Structural reforms and long-term growth – a model based analysis

Ana Fontoura Gouveia and Ana Filipa Fernandes*

Abstract

This paper assesses the impact on potential growth of selected structural reforms foreseen in the 2017 Portuguese National Reform Programme. Relying on QUEST III, a dynamic stochastic general equilibrium model with semi-endogenous growth developed by the European Commission, we focus our assessment on four areas: educational attainment, incentives to innovation, employment incentives and financing of the economy. The estimates show that the implementation of the selected reforms could bring significant long-term gains in terms of potential growth, derived from a boost in investment, improvements in productivity and employment growth.

Key-Words: Structural reforms, potential growth, DSGE model

GABINETE DE PLANEAMENTO, ESTRATÉGIA, AVALIAÇÃO E RELAÇÕES INTERNACIONAIS
MINISTÉRIO DAS FINANÇAS E DA ADMINISTRAÇÃO PÚBLICA
Av. Infante D. Henrique, 1C – 1º
1100 – 278 LISBOA
www.gpeari.min-financas.pt

* Ana Fontoura Gouveia (corresponding author ana.gouveia@gpeari.min-financas.pt) – GPEARI/Ministry of Finance and Nova SBE; and Ana Filipa Fernandes – GPEARI/Ministry of Finance. The opinions expressed are those of the authors and not necessarily of the institutions. The authors gratefully acknowledge the useful discussions with Janos Varga (European Commission) and the comments from Ana Paula Ribeiro (FEP-UP), João Brogueira de Sousa (European University Institute), Sílvia Santos (Banco de Portugal) and the participants of the 2nd Lisbon Conference on Structural Reforms, 6 July 2017. Any errors or omissions are the authors' responsibility.

1. Introduction

Well-designed structural reforms are crucial to unlock growth potential and boost jobs. In Portugal, the so-called National Reform Programme (NRP) presents, in detail, the medium-term strategy to tackle the country's main structural bottlenecks.[1]

The structural measures envisaged in the 2017 NRP are organized along six pillars, namely enhancing skills, boosting innovation, promoting territorial cohesion, strengthening administrative modernisation, tackling indebtedness and reinforcing social cohesion and equity. For each pillar, there are a set of concrete structural measures.

In this paper, we estimate the effect of some of these measures on potential growth, by reform area, using a widely used tool, a dynamic stochastic general equilibrium model, a macroeconomic model with micro foundations that results from the aggregation of optimal decisions by the different economic agents. In particular, we rely on a model developed by the European Commission and calibrated for the Portuguese economy: the QUEST III model with semi-endogenous growth, which is particularly suited for this type of analysis.

There are several studies assessing the impact of hypothetical reforms, where countries close half the gap for EU or EA top performers. These distance-to-frontier assessments are important, by providing estimates of potential impact on growth of hypothetical reform efforts (see, for instance, Varga et al, 2013 for the case of Greece, Italy, Spain and Portugal and Pinelli et al, 2016, for Italy), but they entail a comparison to a setting that does not actually exist in any country (as no country is consistently the top performer in the different reform areas). Also, the optimal choice of the policy mix depends on the specificities and preferences of the different countries, which means that the best framework can be different across countries. National policy mixes differ, based on a set of efficiency and equity considerations and based on national preferences. In this context, quantification exercises of on-going reform efforts (see,

[1] The NRP is presented by each Member State in the context of the European Semester, the cycle for economic policy coordination across the European Union, together with the Stability or Convergence Programmes, which expose the fiscal strategy for a four years period. For more information on this subject, see https://ec.europa.eu/info/strategy/european-semester_en.

for instance, European Commission, 2016) are particular important to contribute to the reform momentum and to deepen the understanding on the reform channels into the economy.

In this paper, we focus on the second approach and we rely on a model which is widely used by other European countries and by the European Commission, allowing for a more transparent methodology and an easier comparison across exercises.

