{2} \gamma_j GK_{t-q1} + \delta_k GEPL_t + \sum_{l=1}^{q3} \sum_{q3=0}^{2} \theta_l GRR_{t-q3} + \varphi_m UD_t + \sigma_n EMS_t + \varepsilon_t \tag{2}$$

$$SC: \; U_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \sum_{p=1}^{3} \beta_i U_{t-p} + \sum_{j=1}^{q1} \sum_{q1=0}^{2} \gamma_j GK_{t-q1} + \delta_k GEPL_t + \theta_l GRR_t + \varphi_m UD_t + \sigma_n EMS_t + \varepsilon_t \tag{3}$$

$$HQ: \; U_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \sum_{p=1}^{3} \beta_i U_{t-p} + \sum_{j=1}^{q1} \sum_{q1=0}^{2} \gamma_j GK_{t-q1} + \delta_k GEPL_t + \theta_l GRR_t + \varphi_m UD_t + \sigma_n EMS_t + \varepsilon_t \tag{4}$$

$$R2: \; U_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \sum_{p=1}^{3} \beta_i U_{t-p} + \sum_{j=1}^{q1} \sum_{q1=0}^{2} \gamma_j GK_{t-q1} + \sum_{k=1}^{q2} \sum_{q2=0}^{1} \delta_k GEPL_t + \sum_{l=1}^{q3} \sum_{q3=0}^{2} \theta_l GRR_t + \varphi_m UD_t + \sum_{n=1}^{q5} \sum_{q5=0}^{4} \sigma_n EMS_t + \varepsilon_t \tag{5}$$

where α_0 is a constant, t is a linear deterministic time trend, and ε_t is a white noise error term.

The four information criteria generate just three different models, as the the SC and the HQ suggest equal lag lengths for all variables. From now on, we will call model 1 to the model generated by AIC, model 2 to the one generated by SC and HQ and model 3 to the one generated by R-squared.

5.2.3 Residual and stability diagnosis

The three models were subjected to the usual residual and misspecification tests. Model 1 and 2 have not shown evidence of suffering from any difficulty related with serial correlation or heteroskedasticity. On the other hand, statistical tests strongly suggest the presence of serial correlation and heteroskedasticity in the Model 3. The results can be consulted in the Table 9 of the "Appendix". From now on, we will rule out model 3 from our analysis because of these unfavorable results.

After the models successfully passed the necessary tests to assess their validity, we are now prepared to evaluate the long-run relationship between the variables through the bounds test approach to cointegration.

5.2.4 Bounds test

According to Pesaran et al. (2001), the first step to apply the bounds test approach to cointegration is to estimate a conditional error correction mechanism (ECM). The conditional ECM is obtained from Eqs. (2) and (3) by subtracting U_{t-1} on both sides of the equation and by adding up and subtracting $\sum_{j=0}^{q} \gamma_j x_{t-1}$ on the right side, where x_t is a vector of the dependent variables. At the end, we get:

$$\begin{aligned} Model\ 1: \ \Delta U_t = {} & \alpha_0 + \alpha_1 t + \pi_1 U_{t-1} + \pi_2 GK_{t-1} + \pi_3 GEPL_{t-1} \\ & + \pi_4 GRR_{t-1} + \pi_5 UD_{t-1} + \pi_6 EMS_{t-1} \\ & + \sum_{i=1}^{2} \phi_i \Delta U_{t-i} + \sum_{i=0}^{1} \nu_i \Delta GK_{t-i} + \sum_{i=0}^{1} \varpi_i \Delta GRR_{t-i} + \varepsilon_t \end{aligned} \tag{6}$$

$$\begin{aligned} Model\ 2: \ \Delta U_t = {} & \alpha_0 + \alpha_1 t + \pi_1 U_{t-1} + \pi_2 GK_{t-1} + \pi_3 GEPL_{t-1} \\ & + \pi_4 GRR_{t-1} + \pi_5 UD_{t-1} + \pi_6 EMS_{t-1} \\ & + \sum_{i=1}^{2} \phi_i \Delta U_{t-i} + \sum_{i=0}^{1} \nu_i \Delta GK_{t-i} + \varepsilon_t \end{aligned} \tag{7}$$

where α_0 is a constant, t is a linear deterministic time trend, and ε_t is a white noise error term.

