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The GDP Impact of Reform: A Simple Simulation Framework

Sebastian Barnes,
Romain Bouis,
Philippe Briard,
Sean Dougherty,
Mehmet Eris

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ABSTRACT/RÉSUMÉ

The GDP impact of reform: a simple simulation framework

This paper presents a framework to assess the impact of a wide range of structural policy reforms on GDP per capita at various horizons by linking together previous empirical studies mostly carried out by the OECD. The simple accounting framework consists of reduced-form equations and offers a more tractable and realistic alternative to an estimated general equilibrium model. Though this involves some risks of double counting the effects of certain reforms and omits interactions across different policy areas, the plausible scenarios suggest that the largest long-run GDP per capita gains may be obtained from reforms that would raise the quantity and quality of education, strengthen competition in product markets, reduce the level and/or duration of unemployment benefits, cut labour tax wedges and relax employment protection legislation. Past reforms in these areas might also have contributed to as much as half of GDP per capita growth in OECD countries in the decade prior to the recent financial and economic crisis. Simulations further indicate that addressing all policy weaknesses in each OECD country by aligning policy settings on the OECD average could raise GDP per capita by as much as 25% in the typical country.

JEL classification codes: E27; O43; O47.
Keywords: Growth; Productivity; Employment; Structural Reforms.

L'impact des réformes sur le PIB : un cadre simple de simulation

Cet article présente un cadre d'analyse pour évaluer l'impact sur le PIB par tête à différents horizons d'un large éventail de réformes de politiques structurelles en reliant ensemble des études empiriques précédemment réalisées pour la plupart par l'OCDE. Le cadre comptable simplifié est constitué d'équations sous forme réduite et offre une alternative plus flexible et plus réaliste qu'un modèle estimé d'équilibre général. Bien que cela implique des risques de double comptage des effets de certaines réformes et l'omission des interactions au sein des différents domaines de politiques, les scénarios plausibles suggèrent que les gains en PIB par tête à long terme les plus élevées pourraient provenir des réformes augmentant la quantité et la qualité de l'éducation, renforçant la concurrence sur le marché des produits, réduisant le niveau et/ou la durée des allocations chômage, diminuant le coin salarial et assouplissant la législation sur la protection de l'emploi. Les réformes passées dans ces domaines pourraient avoir contribué jusqu'à la moitié de la croissance du PIB par tête dans les pays de l'OCDE au cours de la décennie précédant la crise financière et économique récente. Les simulations indiquent en outre que traiter l'ensemble des points faibles de chaque pays de l'OCDE en alignant les positions des politiques sur la moyenne de l'OCDE pourrait accroître le PIB par tête jusqu'à 25% dans le pays moyen.

Codes JEL : E27 ; O43 ; O47.
Mots clé : Croissance ; Productivité ; Emploi ; Réformes structurelles.

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THE GDP IMPACT OF REFORM: A SIMPLE SIMULATION FRAMEWORK

By Sebastian Barnes, Romain Bouis, Philippe Briard, Sean Dougherty and Mehmet Eris[1]

1. Introduction

1. A wide body of OECD and other empirical evidence has been built up over the years regarding the effects of structural reforms on various aspects of economic performance. In particular, OECD empirical studies have explored the impact of a wide set of structural policy indicators (including *inter alia* in the areas of labour and product market regulations, human capital, social transfer programmes, tax systems, trade and FDI policies, R&D incentives) on a broad range of indicators of economic performance (such as total factor productivity, factor accumulation, labour force participation, employment or hours worked) by means of panel data econometric analysis at the country or sector levels (see *e.g.* the OECD Growth Study or the OECD Jobs Strategy and its reappraisal; OECD, 1994; 2003; 2006a). Some of these studies have been used to assess the potential gains from reforms, including recently as part of OECD contributions to the G20 Mutual Assess Process (Bouis and Duval, 2011). However, no attempt has been made at putting these findings together, *i.e.* taking into account the multiple channels through which structural policies may affect economic performance to produce estimates of their overall effects on GDP. Yet estimates of the aggregate impact of policies on GDP can help assess the absolute and relative impacts of various past and potential reforms in different countries over multiple horizons. They can also be used to cross-check the relevance of some of the structural reform recommendations made by the OECD as part of its flagship publication *Going for Growth* (see Section 4 below). The aim of this paper is to provide such "ready reckoners".

2. The main contribution of the framework developed in this paper is to evaluate the impact of policy reforms in terms of GDP per capita by linking together in a coherent way a range of empirical studies (mostly) carried out by the OECD. It is an accounting framework of mostly reduced-form equations that explain individual sub-components of GDP per capita, rather than a structural model of simultaneous equations. Such a simple framework offers a more tractable and realistic alternative than trying to estimate an analogous general equilibrium model (see, for example, Dreger *et al.*, 2007). However, this comes at the expense of not being able to analyse the impact of reforms in a consistent theoretical framework that takes into account complex interrelationships between policies as well as spillover effects. The exercise is subject to other important limitations. The effects of the structural policies considered are point estimates drawn from preferred specifications in the underlying studies, meaning they are subject to both model and parameter uncertainty. Although efforts have been made to avoid it, there is also a risk of double-counting, *i.e.* including the effect of a policy on GDP through a particular channel more than once. Furthermore, since some explanatory variables considered were not included in all equation estimates featured in the

1. OECD Economics Department, except Philippe Briard (now at the French Ministry of Employment). Without implication, the authors would like to thank several OECD colleagues, in particular Andrea Bassanini, Sven Blondal, Alain de Serres, Romain Duval, Jørgen Elmeskov, Giuseppe Nicoletti, Jean-Luc Schneider, for their valuable comments and Martine Levasseur for technical assistance as well as Celia Rutkoski and Olivier Besson for editorial support. The paper has also benefited from comments by members of the Working Party No. 1 of the OECD Economic Policy Committee. The usual disclaimer applies.

underlying studies, there is a risk of bias from omitted variables. In addition, some variables are potentially determined simultaneously, despite equations being estimated independently, so the possibility of endogeneity in the estimates also exists. Finally, interactions across different policy areas are largely ignored, although such interactions have been found to play a role *e.g.* in explaining how countries may achieve good labour market outcomes with different sets of institutions (Bassanini and Duval, 2009). Therefore, the results of the model should be treated as only illustrative. They do not provide precise estimates of the impact of proposed policies on GDP per capita, and cannot be used as a mechanical tool to identify reform priorities.

3. Bearing the caveats in mind, the main findings from this paper are:

- Although policy changes in different areas do not have a common metric and therefore are not strictly comparable, based on plausible reform scenarios the largest GDP per capita gains in the long run would seem to be obtained from reforms that would raise the quantity and quality of education, strengthen competition in product markets, reduce the level and/or duration of unemployment benefits, cut tax wedges and relax employment protection legislation.

- In retrospect, product market reforms seem to have accounted for the bulk of reform-induced gains in GDP per capita over the decade prior to the recent financial and economic crisis.

- Simulations suggest that addressing all policy weaknesses – defined as policy stances (as measured by OECD indicators) weaker than cross-country averages in areas covered by the framework – in each OECD country by aligning policy settings on the OECD average could raise GDP per capita by about 25% in the typical country. About one-fifth of the long-run overall impact – around 5 percentage points – would come from product market regulation policies. Another one-fifth of the impact would come from reforms of the average tax wedge. Significant gains would also be obtained from increased human capital and reforms of unemployment benefit systems.