The reforms covered in our analysis are those in the 2017 National Reform Programme of Portugal and for which (i) the impact on structural indicators can be quantified and (ii) it is possible to capture their effects in the context of the QUEST model (via "shocks to the model"). For instance, as argued by European Commission (2016), the model is not well suited to fully capture the effects of judicial reforms or of measures affecting the insolvency framework. An earlier exercise for the Portuguese economy (Aguiar, Ribeiro and Gil, 2017), exploring different transmission channels, estimated an impact for the increase of judiciary efficiency fairly small (output effects between 0.02% and 0.6% after 10 years, depending on the channel) and an impact of the insolvency framework improvement between 1.7% and 3.4% in 10 years.

In this exercise, further improvements of the judicial system and the reduction in red tape were, in a first stage, also included, as structural indicator estimates were available. However, the modelization strategy is that of European Commission (2014), i.e. via a reduction in entry costs inducing the estimated increase in entry rates. As the entry costs for the Portuguese economy are those of Doing Business from the World Bank and are already very low, we could not fully incorporate the estimated decrease. For this reason, we opted not to include these measures.

As it becomes clear from the above explanation, the fact that a measure is not included does not mean that it does not have an impact on growth. Therefore, our results provide only a partial picture of the potential outcome of the overall strategy and should be seen as illustrative of the potential growth effects.

In this context, we organize our analysis in four main areas: increases in educational attainment, promotion of innovation via R&D employment, incentives to investment via financing lines and employment incentives.[2]

The overall results for the estimated areas, presented in Figure 1, point to the relevance of pursuing the envisaged growth agenda as a way to decisively boost growth, with broad-based contributions from capital, employment and productivity.

Figure 1 – Sum of output effects for the selected reform areas, broken down by capital, labour and TFP contributions (%)

Source: Authors own computations using QUEST model. The figures presented are the sum of individual estimates for the selected reform areas. For presentational purposes, in this chart we consider the mean value of the two estimates computed for ALMP; for the measures providing financing to the economy, we consider that 50% of the amounts are translated into productive investment. Please refer to section 3 for further details.

2. The model

In this exercise, we use a version of QUEST III with semi-endogenous growth, as developed by the European Commission (Roeger et al., 2008 and Varga et al. 2013, for instance). QUEST III is a dynamic stochastic general equilibrium (DSGE) model, with micro-foundations that result from the aggregation of the optimal decisions of a broad set of agents, operating in a context of frictions in the financial, product and labour markets.

The model is based on the product-variety paradigm in which innovation generates endogenous productivity growth by creating new varieties of products. It is an extension of Jones (1995, 2005), with endogenous development of R&D within the framework of a standard DSGE model. Endogenous growth is driven by total factor productivity (TFP), endogenously generated by purposeful knowledge investment decisions of firms and households and technological change increasing

[2] For more details on these reform efforts and for an overview of all reforms, please refer to http://www.portugal.gov.pt/pt/o-governo/pnr/pnr-2017.aspx.

product variety (intermediate goods). The model relates the process of technological change to the underlying market.

This type of models are widely used to estimate the impact of structural reforms on potential GDP and its components, generating results that are presented in the standard format of deviations from a "no-reform" baseline.

In the QUEST model, there are two types of households (liquidity constrained and non-liquidity constrained) that supply three types of labour according to their skill level (low, medium and high) to firms, with unions acting as wage setters in monopolistically competitive labour markets.

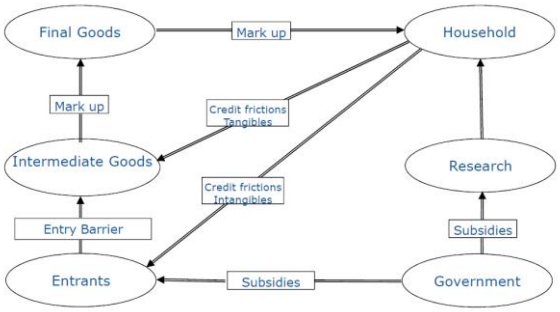
The liquidity constrained households consume their (wage and non-wage) income in each period while the non-liquidity constrained (Ricardian) (i) maximise their intertemporal utility function in consumption and leisure, (ii) buy new patents and designs developed by the R&D sector and license them to intermediate goods sector and (iii) rent tangible capital.