To assess cointegration between variables, the hypothesis $H_0 : \pi_1 = \cdots = \pi_6 = 0$ needs to be opposed against the hypothesis $H_1 : \pi_1 \neq \cdots \neq \pi_6 \neq 0$, where H_0 stands for the absence of a long-run relationship and H_1 stands for the presence of a long-run relationship.

The standard procedure to test for the joint significance of the coefficients involves computing the F-statistic and comparing its value with the critical value taken from the F-distribution. However, this methodology is not valid for the ECM model as the endogeneity of regressors makes OLS biased.

To overcome this difficulty, Pesaran et al. (2001) supply bounds on the critical values for the asymptotic distribution of the F-statistic. They provide lower and upper bounds on the critical values. The lower bound is based on the assumption that all of the variables are I(0), and the upper bound is based on the assumption that all of the variables are I(1). Actually, the true critical value is somewhere in between these two polar extremes.

If the computed F-statistic falls below the lower bound, we conclude that no cointegration exists. If the F-statistic exceeds the upper bound, we conclude that we have cointegration. Lastly, if the F-statistic falls between the bounds, the test is inconclusive (Table 1).

The value of the test statistic allows us to reject the null hypothesis of no cointegration with 5% of significance for Model 1 and 2. That provides a strong evidence for a long-run relationship between the variables contained in the ECM.

Table 1 Bounds test

H_0: No LR relationship exists			
Model 1		Model 2	
Statistic		Statistic	
$F - Stat \sim F_{(5,115)}$	3.9017	$F - Stat \sim F_{(5,115)}$	4.004
Critical values			
I (0)		I (1)	
2.81		3.76	

Critical values for a 5% level of significance

A complementary strategy to confirm the result of cointegration consists of looking at the behaviour of the estimated residuals taken from the static model. If estimated residuals appear to be stationary, this situation favours the conclusion of cointegration. We can obtain the estimated residuals ($\widehat{v_t}$) by estimating the following equation:

$$\widehat{v_t} = U_t - \widehat{\Theta}_0 - \widehat{\Theta}_1 t - \widehat{\Theta}_2 GK_t - \widehat{\Theta}_3 GEPL_t - \widehat{\Theta}_4 GRR_t - \widehat{\Theta}_5 UD_t - \widehat{\Theta}_6 EMS_t \quad (8)$$

After obtaining the estimated residuals series, we may perform the ADF unit root test. The test results clearly show evidence of stationarity, by rejecting the null hypothesis of non-stationarity at 1% significance level—see test results in Table 8 in the "Appendix". For an additional confirmation, we can look at the chart of the estimated residuals in the Fig. 1 of the "Appendix".

5.2.5 Long-run coefficients

The long-run model can be derived from the conditional ECM presented above in Eqs. (6) and (7). It is presented as a static model with the following specification:

$$U_t = \Theta_0 + \Theta_1 t + \Theta_2 GK_t + \Theta_3 GEPL_t + \Theta_4 GRR_t + \Theta_5 UD_t + \Theta_6 EMS_t + v_t \quad (9)$$

where Θ_n are the long-run coefficients computed as follows: $\Theta_0 = \alpha_0/\pi_1$, $\Theta_1 = \alpha_1/\pi_1, \Theta_n = \pi_n/\pi_1, n = 2, \ldots, 6$ and ε_t is a white noise error term.

The following table summarizes the results of Model 1 and 2 (Table 2).

However, long-run coefficients *per se* do not provide any conclusive answer to our research proposal. To know whether NAIRU is exogenous or endogenous relative to capital accumulation it is mandatory to determine their individual significance. Unfortunately, we are unable to perform such statistical tests due to the bias of the OLS estimator in the context of conditional ECM model.