4. The paper is organised as follows. The second section sets out the simulation framework, outlining the basic relationships between policy and performance. The third section describes the properties of the framework and presents simulations to illustrate the impact of 25 distinct policy reforms on GDP per capita. The final section outlines how the framework can be used to derive policy priorities, and compares the priorities derived using the model with the policy priorities presented in the 2009 edition of *Going for Growth*.

2. The simple simulation framework

5. This section sets out the empirical framework. Based on various original econometric analyses, it summarises the effects of a number of structural policies on economic performance through each of the sub-components of GDP: labour productivity, average hours worked and the employment rate. The model is calibrated using parameters based on estimates of the partial effect of policy on performance taken from previous OECD studies. A full list of coefficients and detailed specifications is given in Annex A.

2.1 Overview of how policy affects GDP per capita

6. The model is built around the identity that differences in (log) GDP per capita is the sum of (log) differences in labour productivity, average hours worked, the employment rate and the dependency ratio:

$$\Delta gdpc = \Delta lp + \Delta hrs + \Delta empr + \Delta wpop \quad (1)$$

where delta (Δ) denotes the differences *vis-à-vis* a baseline scenario with no reforms and lower case variables denote logs of their uppercase counterparts in this equation as well as in the rest of the paper.[2] *GDPC* is GDP per capita, *LP* is defined as GDP per hour worked, *HRS* is the average number of hours per employed person, *EMPR* is employment as a share of the working age (15-64) population and *WPOP* is the share of the working age population in the total population, which is assumed to be exogenous.

2.2 Selection of parameters of the model

7. The size of the effects of policy reforms on performance are based on econometric estimates found in previous OECD studies.[3] The estimated coefficients from those studies are taken at face value: it is assumed that the estimates give the "true" parameter for the marginal effect of policy on performance and that the policies can be varied independently of each other. The original studies often include country-specific intercepts (fixed effects) but these are not included because they do not contribute to evaluating the *marginal* effects of policy. Estimated coefficients are applied irrespective of whether a country is in the original estimation sample.[4]

8. In practice, the estimated coefficients differ across specifications in the underlying studies: parameters are chosen from the "preferred" specification identified in the original analysis, from the equations most consistent with other assumptions,[5] or from around the mid-point of available estimates. Annex A provides measures of parameter uncertainty and the range of alternative estimates, and also describes specific issues in applying the existing coefficient estimates to the simulation model.

9. As already stressed above, the framework is subject to some inherent limitations including *inter alia* the lack of a consistent general equilibrium framework that would enable to fully account for interrelationships between policies and various spillover effects, model and parameter uncertainty, risks of double-counting some of the impacts of polices, potential omitted variable bias and endogeneity concerns, as well as the omission of potentially important interactions across different policy areas. This again underlines that the results of the simulation framework should be treated as only illustrative.

2.3 Labour productivity

10. Labour productivity is modelled using an augmented Solow growth model. A wide range of policies have direct and indirect effects on the steady state level of productivity, while others, such as restrictive product market regulation, have been found to have additional short and medium-run effects on actual productivity growth by slowing the rate of convergence to the steady state.

2.3.1 Steady state labour productivity

11. Labour productivity per hour worked is determined in a standard neoclassical Solow growth model augmented for human capital (Lucas, 1990). The production function is of a Cobb-Douglas form

2. Except where stated otherwise.

3. In addition, some effects are calibrated by assumption. Data on structural features of the economy, such as the age composition of the population, are also used to construct the baseline. These account, to a large extent, for cross-country differences in simulation results of equivalent policy reforms (see Box 2). However, changes in composition induced by policy reforms play only a minor role in the simulation results.

4. Analogous methods could be applied if the exercise were extended to new OECD member countries.

5. For example, the estimates of the impact of R&D on growth are only chosen from specifications that also include human capital.

with constant returns to scale and labour-augmenting technical progress. Labour-augmenting technical progress is referred to as total factor productivity (TFP) in the remainder of the document.

12. Policy influences the steady-state level of labour productivity in a number of ways. First, some policies, such as product market regulations, are modelled as having *direct* effects on the level of labour productivity through TFP. Second, some policies have an *indirect* impact on the long-run level of productivity either through their effect on physical and human capital accumulation, or on *intermediate* variables, such as R&D, that in turn affect TFP.

13. The steady state of labour productivity relative to baseline is given, following a derivation and estimates from Boulhol *et al.* (2008) and Arnold (2008)[6] as:

$$\Delta lp^{*} = \gamma.\Delta \mathrm{X} + 0.333 * \Delta s_{k} + 0.611 * \Delta hc. \quad (2)$$

The change in productivity in response to policy reforms depends on associated changes in s_k and *hc*, respectively investment in physical capital and human capital. The term $\gamma.X$ stands for TFP, where the first term is a vector of parameters drawn from Arnold (2008), Bassanini *et al.* (2009), Boulhol *et al.* (2008), and OECD (2007) and giving the response of TFP and the second is a vector of variables representing corresponding OECD indicators of structural policies as well as economic variables that may again be influenced by structural policies, and is given by:

$$\begin{aligned} \gamma.\Delta X = & -0.035 * \Delta regref + 0.042 * \Delta berd + 0.037 * \Delta atrd \\ & - 8.7\lambda * \Delta EPL + 0.25 * \Delta TAXSHARE \end{aligned} \quad (3)$$

where REGREF[7] is an indicator of product market regulation based on the average regulation of seven network industries, BERD[8] is business expenditures on R&D as a share of value added used to proxy for total R&D, ATRD is an indicator of trade openness adjusted for country size, EPL is the employment protection legislation index for regular workers, λ is a coefficient detailed below, and TAXSHARE is the share of consumption and property taxes in total tax revenues.

14. The estimates of the impact of product market regulation (REGREF),[9] investment in physical and human capital, and R&D intensity are derived from Boulhol *et al.* (2008) and OECD (2007). REGREF has a direct negative effect on total factor productivity. This effect is assumed to be in addition to indirect effects via investment (s_k) and trade (*atrd*). This interpretation can be justified on the basis that in Boulhol *et al.* (2008) the impact of REGREF on output is estimated controlling for investment and trade.

15. The effect of EPL on aggregate labour productivity comes from an industry-level analysis of Bassanini *et al.* (2009). As was the case for REGREF, this direct effect on labour productivity is added to

6. Boulhol *et al.* (2008) and Arnold (2008) estimate the impact on GDP per capita. To turn this into a labour productivity equation, it is assumed that the arguments in the GDP-per-capita equation do not affect employment or hours worked. This is only a crude approximation as, for example, REGREF is modelled as influencing employment levels in addition to having direct and indirect effects on productivity. However, this may be reasonable in practice, as the realised effect on employment levels is small.

7. REGREF is now referred to as ETCR in the most recent OECD work on product market regulation.

8. The BERD indicator only partially reflects the impact of R&D on technological know-how, in part because spill-over effects of public R&D are not included.