There are three productive sectors: R&D, intermediate goods and final goods. The R&D sector (i) employs only high-skilled workers, (ii) produce patents and new designs and (iii) features intertemporal externalities and international technology linkages. The intermediate sector operates in a monopolistically competitive market where firms (i) pay a license fee and fixed administrative costs to enter the market, (ii) use new designs to produce a unit of intermediate goods from a unit of capital and (iii) fix their prices with a mark-up over marginal costs. Finally, each firm of the final goods sector produces imperfect substitute goods (i) acting as a monopolistic competitor, (ii) using intermediate inputs and all the three types of labour and (iii) paying fixed entry costs.

Additionally, there is a monetary authority that fixes interest rates based on a Taylor rule, in response to changes in inflation and output gap. As expected, euro area members do not have an independent Taylor rule, as it is the ECB that sets the interest rate based on euro area weighted averages. Also, there is a fiscal authority that charges taxes and gives transfers, subsidies and benefits following a tax rule that forces debt convergence to target.

Figure 2 provides an overview of the model, the interlinkages between the different agents and the frictions considered.

Figure 2 – Overview of the QUEST model



Source: European Commission – DG-ECFIN.

The model is calibrated for Portugal and also includes two other economic areas: the other euro area countries and the rest of the world, from which households and firms import and export goods and technology.

There are three main areas in which it is possible to test shocks – knowledge/innovation, product market and labour market – through a large spectrum of channels, namely R&D subsidies, investment in human capital, mark-ups, fixed entry costs, capital costs, tax-shifts, wage mark-ups, participation rates and benefit replacement rates, among others.

3. Setting the scene

Educational attainment

Portugal has considerably improved its educational outcomes in the last decade. Between 2006 and 2016, the share of those with at most lower secondary education (ISCED levels 0-2) – henceforth the low-skilled ratio – decreased by almost 19pp, from 72% to 53%. However, Portugal still lags behind its European partners. Although the gap is being progressively reduced since 2008 (Figure 3), it is still large (26 and 23pp above the EU28 and the euro area, respectively).

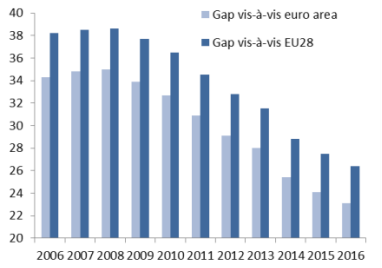
It is worth noting that the results for the younger generations are much closer to those of the EU (Figure 4). However, the legacy of the older generations, with worse educational attainment, can only be overcome with time, as earlier cohort effects fade out.

It is therefore crucial that the country maintains the positive path achieved so far. In this vein, the 2017 National Reform Programme includes a number of

measures aimed at increasing educational attainment such as (i) the promotion of the generalization of secondary education, namely through the diversification of the training offers, including vocational education; (ii) the modernisation of the education system, based on digital education resources, in order to innovate learning, manage, monitor and evaluate information and promote digital skills development; and (iii) the reinforcement of the support for disadvantaged students and the promotion of educational attainment, namely through the National Programme for the Promotion of Educational Attainment, the generalisation of the pre-school education since the age of 3, the gradual gratuity of the schoolbooks, the limitation of the number of students per class, among other measures, aiming to reduce retention and early withdrawal.

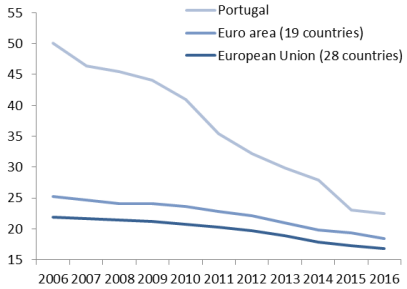
The goal of these measures is to reduce dropouts (from 14% to 10% by 2020) and failure rates (retention at 15 years old from 35% to 25% by 2020), reaching a ratio of low-skilled of 50% by 2020.

Figure 3 – Share of low-skilled in the population aged 15 to 64 years old



Source: Eurostat.
Notes: Low-skilled defined as ISCED levels 0-2 – Less than primary, primary and lower secondary education. The gap is the difference between the share for Portugal and the one for the reference area.