To surpass this obstacle, we will follow the recommendation made by Pesaran and Shin (1998) and build an ECM according to the transformation proposed by Bewley (1979).

5.2.6 Bewley transformation

Bewley (1979) recommended an ECM transformation which has the advantage of explicitly estimating the long-run coefficients. Taking the general form of the ARDL model dispalyed in Eq. (3) as a starting point,

Table 2 Long-Run Coefficients

	Variables	Model 1 (AIC) Coefficients	Model 2 (HQ)
Θ_1	*t*	0.1245	0.1262
Θ_2	*GK*	− 1.2185	− 1.2162
Θ_3	*GEPL*	4.6063	4.1238
Θ_4	*GRR*	− 1.5665	− 1.0035
Θ_5	*UD*	0.0147	0.0494
Θ_6	*EMS*	2.5687	2.8876

$$y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \beta_i L^i y_t + \sum_{j=0}^{q} \gamma_j L^j x_t + \epsilon_t \tag{10}$$

we simply need to subtract $\sum_{i=1}^{p} \beta_i y_t$ on both sides of the equation and sum and subtract $\sum_{j=0}^{q} \gamma_j x_t$ on the right side of the equation to perform the Bewley's transformation. At the end, we may express it as follows:

$$y_t = \alpha_0 + \alpha_1 t + \sum_{j=0}^{q} \chi_j x_t + \sum_{i=0}^{p-1} \varsigma_i L^i y_{t-i} + \sum_{j=0}^{q-1} \varrho_j L^j x_{t-j} + \varepsilon_t \tag{11}$$

Applying that transformation to our ARDL model, we achieve the following regression structure:

$$\begin{aligned} Model1 : U_t = {} & \lambda_0 + \lambda_1 t + \lambda_2 GK_t + \lambda_3 GEPL_t + \lambda_4 GRR_t + \lambda_5 UD_t + \lambda_6 EMS_t \\ & + \sum_{i=0}^{2} \varpi_i \Delta U_{t-i} + \sum_{i=0}^{1} \psi_i \Delta GK_{t-i} + \sum_{i=0}^{1} \rho_i \Delta GRR_{t-i} + \varepsilon_t \end{aligned} \tag{12}$$

$$\begin{aligned} Model2 : U_t = {} & \lambda_0 + \lambda_1 t + \lambda_2 GK_t + \lambda_3 GEPL_t + \lambda_4 GRR_t + \lambda_5 UD_t + \lambda_6 EMS_t \\ & + \sum_{i=0}^{2} \varpi_i \Delta U_{t-i} + \sum_{i=0}^{1} \psi_i \Delta GK_{t-i} + \varepsilon_t \end{aligned} \tag{13}$$

This ECM specification, however, cannot be directly estimated by OLS. The inclusion of the contemporaneous first difference on the right-hand side of the equation (ΔU_t) creates endogeneity, a situation in which one of the regressors is correlated with the error term, making the OLS estimator biased.[3]

[3] Another possible source of concern would be the presence of serial correlation in the error term. However, we have already ruled out that possibility.

To overcome this obstacle, we need to estimate the equation through Instrumental Variables (IV). This estimation method consists of replacing the endogenous variable (ΔU_t) with an instrumental variable (Z) which has to satisfy two conditions: (1) Be correlated with the endogenous variable [$COV(Z, \Delta U_t) \neq 0$] and (2) Be uncorrelated with the error term [$COV(Z, \varepsilon_t) = 0$]. Bewley (1979) proposes using the lagged value of the dependent variable as instrumental variable ($Z = U_{t-1}$). He also shows that, under these conditions, the estimated long-run coefficients are equivalent to the ones computed from the conditional ECM.

To sum up, we are going to estimate Bewley's ECM through Instrumental variables for two main reasons: first, it provides explicit values of the coefficients and of its standard-errors and second it allows for directly testing the individual significance of the regressors, an essential procedure to assess my research question. The IV estimator chosen was the two-stage least squares (2SLS).