9. The measurement of product market regulation is discussed further in Annex 3, but it is proxied by the REGREF indicator of regulation in network industries, although it is also possible to use the alternative economy-wide product market regulation indicator (excluding restrictions on trade and FDI that are included separately as determinants of trade).

effects of EPL on trade and R&D spending. The coefficient λ reported in equation (3) is a measure of the extent to which EPL puts effective constraints on labour turnover. It is given by

$$\lambda = \sum_j \theta_{bj} \times (Layoff_j^{US} - 4) \quad (4)$$

with θ_{bj} the value added share of the "EPL-binding" industry j and $Layoff_j^{US}$ the average layoff rate of industry j in the United States over 2001-03. An industry is said to be "EPL-binding" if its layoff rate (defined as the ratio of annual recorded layoffs to wage and salary employment) was greater than 4% in the United States over 2001-03.[10,11]

16. The estimated effect of the share of consumption and property taxes in total tax revenues (TAXSHARE) is from Arnold (2008). This estimate is obtained after controlling for the overall tax burden in the economy and other determinants of productivity such as R&D expenditures.[12]

2.3.2 Policy effects on intermediate determinants of total factor productivity

17. The effect of policy variables on R&D spending is calibrated on the evidence in Jaumotte and Pain (2005):

$$\Delta berd = -10.73 * \Delta REGREF - 3.48 * \Delta EPL - 0.48 * \Delta bindex + 0.01 * \Delta rd\_sub \quad (5)$$

where *EPL* is an indicator of the restrictiveness of job protection regulation taking into account both permanent and temporary contracts, *BINDEX* is an indicator of tax breaks in favour of R&D and measures the ratio of the after-tax cost of R&D to the after-tax returns and *RD_SUB* measures explicit budgetary subsidies to private R&D.

18. Policy affects the measure of trade openness (*ATRD*) through the shares of goods and services exports in GDP:

$$\Delta atrd = f\left(\Delta(XG/GDP), \Delta(XS/GDP)\right) \quad (6)$$

10. Such a criterion is needed because the analysis carried out in Bassanini *et al.* (2009) is a differences-in-differences approach that only identifies the impact of EPL on the productivity growth gap between binding and non-binding industries, while the effect on non-binding industries is not identified. The assumption made here that EPL has no impact on productivity growth in non-binding industries – as well as the omission of any possible impact of EPL on reallocation of resources from lower to higher-productivity growth sectors – means that the simulated effects of EPL reform on productivity growth should be seen as lower-bound estimates.

11. EPL-binding industries identified using this criterion are Textiles, wearing apparels and leather; Wood and wood products; Paper, printing and publishing; Coke, refined petroleum, nuclear fuel; Rubber and plastics; Non-metallic mineral products; Basic metals and fabricated metals; Machinery n.e.c.; Electrical and optical equipment; Transport equipment; Manufacturing, n.e.c. and recycling; Construction; Transport and storage; Post and telecommunication. Data on value added at the industry level come from the OECD STAN database (Structural Analysis Database) except for Mexico and Turkey for which the UNIDO (United Nations Industrial Development Organization) database is used.

12. It should be noted that unlike the coefficients on REGREF, BERD, and ATRD, the coefficients on EPL and on TAXSHARE are semi-elasticities. For example, in the case of TAXSHARE, the reported coefficient indicates that increasing the share of consumption and property taxes (or decreasing the share of income taxes) in total tax revenues by 10 percentage points may raise labour productivity in the long run by 2.5%.

where *XG* and *XS* are respectively total goods and services exports. The exact functional form of the relationship between *ATRD* and exports is given in Annex A.

19. Exports of goods and services are calibrated using the results of Nicoletti *et al.* (2003):[13]

(7) $$\Delta xg = 0.54 * \Delta hc + 0.208 * \Delta berd - 0.137 * \Delta tariff - 0.399 * \Delta tw - 0.253 * \Delta regref$$

(8) $$\Delta xs = -0.011 * \Delta epl - 0.608 * \Delta tw - 0.399 * \Delta fdi^{restrict}$$

where *TARIFF* represents tariff barriers on trade, $FDI^{restrict}$ is an indicator of restrictions on foreign direct investment (FDI)[14] and *TW* is the average tax wedge on labour income.[15] Policy simulations with the framework are made under the assumption that there are no reforms in partner countries, so there are only gains from reforming the domestic policies that the government controls. This leaves aside beneficial spill-over effects from reforms elsewhere.[16]

2.3.3 Human capital accumulation

20. Labour productivity also depends on investment in human capital. Changes in human capital are proxied by the change in average number of quality-adjusted years of schooling, calculated as the weighted sum of quality-adjusted average years of schooling of each cohort of the population aged 25 to 64:

(9) $$\Delta HC = \sum_{c=1}^{c=C} \Delta\left(\omega_c SH_c\right)$$

where ω is the quality-adjusted average years of schooling of each cohort *C* and *SH* their share in the population. Changes in the quality-adjusted years of schooling for each cohort depend on changes in the length of education and changes in the quality of education converted into year-equivalents:

(10) $$\Delta\omega_C = \Delta\omega_C^l + \Delta\omega_C^q$$

where the length of education component has superscript *L* and quality has *Q*.

13. Nicoletti *et al.* (2003) report results from a number of different approaches, both static and dynamic. The results here are based on Table 4b (page 57).

14. The indicator of FDI restrictions has been revised since the original estimates (see Koyama and Golub, 2006), but the new and the old series are very highly correlated in cross-section and similar for most countries. Note that the new indicator is scaled 1-10 while the old variable is scaled 0-1, although the scales are comparable otherwise.

15. The average tax wedge on labour income is defined as the employees' and employers' social security contributions and personal income tax net of standard transfer payments as percentage of gross labour costs.

16. A similar issue arises in the context of the catch-up model of convergence estimated in Conway *et al.* (2006) and discussed below, where reform in the leading country would also benefit follower countries by pushing up the technological frontier. Reforms may also change the identity of the leading country. The simulation model ignores these effects.

21. The average number of years of schooling of the current cohort of students (*i.e.* those in the 15-24 age group) is assumed to be controlled directly by policies outside the model.[17] Reforms generate a permanent shift toward more years of schooling for those of school age. Changes in the quality component depend on changes in PISA scores:

$$(11) \qquad \Delta\omega^{q}_{1524} = 0.025 * \Delta PISA$$

The size of this effect is calibrated under the assumption that one standard deviation of the OECD cross-section in PISA scores is equivalent in terms of human capital to half a year of schooling.[18]

2.3.4 Physical capital accumulation

22. The model does not include direct effects of policy on aggregate investment, but policy does affect investment in information, communications and telecommunications (ICT) equipment.[19,20] The growth of ICT capital has played a very important role in explaining overall economic growth over the last two decades (*e.g.* Colecchia and Schreyer, 2001). The implied effect on aggregate investment, assuming that all ICT spending is incremental, is given as:[21]

$$(12) \qquad \Delta s_K = \frac{\Delta ICT_{share}}{1 - \Delta ICT_{share}} s_{K-1}$$

where ICT_{share} is the share of ICT investment in total investment in nominal terms. The effect of policy on ICT investment is as estimated by Conway *et al.* (2006):

$$(13) \qquad \Delta ICT_{share} = -0.02 * \Delta REGREF + 0.02 * \Delta HC$$

2.3.5 Adjustment to steady state labour productivity

23. Actual labour productivity growth is described by a policy-dependent log-linear partial adjustment process. The short and medium-term growth rate therefore depends on how far labour productivity is below the (policy-determined) steady state, the structural rate of convergence to steady state and product market regulations.

17. It would be possible in principle to extend the framework to make average years of schooling depend on other policy factors through the effect on the share of the population based on Oliveira Martins *et al.* (2007).

18. The standard deviation is calculated excluding Mexico and Turkey. This effect is broadly in line with Box 2.2 of OECD (2004), which suggests that one school year corresponds to 41 score points on the PISA mathematics scale. The standard deviation of average PISA scores used in the simulations is around 20 points.