Figure 4 – Share of low-skilled in the population aged 20 to 24 years old



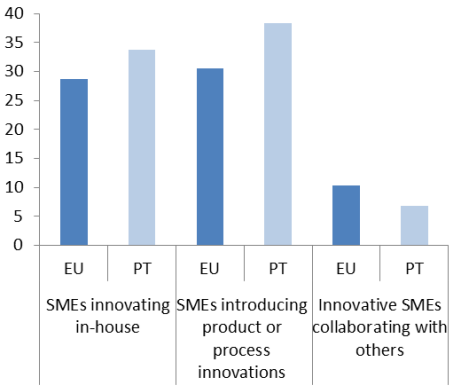
Source: Eurostat.
Notes: Low-skilled defined as ISCED levels 0-2 – Less than primary, primary and lower secondary education.

Incentives to Innovation

Portugal is a high-performing country in a number of important innovation related variables.[3] For instance, and despite the weaknesses in the qualifications of its labour force (as discussed in the previous sub-section), the number of new doctorates per 1000 population aged 25-34 clearly outperforms the EU, with a figure of 3.1 vis-à-vis 1.8 (2015 data). The number of international scientific co-publications per million population has more than doubled since 2008 and is, in 2015, 795 (459 in the EU).

It is important to understand if these innovation enhancing variables translate in actual innovative activities. While the share of SMEs innovating in-house and that of small and medium enterprises (SMEs) introducing innovations is high for EU standards (Figure 5), the collaboration between them has scope for improvement (7% vis-à-vis 10%). This is even more pronounced in terms of public-private partnerships, with the number of co-publications per million population significantly lagging behind its EU partners (7 and 34, respectively).

Figure 5 – Share of SMEs engaging in innovative activities (2015)



Source: Innovation Union Scoreboard – European Commission

This lack of interconnections translates in comparably low levels of employment in knowledge-intensive activities, modest results in terms of PCT (Patent Cooperation Treaty) patents applications per billion GDP and a wide scope for improvement in terms of the share of medium and high-tech product and knowledge-intensive services exports.

[3] Data in this section are sourced from the Innovation Union Scoreboard of the European Commission.

To overcome the existing bottlenecks, the 2017 National Reform Programme outlines a number of measures potentiating the employability of recent doctorates and collaborative innovation. Examples of these measures are (i) stimulus to higher education success through pedagogical monitoring and modernisation, to reduce drop out; (ii) stimulus to scientific employment in universities and research centres, by hiring young professors/researchers with doctorates; (iii) the Interface Programme, aiming at the development of R&D capacity in firms trough Collaborative Laboratories and Technological and Engineering Centres together with Business Innovation Contracts, also fostering the collaboration between firms and universities and strengthening the capacity of research centres; (iv) scientific and technological infrastructure re-equipment, fostering businesses internationalisation; (v) the CapaCITar Programme, supporting innovation centres and promoting the increase of competitiveness by the hiring of qualified personnel.

These measures are expected to increase scientific employment by nearly 8500 until 2020.

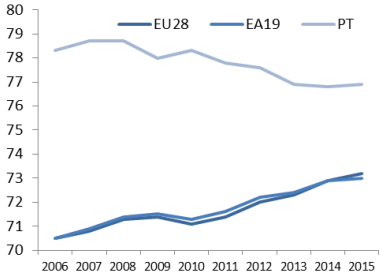
Employment incentives

Unemployment rates have been steadily declining since the peak in 2013 (16.2%), reaching 11.1% in 2016 (9.5% in April 2017, the most recent data available). Despite the positive path, unemployment is still high, in particularly for the youth (28.0% in 2016, after a reduction of 10.1pp after the 2013 peak). Long-term unemployment is also decreasing since 2013 but is still at 6.2% in 2016, affecting more than half of the unemployed.[4]

These developments contribute to discourage work. Indeed, participation rates, although high in relative terms, presented a declining trend up to 2014 (even more pronounced for those with lower skills), which contrasts with the positive trend in the EU and euro area (Figure 6). The decline was recently interrupted and participation is again improving.

The NRP includes a set of measures to promote participation and tackle youth and long-term unemployment. In our assessment, we focus on a sub-set of measures, namely (i) *Contrato Emprego*, through the allocation of financial support to hire registered unemployed, privileging open-ended contract, and (ii) professional internships, aiming to insert youth in the labour market and to the retrain long-term unemployed, including thought financial support when companies hire trainees after the traineeship, which are expected to increase employment by 2.25pp by 2020 (cumulative effect), due to both direct employment effects and to the increased employability of those benefiting from these programs.