The estimation results are displayed in the following table (Table 3).

5.2.7 Discussion of results

In a first look at the results, we can easily confirm that the long-run coefficients estimated through 2SLS are equal to the ones computed from the conditional ECM estimated by OLS ($\lambda_i = \Theta_i$). For a proof of this equivalence, see Wickens and Breusch (1988).

The results of the two models are similar, both in terms of the value of coefficients and in terms of their statistical significance. The similarity is a strong argument supporting the robustness of the results.

All coefficients display the expected signs with the exception of *GRR*. In fact, results suggest that an increase in *GRR* generates a decrease in the unemployment rate. A possible explanation for this surprising result may be related to the automatic stabilizer effect of unemployment benefits, which smooths the economic cycle fluctuations by providing income to unemployed workers during recessions. Nevertheless, we should not pay too much attention to this relationship since the variable is not statistically significant.

The first differences of the lagged values of U_t ($\Delta U_{t-1}$and ΔU_{t-2}) have statistically significant coefficients, which confirms the well known presence of hysteresis in the unemployment series.

Concerning the results more strictly linked with our research, we can observe that *GK* coefficient is highly significant. At 1% significance level, we estimate that an 1% increase in capital accumulation causes a long-run decrease of 1.2185 percentage points in the unemployment rate for Model 1 and a decrease of 1.2121 percentage points for Model 2.

On the other hand, none of the institutional variables shows a significant coefficient at a 5% level. Only *GEPL* has a significant coefficient if we extend the level of significance to 10%.

The Wald Test shows that the institutional variables *GEPL*, *GRR* and *UD* are not jointly significant at 5% for both models—see Table 10 in the "Appendix". This result suggests that institutional variables as an all are not relevant for explaining the long run unemployment path in the Portuguese labour market.

Table 3 2SLS Estimation

	Variable	Model 1 (AIC)	Model 2 (HQ)
		Coefficients	Coefficients
λ_0	*intercept*	− 42.4528* (21.5958)	− 37.2474* (20.9361)
λ_1	t	0.1245 (0.0056)	− 0.1262*** (0.0055)
λ_2	GK	− 1.2185*** (0.1148)	− 1.2128*** (0.1161)
λ_3	$GEPL$	4.6063* (2.4563)	4.1238* (2.4166)
λ_4	GRR	− 1.5665 (2.0852)	− 1.0035 (2.1230)
λ_5	UD	0.0147 (0.0736)	0.0494 (0.0675)
λ_6	EMS	2.5687 (2.6175)	2.8876 (2.7892)
ϖ_0	ΔU_t	− 2.8776*** (0.9312)	− 2.9694*** (0.0886)
ϖ_1	ΔU_{t-1}	1.0169** (0.4457)	1.0050** (0.4622)
ϖ_2	ΔU_{t-2}	0.9740** (0.3885)	0.9859** (0.4054)
ψ_0	ΔGK_t	− 0.0283 (0.4558)	− 0.0053 (0.4738)
ψ_1	ΔGK_{t-1}	− 0.9498* (0.5278)	− 1.0078* (0.5635)
ρ_0	ΔGRR_t	− 3.6366 (4.6182)	−
ρ_1	ΔGRR_{t-1}	− 5.2075 3.7683)	−
	Instrument list: $\alpha_0, t, GK_t, GEPL_t, GRR_t, UD_t, EMS_t, U_{t-1}, \Delta U_{t-1}, \Delta U_{t-2}, \Delta GK_t, \Delta GK_{t-1}$		*Instrument list:* $\alpha_0, t, GK_t, GEPL_t, GRR_t, UD_t, EMS_t, U_{t-1}, \Delta U_{t-1}, \Delta U_{t-2}, \Delta GK_t, \Delta GK_{t-1}, \Delta GRR_t, \Delta GRR_{t-1}$

Standard-errors between parentheses

*; ** and ***Significance at 10, 5 and 1 % level

These results are in accordance with the most recent ILO report about the Portuguese Labour Market (ILO 2018), in which is explicitly stated that "adjustment reforms reduced protections without benefit to employment or the labour market". However, it is contrary to conclusion of OECD (2016), which sustains that labour market reforms will be important for promoting employment and productivity in the long-run.