19 . The present model may be expanded on the basis of recent OECD analysis assessing the impact of structural policies on investment behaviour (see Kerdrain *et al.* 2010).

20. The OECD Growth Study (OECD, 2003) found that private investment was influenced by macroeconomic conditions such as inflation variability.

21. See Annex A for the derivation.

24. The rate of convergence in the absence of effects of policy is calibrated using a plausible cross-country value from Boulhol *et al.* (2008).[22] Countries further below steady state will tend to grow faster but the rate of convergence is slowed by restrictive product market regulation (Conway *et al.*, 2006):[23]

$$\Delta lp = \left(0.09 - 0.02 * REGREF\right) * \left(lp^{*} - lp\right) \quad (14)$$

where * stands for the steady state value of the corresponding variable (labour productivity). Economies where labour productivity is furthest below their long-run potential have the most to gain from product market reforms as these will increase growth by more in the short and medium-term through speeding up convergence than for countries with similar product market regulation but smaller gaps to steady state labour productivity.

25. In the long run, there is *conditional convergence* of labour productivity: the level of steady state labour productivity depends on policy and intermediate variables and therefore differs across countries.[24] Productivity growth in steady state is driven by rising TFP.

2.4 Employment rate

26. The effects of labour market institutions and policies on employment rates vary across groups, with young and older workers particularly sensitive to certain policies. The effect of reform on aggregate employment is therefore modelled in a disaggregated way:[25]

$$\Delta EMPR^{*} = \sum_{j=1}^{j=4} \frac{POP_{j}}{POP_{1564}} \Delta EMPR_{j}^{*} \quad (15)$$

where *EMPR* is employment as a share of the working-age population and *POP* is the population. There are four demographic groups: 15-24 year-olds, 25-54 year-old men, 25-54 year-old women and those aged 55-64.[26] It is assumed that employment increases for a specific group have no offsetting effects on the employment of other workers (except changes induced by reforms of EPL).

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22. Boulhol *et al.* (2008) report rates of convergence ranging from 0.09 to 0.23 in alternative specifications. *The OECD Growth Study* (OECD, 2003) reports average rates of convergence ranging from 0.05 to 0.23.

23. See Annex A for a description of how this equation is adapted from Conway *et al.* (2006). Other regulations, particularly in the labour market, may also slow the rate at which the economy adjusts and grows but there is no explicit evidence in existing OECD studies for effects other than labour productivity.

24. The effects of R&D on productivity, which are often interpreted as relating to the diffusion of technology, are assumed to be accounted for in the term $\gamma.X$.

25. This framework could be augmented to include certain effects that have only been identified in empirical work for aggregate unemployment. These include interactions between certain policies that have been established by Bassanini and Duval (2006; 2009), such as between unemployment benefit replacement rates and spending on active labour market programmes per unemployed person and between tax wedges and minimum wages. However, these effects are not accounted for here due to the very large estimated differences across different countries. Additionally, the effect of disability benefit systems on employment could potentially be modelled. However, at present empirical studies on this link are not available.

26. Effects for prime-age women are for the group as whole and do not separate the impact on full and part-time workers. Bassanini and Duval (2006) provide estimates of the determinants of full and part-time participation of women.

2.4.1 Youth employment

27. The change in the youth employment rate depends on changes in the unemployment benefit replacement rate, the average tax wedge and job protection (Bassanini and Duval, 2006):[27]

$$(16) \qquad \Delta EMPR^{*}_{1524} = -0.24 * \Delta ARR - 0.34 * \Delta TW - 2.35 * \Delta EPL$$

where *ARR* is a summary indicator of the replacement rates of unemployment benefits, *EPL* is the overall employment protection legislation index and *TW* is the average tax wedge facing workers earning the average wage.[28]

2.4.2 Employment of prime-age males

28. The employment rate of prime-age males depends on the average replacement rate and the average tax wedge (Bassanini and Duval, 2006):

$$(17) \qquad \Delta EMPR^{*}_{2554,M} = -0.17 * \Delta ARR - 0.3 * \Delta TW$$

2.4.3 Employment of prime-age females

29. The employment rate of prime-age women is more sensitive to policy factors than the rate for prime-age men and depends on a wider range of policies, including those related to their frequent role as second earners and carers for young children:

$$\begin{aligned} (18) \qquad & \Delta EMPR^{*}_{2554,F} = -0.32 * \Delta ARR - 0.5 * \Delta TW - 1.6 * \Delta REGREF - 0.24 * \Delta CHILDBEN \\ & + 0.06 * \Delta LEAVEWEEKS - 0.0003 \Delta \left(LEAVEWEEKS^{2} \right) \\ & + \left(0.5 * \Delta hc + 0.05 * \Delta childcare - 0.22 * \Delta rmtx \right) * EMPR^{*}_{2554,F} \end{aligned}$$

where *CHILDBEN* is family cash benefits, *LEAVEWEEKS* is the statutory numbers of weeks of paid maternity leave, *CHILDCARE* is public support for childcare and *RMTX* captures marginal taxes on second earners, proxied as the relative marginal tax on second earners when the main earner has average earnings and the second earner 67% of the average.

30. Family cash benefits are generally found to have a negative effect on female employment (Bassanini and Duval, 2006).[29] Parental leave increases female employment, if not overly long.[30] Public expenditures on childcare are modelled as raising female participation and employment, although the

27. The effect of EPL on youth employment is supported by other OECD evidence (see Elmeskov *et al.*, 1998).

28. The *average replacement rate* is the average of the net replacement rates (including social assistance) over 60 months of unemployment for four family types and two earnings levels (67% and 100% of average wage levels). The data from the OECD Tax-Benefit model for the average (net) replacement rate and the average tax wedge have recently been revised due to changes in definition of the average worker, substantially changing both the average level of the replacement rate and tax wedge and the pattern across countries. However, the cross-sectional standard deviation is similar for both measures, and the coefficients estimated on the old data are applied to the new series.

29. See the significant results for aggregate female employment. More generally, the literature provides a mixed picture of the effects.

30. The non-linearity of the effects over the relevant range is fairly weak.

evidence on this effect is somewhat mixed overall. Marginal taxes on second earners have particularly strong effects on female employment rates given that women have traditionally been the second earners within a household (Jaumotte, 2003).[31]

31. Restrictive product market regulation is also found to have a negative effect on female employment, based on Bassanini and Duval (2006).[32] Quantitatively, this estimate is in line with the lower end of the aggregate employment effects reported by Nicoletti and Scarpetta (2005).[33]

32. Higher education increases the employment rate of prime-age women by raising female participation (Jaumotte, 2003).[34] In the absence of data, the average years of schooling for the adult population in general is used as a proxy for the average years of schooling of prime-age women. In practice, there is a very strong correlation across countries between the average years of schooling in the 25-34 year old cohort and that of women of the same age. It is assumed that the same correlation applies to other women of prime age. Women tend to have a similar number of years of schooling as men but their labour market attachment is more sensitive to the level of education.[35]

2.4.4 Employment of older workers (55-64 age group)

33. The employment rate of older workers depends both on general labour market policies and specific policies that affect those close to retirement age (Bassanini and Duval, 2006):

$$\Delta EMPR^{*}_{5564} = -0.23 * \Delta ARR - 0.33 * \Delta TW + 1.90 * \Delta EPL - 0.15 * \Delta IMPLICIT + 0.65 * \Delta SRET \quad (19)$$

where *IMPLICIT* is the implicit tax on continued work (between age 55 and 60 in early retirement pathways (50%) and between age 60 and 65 in both early retirement pathways (25%) and old-age pension schemes (25%)) and *SRET* is the standard retirement age.