Figure 6 – Active population as a share of active age population



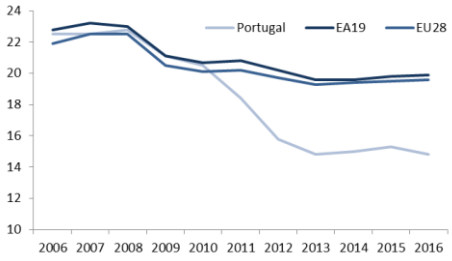
Source: Pordata based on Eurostat.
Note: There is a break in the series in 2011.

Financing the economy

Gross fixed capital formation decreased sharply between 2008 and 2013. Despite the modest recovery in 2014 and 2015, in 2016 the investment was still below 15% of the GDP, lagging behind EU and euro area averages of around 20% (Figure 7). While there are important composition effects, due to a reallocation of resources in the aftermath of the crisis, boosting investment is a policy priority.

The share of SMEs reporting access to finance as a significant problem has decreased sharply since 2012. However, in Portugal like in other euro area countries, there are still one-third of SMEs reporting access to finance as an important issue for their companies (Figure 8).

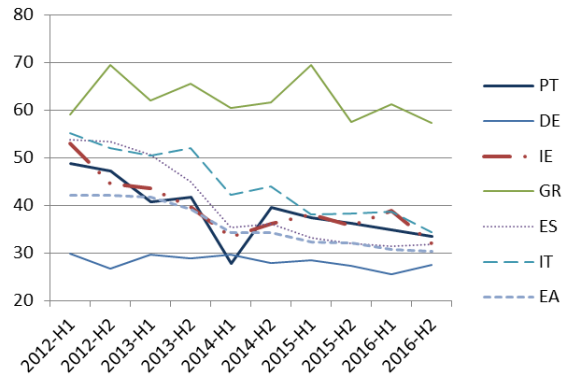
Figure 7 – Gross Fixed Capital Formation, % of GDP



Source: Pordata based on Eurostat.

[4] Data sourced from Statistics Portugal (INE).

Figure 8 – Percentage of SMEs signalling access to finance as an important problem



Source: Survey on the Access to Finance of Enterprises (SAFE), ECB.

Indeed, the 2017 NRP foresees a broad package of measures targeting investment, promoting innovation and fostering firms' capitalisation. Examples of these programmes include Capitalizar Fund, Start-up Portugal Programme and Indústria 4.0. The funds made available to firms until 2020 through the investment lines amount to 2.75% of GDP.

4. Methodology and results

As it is common in this type of exercises (e.g. European Commission, 2016), we depart from actual reform measures and translate them into structural indicators that feed the macroeconomic model. This mapping may be direct, for instance in the case of education reforms which improve the skills ratio, or indirect, as in the case of innovation, where the wage subsidy to R&D workers is adjusted in order to achieve the estimated impact on R&D employment.

Table 1 summarizes the reform areas and methodological approach followed, which are further discussed in the following sub-sections.

There are different options in the literature concerning the modelization of budgetary costs of the measures. Given the information available on the measures being modelled in this paper, we consider that in the short- to medium-run there is no budgetary implication, as the potential costs of the reforms are financed through a reorganization of existing funds. In the longer-run, we consider a debt stabilizing rule, ensuring that debt to GDP ratio is kept constant.

Table 1 – Modelling strategy by reform area

Reform area	Input	QUEST modelling strategy
Educational attainment	Reduction of the share of population with low-skills	Direct via the reduction of low-skilled share and increase of medium-skilled share
Incentives to Innovation	Increase in R&D employment	Indirect via an increase in the subsidies to R&D wages such that the model delivers the estimated increase in R&D labour
Employment incentives	Increase in employment	Option A: Indirect via an increase in participation rates resulting in the expected increase in employment Option B: Indirect via a decrease in the tax on labour income inducing the expected increase in employment
Financing of the economy	Total amounts of funds available in the form of financing lines	The reduction of the cost of capital such that the model delivers the potential increase in investment, considering different degrees of take-up of the available funds

Source: authors' own elaboration.