All things considered, the results seem to support the Keynesian hypotheses, showing a highly significant long-run relationship between capital accumulation and unemployment. On the other hand, the results are broadly unsupportive of the

exogenous NAIRU hypothesis, provided that institutional variables are jointly not significant.

6 Conclusion

On this article we examined the impact of labour market variables and capital accumulation on the long-run unemployment of the Portuguese economy during the 1985–2013 period. By studying this relationship, we intended to verify the consistency between the labour market reforms included in the *Troika* memorandum and the past behaviour of the Portuguese labour market. Results favourable to the importance of the labour market institutional variables would be supportive of the approach taken by Troika, as well of the exogenous NAIRU that theoretically underlies its recommendations. On the other hand, results sustaining the importance of capital accumulation and the lack of relevance of the labour market variables would be supportive of the endogenous NAIRU theory, revealing the absence of empirical reasoning for the structural reforms that have been proposed and implemented.

We are aware of the limitations of this retrospective research exercise: the study can be assertive in stressing the inconsistency between the reforms proposed by Troika and the historical behavior of the Portuguese labour market but cannot present any conclusive answer regarding the effective impact of those measures in the future long-run unemployment. That answer can only be addressed by future research considering the developments of the labour market in subsequent years. Even so, we argue that our approach remains meaningful, since it is not reasonable to apply a policy strategy which fails to be coherent with the past behavior of the economic field that it intends to reform.

The results of the econometric estimation provided no evidence supporting the exogenous NAIRU theory. Out of the three institutional variables tested, just one of them proved to be individually significant at 10% level. Moreover, the institutional variables are jointly not significant at 5% level. In contrast, the estimation showed a strong inverse long-run relationship between unemployment and capital accumulation, statistically significant at 1% level. Thus, the results are supportive of the endogenous NAIRU theory, by suggesting that aggregate demand is the main determinant of the long-run unemployment, contradicting the usual assumption that potential output is invariant to demand shocks.

Given these results, this investigation concludes that the labour market reforms proposed by the *Troika* revealed lack of adequacy to the characteristics of the Portuguese labour market.

Appendix

See Tables 4, 5, 6, 7, 8, 9 and 10; Fig. 1.

Table 4 ADF unit root test

Variables	Level		1stdifferences		Conclusion
	Intercept	Intercept and trend	Intercept	Intercept and trend	
U	− 0.9595	− 2.1486	−3.7075***	−3.8300**	I (1)
GK	− 2.2000	− 1.1369	−3.2702**	−3.8416**	I (1)
GEPL	− 3.4264**	− 3.3068*	–	–	I (0)
GRR	− 2.5315	− 2.5105	−3.8240***	−3.7638**	I (1)
UD	− 3.40185**	− 3.4666***	–	–	I (0)
EMS	− 1.8689	− 1.3067	−12.0915***	−12.2216***	I (1)

*; ** and ***Significance at 10, 5 and 1% significance level. Number of lags chosen by Akaike Information Criteria (AIC)

Table 5 Data sources

	Original time series	Data source
U	Unemployment rate	Bank of Portugal
GFC	Gross fixed capital formation	Bank of Portugal
NMW	Nominal minimum wage	INE (Statistics Portugal)
CPI	Consumer Price Index	INE (Statistics Portugal)
SEPR	Strict employment protection legislation of regular workers	OECD
SEPT	Strict employment protection legislation of temporary workers	OECD
REGPROP	Proportion of regular workers in the employed population	Pordata
TEMPROP	Proportion of temporary workers in the employed population	Pordata
TOT	Terms of trade	OECD
GDP	Gross domestic product	Bank of Portugal
EX	Exports	Bank of Portugal
IM	Imports	Bank of Portugal
UD	Union density	OECD
GRR	Gross replacement rate	OECD