2.4.5 Substitution across groups

34. The effects of labour market institutions and policies on employment rates vary across groups, with young and old workers particularly sensitive to certain policies as discussed above. Some policies may also lead to substitution between different types of workers with only a small overall impact on

31. Bassanini and Duval (2006) only find significant effects of this indicator for full-time employees and only under a particular specification, where the effects are large but consistent (assuming that all increases in female participation contribute to employment) with the aggregate value used here. Although this effect is insignificant, it is similar in value to that of Jaumotte (2003) if evaluated at the mean level of the indicator of around 30%, the Bassanini and Duval specification being defined in levels rather than logs.

32. The negative effects of product market regulation on employment reflect the consequence of entry barriers reducing output in highly regulated industries.

33. The effect for females of -1.6 corresponds to around -0.5 at the aggregate level given the typical share of prime-age women in the population. Assuming the aggregate effects only apply to the business sector for which they were estimated (70% of employment), the aggregate effects of around -1.0 are a little stronger than this figure although the range of estimates goes to around -0.5 which implies a smaller effect than that identified here for women alone.

34. This effect is applied only to prime-age women as this covers most female workers and to maintain the separation between the four standard groups used.

35. Furthermore, measures of the average years of schooling derived from data published in *Education at a Glance* (OECD, 2006b) imply small differences between males and females in each country.

aggregate employment. For example, there is a negative effect of EPL on youth employment, but this is partly offset by the protection afforded to older workers for whom it raises the employment rate. Therefore, the net effect of stricter EPL on the aggregate employment rate is typically small and depends on the relative size of the effects and the shares of each group in the population.

2.4.6 Adjustment to the steady-state employment rate

35. Actual employment converges towards steady-state employment according to the following partial adjustment process, set to one-tenth of the gap to the steady state, each year (Bassanini and Duval, 2006):[36]

$$\Delta empr = 0.1 * \left(empr^{*} - empr \right) \quad (20)$$

2.5 Average hours worked

36. The effects of policy on average annual hours worked may operate through the intensive margin of labour supply. Furthermore, changes in employment on the extensive margin may alter the composition of the workforce and hence the number of average annual hours per worker, given between-group differences in average annual hours worked:

$$\Delta hrs = \Delta\left(\sum_{j=1}^{j=J} \frac{EMP^{j}}{EMP^{15-64}} hrs_{j} \right) \approx \sum_{j=1}^{j=J} \left(\frac{EMP^{j}}{EMP^{15-64}} \Delta hrs_{j} + \Delta\left(\frac{EMP^{j}}{EMP^{15-64}} \right) hrs_{j} \right) \quad (21)$$

where EMP^{j} is the number of persons employed in each group j. The compositional effect (final term) is taken into account in the simulation framework as described in Subsection 2.6 below.

37. Annual average hours worked can further be decomposed into two components:

$$\Delta hrs_{j} = \Delta whrs_{j} + \Delta wks_{j} \quad (22)$$

where *WHRS* stands for average weekly hours worked and *WKS* is the number of weeks worked annually. The model includes the effects on weekly hours of taxation, working-time and product market regulations based on estimates by Causa (2008).[37] By contrast, the number of weeks worked annually is treated as exogenous.

38. Weekly hours worked by prime-age females depend on the marginal tax on the second earner (*RMTX)*:

$$\Delta whrs_{2554,F} = -0.805 * \Delta RMTX \quad (23)$$

For prime-age men, weekly hours worked are influenced by product market regulation (*REGREF*) and an indicator of working time regulations (*AWR*):

$$\Delta whrs_{2554,M} = -0.009 * \Delta REGREF + 0.006 * \Delta AWR \quad (24)$$

36. Scarpetta (1996) reports adjustment rates, ranging from 0.37 for the United States to 0.11 for Portugal and Belgium, for 17 OECD countries.

37. Sickness benefit entitlements may affect annual average hours worked by influencing the number of weeks worked per year. These effects are excluded from the simulation framework due to lack of robust empirical evidence in this area.

where AWR is the average of statutory standard and overall weekly hours limits.

39. Finally, in the absence of adequate empirical evidence on dynamic adjustment of hours, actual average hours are assumed to adjust instantaneously to their steady-state level.

2.6 Marginal effects on output of changes in labour utilisation

40. The marginal effects on GDP per capita of reforms that increase labour utilisation take into account the diminishing returns on output of increasing labour inputs that lead to a partially offsetting decrease in measured labour productivity. These offsetting effects are the result both of the imperfect substitutability between factors in the assumed production function and because the quality of labour inputs is likely to be lower at the margin. Furthermore, the impact of higher employment on GDP per capita is partly offset by a reduction in average hours worked, as workers at the margin tend to work shorter hours (see Causa, 2008). For ease of interpretation, these effects are applied to employment and hours rather than labour productivity and hours. The size of these effects is based on estimates by Bourlès and Cette (2005) for productivity, where the impact is greater for additional hours than additional employment.

$$\Delta gdpc = \Delta lp + (1 - 0.56) * \Delta hrs + (1 - 0.42) * \Delta empr \quad (25)$$

The overall effect on GDP per capita of policies that raise employment, taking into account the implied reduction in labour productivity, is that GDP per capita increases by around 0.9% for a 1 percentage point increase in the employment rate.[38]

2.7 Contributions of policies to GDP per capita gaps

41. The vast majority of empirical studies that underpin the simulation framework identify the effects of policy settings on the basis on their time-series (within) variation, controlling for all other unobserved factors (*e.g.* geography) that contribute to explaining cross-country differences in performance. As a result, one would expect the simulation framework to do a better job at predicting the marginal effect of policy reforms than at explaining cross-country gaps in performance. Nevertheless, it is worth checking the extent to which the framework accounts for GDP per capita gaps across OECD countries. To this end, Table 1 reports the estimated contributions of various types of policies to GDP per capita gaps (relative to the average) among the 24 highest-income OECD countries. These countries are considered because they were covered in the samples of at least some of the underlying studies. Applying the simulation framework to the lowest-income OECD countries would yield larger unexplained gaps than shown here, reflecting the inability of the structural policy settings considered here to explain their large gaps in GDP per capita relative to the average.

42. Overall, the framework provides some contribution to explaining GDP per capita gaps across the 24 countries considered. The sign of that gap (relative to average GDP per capita across the sample) is predicted correctly for two-thirds of the 24 countries considered, and the explanatory power of the framework turns out to be quite good for some countries with both positive (*e.g.* United States) and negative (*e.g.* Portugal) gaps. However, the framework performs poorly for some countries including Italy, Luxembourg or New Zealand, although specific factors may account for low explanatory power in each of these cases (*e.g.* the provision of individual job and income loss insurance by firms – through the *cassa integrazione* – rather than by the unemployment benefit system at least until recently, financial sector activity and the role of migrant workers, and geographic distance to main international markets,

38. The employment rate is typically around 65%, so that a 1 percentage point increase in the employment rate is roughly equivalent to a 1.5% increase.

respectively). The framework also over-predicts somewhat GDP per capita levels in some of the countries with relatively lax labour and product market regulations and moderate social transfer programmes (Australia, Canada, Korea), and under-predicts GDP per capita levels in some of the countries with stringent regulations and more extensive welfare states (Belgium, France, Sweden). This points to some omitted factors (including interactions across policies and institutions), as already noted.