Educational attainment

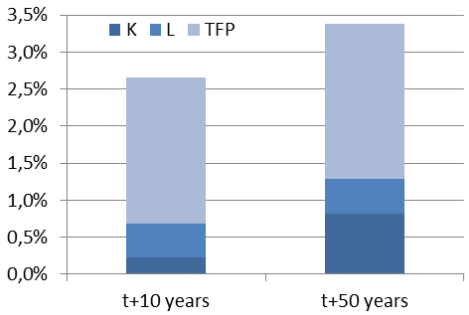
The educational reforms described in Section 3 can be directly modelled in QUEST by reducing the share of low-skilled to 50% and correspondingly increasing the share of medium skilled.[5]

[5] Low-skilled correspond to the standard classification of ISCED 0-2 education levels while high-skilled are human resources in science, mathematics and computing, engineering, manufacturing and construction. Medium-skilled correspond to those not classified as high-skilled or low-skilled in the model.

Given that the model is calibrated with 2015 data, this implies a gradual reduction of 4pp until 2020. The outcome is an improvement of GDP by 2.7% after 10 years and of 3.4% after 50 years. As expected, these gains are mainly driven by total factor productivity improvements, although there are also employment and investment gains (Figure 9).

The intuition behind these results is as follows: the higher supply of medium skilled workers decreases their skill premium and implies lower relative wages for this group of workers. Given the imperfect substitution between different types of workers, relative wages for the low-skilled increase, given that they are relatively scarcer. This brings overall employment gains. The larger availability of medium-skilled workers, who are more productive, increases productive efficiency, bringing TFP gains. In addition, as capital and labour are complements, investment also increases.

Figure 9 – Output effects of education related measures, broken down by capital (K), labour (L) and total factor productivity (TFP) contributions



Source: Authors own computations using QUEST model.

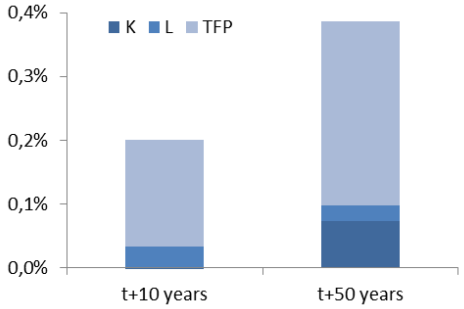
Incentives to Innovation

Given the policies being implemented and the possibilities of the QUEST model, the starting point of our estimate is the number of direct R&D employment opportunities created up to 2020. We translate this into the model as an increase in the share of workers allocated to R&D activities. Another option would have been to model this as an increase in the share of high-skilled workers (reducing that of medium and low-skilled). We opted for the first approach given that these policies are primarily aimed at shifting human resources to R&D activities rather that increasing the overall number of doctorates.

Given that the share of R&D labour in the model is endogenous, and considering the nature of the policies being implemented, we model this change as an increase in the government' subsidy to high-skilled workers wage in the R&D sector.[6] Note that in QUEST, high-skilled labour can be allocated to the final goods production or the R&D sector. A wage subsidy in the R&D sector reduces the costs in the sector and increases high-skilled labour allocated to R&D, fostering innovation. The increased supply of patents implies new intermediate varieties, lowering entry costs and increasing mark-ups in this sector, turning it more profitable and boosting output.

Indeed, after 10 years, output is expected to expand by 0.2% vis-à-vis the baseline scenario and by close to 0.4% after 50 years (Figure 10). As expected with innovation-related reforms, most gains are due to the TFP contribution. Employment gains are rather limited, given the reduced weight of R&D employment on total employment and the fact that an increase in high-skilled workers in R&D sectors reduces their availability in the final goods sector.

Figure 10 – Output effects of innovation related measures, broken down by capital, labour and TFP contributions



Source: Authors own computations using QUEST model.

Employment incentives

Given the outset of our model, we consider two alternative modelling strategies.[7]

The first assumes that the labour market reforms described above have a direct positive impact on

[6] An alternative would be to consider an R&D subsidy in the form of tax credits, as done, for instance in Pinelli et al (2016). The results are broadly similar: 0.14% in 10 years and 0.50% after 50 years.