Table 6 Composite variables

GK	$log(GFC)$
RMW	NMW / CPI
EPL	$SEPR \times REGPROP + SEPT \times TEMPROP$
GEPL	$log(RMW \times EPL)$
TO	$(EX + IM)/GDP$
EMS	$log(TO \times TOT)$

Table 7 Descriptive statistics

Variables	Mean	Median	Maximum	Minimum	SD	Observations
U	7.39	6.59	17.08	3.50	3.14	116
GK	8.21	8.22	11.23	4.09	1.95	116
GEPL	1848.97	1862.50	2008.72	1437.27	107.09	116
GRR	36.87	39.00	45.00	22.00	5.23	116
UD	25.39	22.52	45.71	17.96	6.73	116
EMS	4.32	4.29	4.51	4.19	0.07	116

Table 8 Unit root test-ADF test

H_0: *There is a Unit Root*	
Statistic	
$ADF - Stat$	− 3.8737
	(0.003)

ADF-statistic is reported; *p* values between parentheses

Lag Length: 4

Table 9 Residual and stability diagnosis

Test	AIC		HQ and SC		R2	
	Statistic	Value	Statisitc	Value	Statistic	Value
BG serial correlation LM test	$nR_u^2 \xrightarrow{d} \chi^2_{(20)}$	1.4017 (0.077)	$nR_u^2 \xrightarrow{d} \chi^2_{(20)}$	1.5015 (0.0614)	$nR_u^2 \xrightarrow{d} \chi^2_{(20)}$	3.2343 (0.0114)
Heteroskedasticity test: BPG	$nR_u^2 \xrightarrow{d} \chi^2_{(13)}$	1.2699 (0.2406)	$nR_u^2 \xrightarrow{d} \chi^2_{(11)}$	1.5737 (0.1218)	$nR_u^2 \xrightarrow{d} \chi^2_{(13)}$	3.455 (0.0101)
RESET test	$F - Stat \sim F_{(2,100)}$	0.1262 (0.8815)	$F - Stat \sim F_{(2,102)}$	0.2177 (0.8047)	$F - Stat \sim F_{(2,91)}$	2.9812 (0.0235)

$F -$ Statistic and $\chi^2 - Statistic$ are reported. *p*values between parentheses.

Omitted variables used in RESET test: Powers of fitted values from 2 to 3

Table 10 Wald test

H_0: $\lambda_3 = \lambda_4 = \lambda_5 = 0$			
Model 1		Model 2	
Statistic	Value	Statistic	Value
$F - Stat \sim F_{(2,104)}$	1.0134 (0.2334)	$F - Stat \sim F_{(2,104)}$	1.0021 (0.2534)

F-statistic is reported; p values between parentheses

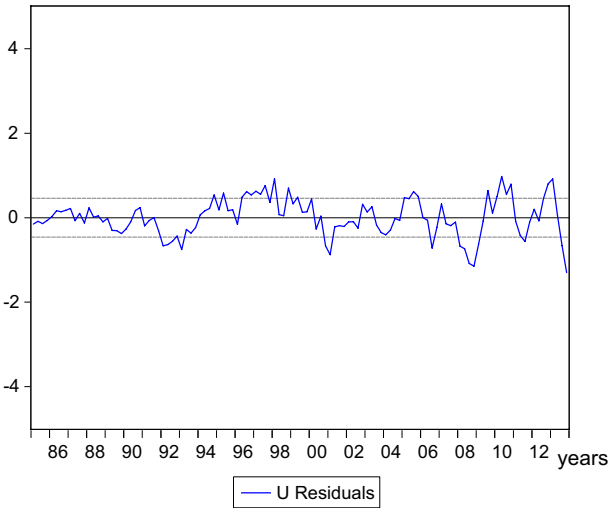

Fig. 1 Estmated residuals

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