Table 1. Contributions of policies to GDP per capita gaps relative to OECD average

(% change, except otherwise indicated)

	Labour Market Policies								Taxation		
	Average replacement rate	Employment protection legislation	Maternity leave weeks	Childcare benefits	Childcare support	Standard retirement age	Implicit tax on continued work	Average weekly normal hours and overtime	Average tax wedge	Marginal tax wedge	Share of consumption and property taxes
AUS	1.4	1.7	-0.6	0.0	0.0	0.0	0.3	…	5.6	1.2	0.3
AUT	-1.6	-1.1	0.2	0.0	0.0	-0.4	-0.5	-0.2	-5.9	-1.4	-1.5
BEL	-4.0	0.8	0.2	0.0	0.0	0.2	-0.5	-0.1	-11.5	-2.2	-1.0
CAN	2.2	2.1	0.1	0.0	0.0	0.1	0.4	0.0	2.6	0.7	-0.2
CHE	-4.9	3.0	0.1	0.0	0.0	0.0	0.2	0.2	4.0	1.3	-1.1
DEU	-2.0	-3.5	0.3	0.0	0.0	0.2	0.5	-0.1	-7.2	-1.9	-0.8
DNK	-7.0	1.2	0.3	0.0	0.0	0.2	1.0	-0.2	-2.4	0.3	0.5
ESP	3.9	-1.3	-0.2	0.0	0.0	0.2	-1.7	-0.3	-3.8	-0.2	-0.6
FIN	-4.8	-0.6	0.4	0.0	0.0	0.2	-0.4	-0.1	-4.9	-1.1	-0.4
FRA	-1.5	-1.1	0.4	0.0	0.0	-1.1	-0.9	-0.6	-9.8	-0.6	-0.5
GBR	-1.1	2.8	-0.4	0.0	0.0	-0.3	0.2	1.2	1.0	0.9	1.5
GRC	16.9	-0.4	-0.5	…	0.0	-0.6	-5.4	-0.2	-9.6	-0.5	1.7
IRL	-6.1	1.4	-0.3	0.0	0.0	0.4	-0.2	-0.1	7.2	-0.9	2.3
ISL	-1.7	0.8	-0.2	0.0	0.0	0.4	0.7	…	4.9	0.8	1.9
ITA	26.7	0.8	0.2	0.0	0.0	-0.7	1.2	-0.1	-8.7	-0.7	-1.4
JPN	-6.2	0.5	-0.4	0.0	0.0	-0.4	0.5	…	2.1	1.3	-1.9
KOR	9.3	-1.2	-0.5	0.0	0.0	-1.4	1.1	…	8.2	1.9	2.3
LUX	-4.7	-1.7	0.2	0.0	0.0	0.2	-2.6	0.0	7.5	-0.7	0.3
NLD	…	-1.7	-0.2	0.0	0.0	0.1	0.9	0.0	-1.0	0.0	-0.3
NOR	-5.6	-0.4	0.2	0.0	0.0	0.5	0.2	0.0	-2.1	-0.5	-1.5
NZL	-0.1	1.4	-0.6	0.0	0.0	0.1	0.8	…	10.2	1.4	1.5
PRT	-1.3	-5.6	-0.2	0.0	0.0	0.2	0.5	-0.2	-0.6	-0.1	1.5
SWE	-3.3	-2.7	0.2	0.0	0.0	0.1	0.1	-0.2	-5.2	-0.1	-1.1
USA	11.4	0.9	-0.8	0.0	0.0	0.3	0.7	1.3	5.7	1.4	-1.4

Notes: "…" denotes missing data on the policy variable.

Table 1. Contributions of policies to GDP per capita gaps relative to OECD average *(cont.)*

(% change, except otherwise indicated)

	Product Market Regulation	Openness		R&D Incentives		Human Capital		Overall GDP per capita gap predicted by the framework (in %)	Observed GDP per capita gap in 2009[1] (in %)	Deviation observed from predicted GDP per capita gap (in percentage points)
	REGREF	FDI restrictions	Tariff barriers	R&D tax subsidies	R&D direct subsidies	PISA score	Average years of schooling			
AUS	7.1	-0.1	0.0	0.0	0.0	1.7	3.3	22.0	10.3	-11.6
AUT	2.8	-0.1	0.0	-0.6	0.0	-0.1	1.9	-8.5	5.7	14.1
BEL	1.6	0.1	0.0	-0.5	0.0	0.8	2.0	-14.3	-1.5	12.8
CAN	-0.8	0.0	0.0	1.4	-0.1	2.6	3.8	14.9	5.3	-9.5
CHE	-6.2	0.0	…	0.0	…	1.0	3.1	0.6	13.0	12.3
DEU	10.3	0.1	0.0	0.0	0.0	0.2	3.3	-0.7	-2.2	-1.6
DNK	8.7	0.0	0.0	0.3	0.0	-0.2	0.7	3.4	-1.6	-4.9
ESP	4.7	0.0	0.0	1.3	0.0	-2.6	-3.7	-4.2	-17.5	-13.3
FIN	-2.6	0.0	0.1	0.0	0.0	5.3	-0.6	-9.8	-6.2	3.6
FRA	-2.2	0.1	0.0	1.5	0.0	-1.1	-1.0	-18.6	-7.1	11.5
GBR	11.4	0.3	0.0	0.4	0.0	-0.2	-4.4	13.2	-1.9	-15.1
GRC	-22.0	0.0	0.0	-8.4	…	-3.7	-2.1	-35.0	-19.1	15.9
IRL	-9.7	0.1	0.0	-0.1	…	0.6	1.1	-4.4	10.2	14.6
ISL	-2.0	-0.1	…	0.0	0.0	-1.1	-2.8	1.5	3.5	2.0
ITA	-0.3	0.1	0.0	0.0	0.0	-3.4	-2.0	11.6	-18.4	-29.9
JPN	-2.7	0.1	0.1	0.3	-0.1	1.3	3.4	-2.0	-9.5	-7.5
KOR	-36.8	0.0	-0.1	0.5	0.0	3.4	4.3	-9.0	-22.3	-13.3
LUX	-4.3	…	0.0	0.0	0.0	-1.9	-1.3	-9.1	65.4	74.5
NLD	3.6	0.1	0.0	0.9	-0.1	1.8	1.5	5.7	10.8	5.1
NOR	-0.3	0.0	0.8	1.0	0.0	-1.8	0.5	-9.0	14.4	23.4
NZL	1.6	0.0	0.0	0.0	0.0	2.3	2.4	21.0	-23.2	-44.2
PRT	-8.5	0.0	0.0	1.1	-0.1	-3.9	-17.9	-34.9	-34.9	0.0
SWE	2.7	0.0	0.0	0.0	0.0	0.1	-0.1	-9.4	-1.5	7.9
USA	2.2	0.0	0.1	-1.2	0.0	-2.4	-0.1	18.0	28.3	10.3
Average										2.4
Average of absolute deviation										15.0

Notes: "..." denotes missing data on the policy variable.