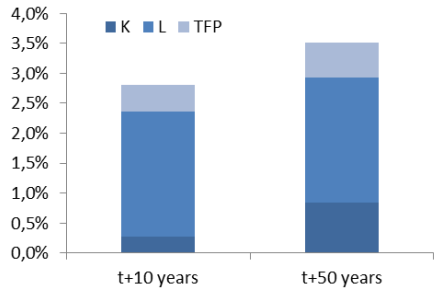
[7] A third option would have been to reduce leisure incentives by decreasing the unemployment benefit replacement rate, increasing labour supply. However, our modelling strategy reflects more closely the type of reforms being implemented given the structure of our model.

participation rates (of low and medium-skilled agents), inducing the estimated change in employment.

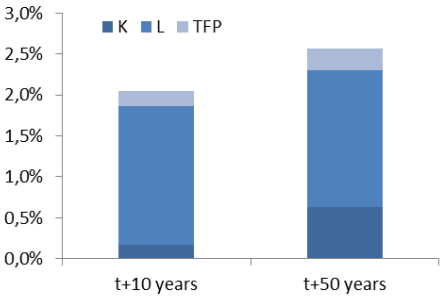
Increasing the participation rate will increase competition in the labour market, pressuring wages of low and medium-skilled workers downwards and fostering employment. The operating costs of the final goods sector decrease, increasing the demand for new varieties and, consequently, for new patents, thus promoting growth.

Figure 11 – Output effects of labour-market measures, broken down by capital, labour and TFP contributions

a. Option A



b. Option B



Source: Authors own computations using QUEST model.

The other option assumes that the measures envisaged work as an incentive to labour supply, which we mimic in the model by lowering the tax on labour (in an amount that allow us to reach the expected employment change).

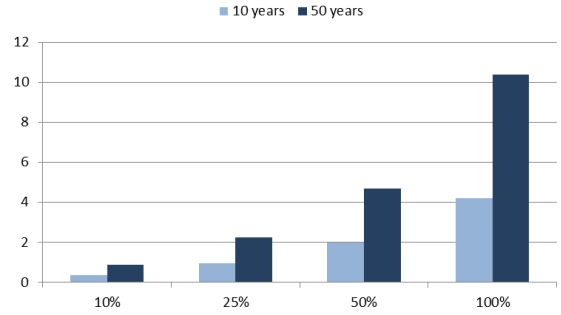
The increase in after tax wage income increases the cost of leisure and thus increases the incentives to work for all skill groups, leading to an increase of labour supply and a decrease in wages. As in the first option, this decreases operating costs for final goods production and therefore demand for new intermediate varieties, resulting in more patents and R&D.

The results point to an effect on GDP between 2.1% and 2.8% after 10 years and between 2.6% and 3.5% after 50 (Figure 11). While up to 2020 the two options deliver the same employment gains, as the model adjusts the further increases in employment are higher in Option A as it leads to a stronger reduction in wages.

Financing of the economy

Given the outset of the model, we calibrate the risk premium for investment on tangible assets such that we reach the potential boost in investment. Given that the uptake of the funds is not yet known, we consider different scenarios. Broadly speaking, according to our estimates, for each 10pp of invested funds, GDP would grow by around 1% vis-à-vis a no policy change scenario (Figure 12). As expected, the largest share of GDP gains is due to capital accumulation (Figure 13).

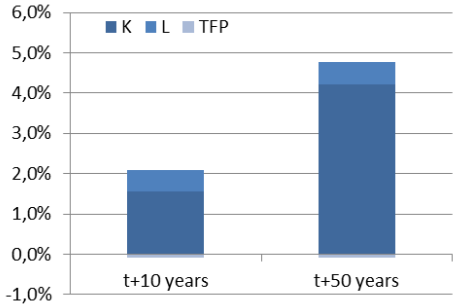
Figure 12 – Output effects of financing measures, by proportion of financing considered



Source: Authors own computations using QUEST model.

Intuitively, the reduction of tangible capital costs decreases the rental rates for tangible capital, reducing the operating costs in the intermediate sector, increasing supply and boosting demand for new varieties. This, in turn, increases the production of patents, increasing output growth.