1. Norwegian GDP per capita data are for Norway mainland.

3. The simulated impact of policy reforms on GDP per capita

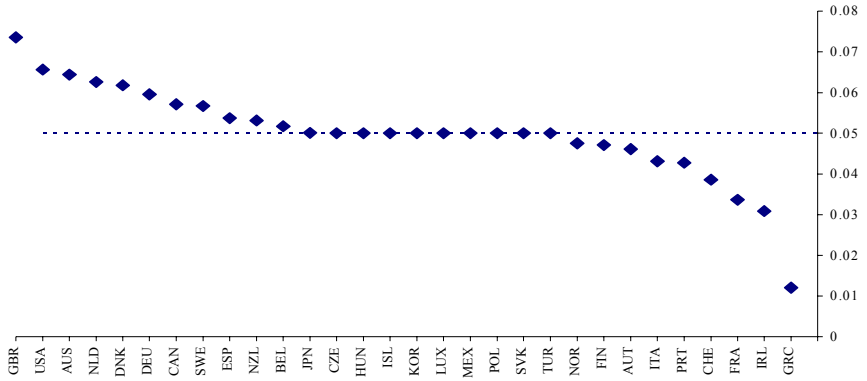
43. This section presents simulations of the framework discussed in the previous section to assess the impact of 25 distinct policy reforms on GDP per capita. The simulations are baseline dependent, and the baseline is described in Box 1. This section first presents the steady-state effects of reforms before turning to the adjustment towards the steady state.

Box 1. Baseline scenario

The baseline simulation is designed to give a realistic picture of each country in the control case. That is, even in the absence of policy reforms, an economy is assumed to grow at a rate consistent with trend growth in labour utilisation and labour productivity that is a function of both the distance from its steady state and the speed of adjustment to the steady state. How fast an economy adjusts to its steady state is related to the stance of its product market regulation. The varying strictness of product market regulation leads to wide differences in the rate of convergence to steady-state labour productivity across countries (Figure A). The gap between actual and steady-state labour productivity in each country is central to the determination of the growth rate in the baseline scenario. In the framework, policies are assumed to have their full impact on the steady-state level of labour productivity and consequently, convergence is conditional on the set of policies affecting the level of labour productivity. For that reason, the gap between actual and steady-state labour productivity is calculated by accounting for current policy settings and factors related to the structure of the economy such as the demographic structure, the share of investment in physical capital in GDP, among others (see Annex A for a more detailed discussion).

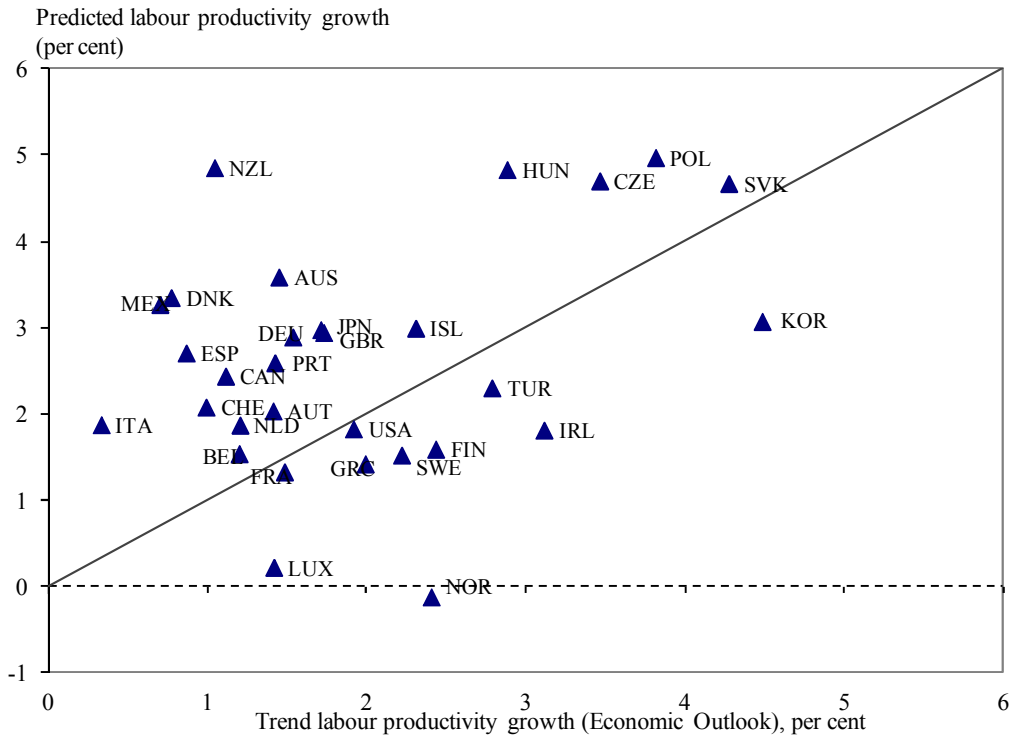
The trend growth rates of employment, average hours and the population in the baseline are close by construction to those in the *Economic Outlook 2010* (OECD, 2010) and *Going for Growth 2009* (OECD, 2009).[1] Labour productivity growth is also relatively similar in several cases (Figure B). This suggests that the combination of assumed adjustment rates and gaps to steady state in the framework is reasonable.[2]

Figure A. Adjustment coefficient incorporating the effect of product market regulation



Box 1. Baseline scenario *(cont.)*

Figure B. Trend labour productivity growth in baseline simulation and Going for Growth*



* Annual trend labour productivity growth in year zero of simulation and trend measure derived from Going for Growth. Trend productivity data for Mexico and Turkey are based on OECD estimates.

1. The current OECD estimate for trend growth in hours is projected forward subject to some adjustments. The employment rate trend is based on OECD projections of group-specific employment rates and demographic forecasts.
2. Only Greece, Iceland, Ireland and Luxembourg are more than 2 percentage points different. For Greece, this is partly due to the very slow rate of convergence created by highly restrictive PMR. Removing this interaction effect for all countries would close the gap between the two estimates by just over half.

3.1 Steady-state effects of policy reforms

44. Tables 2 to 4 show the cross-country average steady-state effects of the policy reforms derived from three basic simulations:

1. A "unit" simulation (Table 2): Policy indicators are changed by a standardised "unit" in each country and the impact on GDP is derived. For example, unemployment benefit replacement rates are reduced by 10 percentage points and product market regulation indices are reduced by 0.1 index points. This simulation provides "multipliers" for the average OECD country (see Box 2 on variations in multiplier effects across countries). However, the shocks do not have a common metric and hence the simulations cannot be compared across policy instruments (though Box 3 provides information to put the shocks into context).
2. A "ten per cent" simulation (Table 3): Policy indicators are changed by 10% of their most recent available values in each country in the direction of increasing GDP and the simulated impact on GDP per capita derived. For example, unemployment benefit replacement rates and the product market regulation indices are reduced by 10% of their most recent values. This simulation

provides average elasticities for each policy instrument. These shocks tend to be much bigger than most reforms carried out in the OECD area over the past decade (except in the area of product market regulation), though some individual OECD countries have implemented more ambitious reforms.