Figure 13 – Output effects of financing measures, broken down by capital, labour and TFP contributions



Source: Authors own computations using QUEST model.

5. Conclusion and way forward

This paper provides an assessment of the impact on potential growth of selected reform areas. Unlike some other studies in the same field, we do not focus on hypothetical reform plans (e.g. closing half the gap vis-à-vis top performers) but on actual reform measures, already foreseen by the national authorities.

In that context, taking into account the availability of estimates of underlying structural indicators and the channels foreseen in the QUEST model, we estimate the impact on potential growth of a sub-set of measures included in the 2017 Portuguese National Reform Programme, organizing them around four main areas: educational attainment, incentives to innovation, employment incentives and financing of the economy.

The estimated effects, summarized in Table 2, highlight the relevance of fully implementing the envisaged reform strategy, given the significant growth impact. Earlier studies have also provided evidence of the relevance of a well-targeted reform agenda to boost growth (see, for instance, European Commission, 2016 or Aguiar, Ribeiro and Gil, 2017).

Table 2 – Summary of the estimated impact on GDP, by policy areas

Effects		Policy Area			
		Educational attainment	Incentives to innovation	Employment incentives	Financing of the economy
GDP growth	t+10 years	2.7	0.2	2.1-2.8	2.0
	t+50 years	3.4	0.4	2.6-3.5	4.7

Source: Authors own computations using QUEST model. The figures reported for the financing of the economy assume that 50% of the available funds are translated into productive investment (for different options, see Section 4).

It is important to note that, for several reform measures, it is not possible to reliably estimate the foreseen impacts on the structural indicators that can then be used as inputs in the model. Examples of measures not included are those related to administrative simplification (SIMPLEX+), promotion of digital skills, adults qualifications, territorial cohesion, among others. This does not mean that they would not have an important impact on growth.

Even in the cases where this is possible, there is an important degree of uncertainty surrounding the structural indicators estimates and their translation as inputs into the model that needs to be acknowledged. Our estimation tool is a model which, by its very nature, is a simplification of reality and thus cannot capture all types of reforms nor the full range of the effects of the measures for which an estimate is actually made.

For instance, in the case of education, we focus on quantity changes from low to medium skill. However, there are also quantity effects from further increases in the share of high skilled or from boosts in quality, which could not be quantified in this exercise and that are likely to be high. Also, while we account for the impact of digitalization on school attainment, the full impact of the digitalization strategy is much broader.[8]

Finally, the analysis presented for each reform area is *ceteris paribus*, i.e. assumed that all other reform areas are kept unchanged. In reality, there are spillovers across reforms areas that call for an adequate sequencing and bundling of reform efforts (e.g. incentives to R&D may boost innovation and therefore render the use of available funding for investment more efficient).

Also, the modelling strategy assumes that reforms in all other countries are kept constant. However, this is not the case in reality and, as described in Varga and In't Veld (2014), there are different types of spillovers at play, namely demand spillovers, competitiveness effect, international financial flows and knowledge spillovers. Although they act in different directions, the authors estimate that the joint implementation of reforms further increases the overall GDP impact.

Finally, we do not focus on distributional considerations, which are a key ingredient for a proper assessment of the impact of reforms. While the model allow us to have a rough estimate of these effects – for instance, in the case of educational attainment reforms, increasing the share of medium-skilled workers relatively to that of low-skilled improves the wages of low-skilled, given the imperfect substitutability between skill types – a more

[8] For instance, concerning the share of high-skilled in Portugal, Varga et al (2013) estimate that the impact of closing half the gap for top performers in the EU would be, in the long-run, 5.8%. Also, Aguiar, Ribeiro and Gil (2017) estimate that the schooling quality improvement in Portugal from 2010 to 2012 increased potential growth by 0.12% in 10 years and 0.74% in the longer-run. Lorenzani and Varga (2014) estimate that the impact of the Digital Agenda for Europe in the long-run would entail additional 3% of GDP growth for Portugal over the baseline, on top of the 1% already achieved from past efforts (respectively, 0.5% and 1,7% in 10 years).

thorough and robust assessment is only possible with an extension of the model, further exploring differences across households.

6. References

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