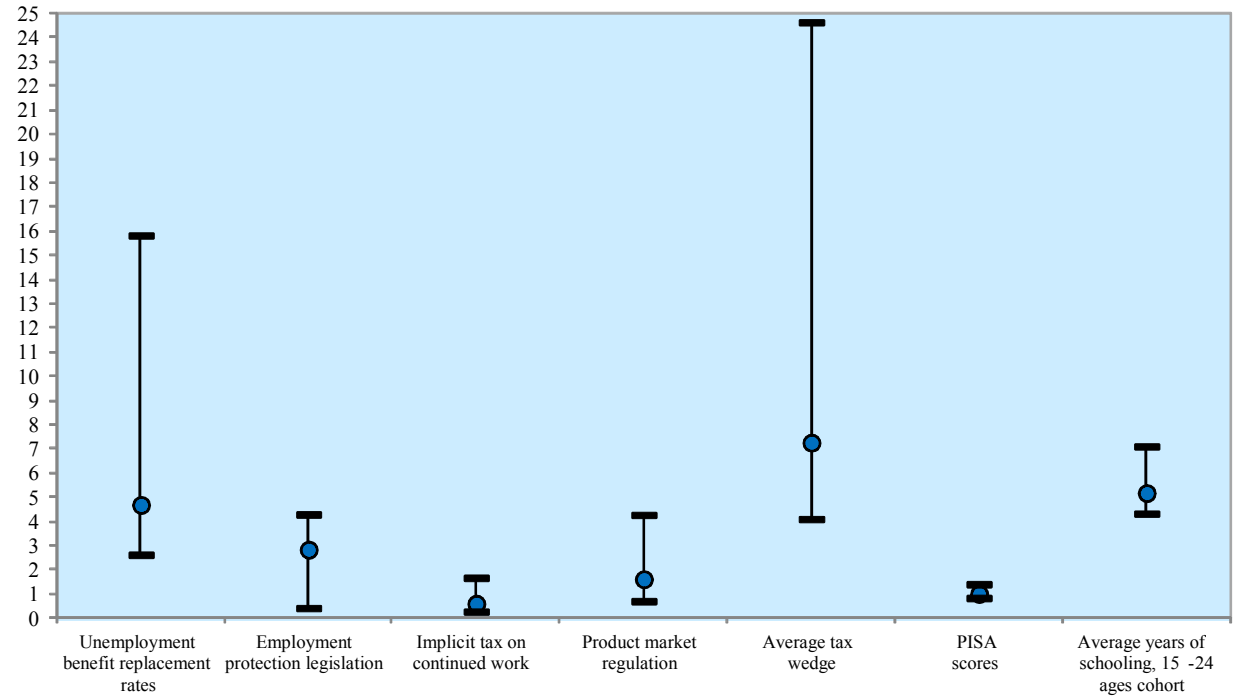
3. A "one standard deviation" simulation (Table 4): Policy indicators are changed by one standard deviation of their most recent values across OECD countries in the direction of increasing GDP. For example, unemployment benefit replacement rates are reduced by 18 percentage points. This simulation standardises the shocks in one dimension, but the absolute size of the shocks is by construction dependent on the degree of cross-country variation. Again, the shocks are generally bigger than reforms in the OECD area over the past decade, though some countries have pursued more ambitious reforms in some policy areas.

Together, these simulations provide information about the impact of different policies in raising GDP per capita seen from different perspectives. As supplementary information, Box 3 shows the estimated effects of actual reforms carried out on average in the OECD area over the past decade. Table 5 shows the steady-state effects of a "unit" simulation of each reform country by country.

Box 2. Differences in GDP impacts of equal reforms across countries

The GDP-per-capita impacts of policy reforms of equal sizes may vary markedly across countries, although the effects of policy reforms on performance areas directly associated with them are assumed to be identical. Indeed factors such as the composition of the labour force and employment, the demographic structure, and how far the economy is from its long-run potential labour productivity essentially translate identical policy reforms into sometimes very different ultimate GDP-per-capita impacts.

Impact of unit reforms of selected policies: Cross-country difference in GDP per-capita effect[1]



1. For the definition of the unit reforms, see Table 2. The circle shows the cross-country average; the upper and lower bounds show the strongest and weakest country effects. These steady-state effects refer to a 30-year horizon.

In the model, the effects of labour market institutions and policies on employment differ across groups. Some policies, such as those that influence the implicit tax on continued work and maternity leave weeks, are targeted at specific groups and, consequently, they affect employment rates disproportionately across groups. Also, some groups are more sensitive to some policy reforms than others. For instance, prime-age females are more likely to respond to changes in marginal tax rates than prime-age males and older workers. Consequently, the overall GDP effects of policies differ to the extent that shares of different groups vary across countries.

Product market regulations are assumed to raise the steady-state level of labour productivity by having a direct impact on labour productivity but also by speeding up the rate of convergence to the long-run potential in a context where the technology frontier is a moving target. Therefore, an economy which is further below its long-run potential grows faster in response to a product market reform than an economy with similarly stringent product market regulations but that is closer to its long-run potential.

Box 3. Simulation of past reforms

In order to assess how plausible the three alternative simulations in Section 3 are, retrospective simulations of the accounting framework were made based on the scale of past reforms, illustrating the extent to which these may have contributed to past growth. The average effects of past changes in relevant policies on GDP per capita are given in the following table. Their overall scale is considerable, since they suggest that reforms in these areas have contributed to yield as much as half of growth in GDP per capita in OECD countries over the past decade prior to the recent financial and economic crisis.

Past reforms and their simulated impacts in retrospect

			GDP per capita impact-	
	Period	**Change in OECD average**	**After 10 years**	**Steady State**
Labour Market Policies				
Average replacement rate	2001-2005	-2.6 ppt.	0.8	1.2
Employment protection legislation	1998-2006	-0.02 index points	0.03	0.1
Implicit tax on continued work	2003-2005	-1.6 ppt.	0.05	0.1
Average weekly normal hours and overtime limits	1996-2005	-0.15 hours	-0.02	-0.02
Taxation				
Average tax wedge	2002-2006	-0.3 ppt.	0.1	0.2
Marginal tax wedge	2000-2006	-1.4 ppt.	0.2	0.2
Product Market Regulation				
REGREF	1998-2003	-0.9 index points	9.0	15.3
Human Capital				
PISA score	2003-2006	1 point	0.01	0.1
Average years of schooling (15-24 Cohort)	1995-2004	0.7 years	0.8	3.6

Although the impacts are not directly comparable with each other, as changes in policies are considered over different periods, product market regulation and human capital reforms appear to account for most of the reform-induced gains in GDP-per-capita growth over the decade prior to the crisis. Note however that only modest gains were reaped from human capital reforms over the decade as such reforms take the longest time to pay off in the empirical framework. Surprisingly, the average tax wedge contributes marginally to growth in the past, despite the fact that it has a very strong unit impact. This illustrates that policy levers with strong unit impacts can have minor effects in simulations of past reforms, if reforms carried out in those areas are limited.

Table 2. The effects of "unit" reforms on GDP per capita

(% change) Average across OECD countries

	Definition of "unit" shock	OECD average level	OECD standard deviation	After 10 years	Steady state
				(% change)	
Labour market policies					
Average replacement rate	-10 ppt.	54.5	18.1	2.9	4.7
Employment protection legislation (EPL)	-1 index point	2.1	0.7	1.6	3.0
Maternity leave weeks	+10 weeks	27.0	20.2	0.2	0.2
Childcare benefits	-1 ppt.	0.6	0.1	0.1	0.1
Childcare support	+10 ppt.	0.6	0.1	0.0	0.0
Standard retirement age	+1 year	63.8	2.1	0.1	0.3
Implicit tax on continued work	-10 ppt.	21.7	21.2	0.3	0.6
Average weekly normal hours and overtime	+1 hour	44.3	4.6	0.1	0.1
Taxation					
Average tax wedge	-10 ppt.	28.5	9.7	4.6	7.3
Marginal tax	-10 ppt.	45.9	11.3	1.1	1.2
Share of consumption and property taxes	+10 ppt.	36.2	7.2	1.0	2.5
Product Market Regulation - REGREF					
Gas	-0.1 index points	2.4	1.1	0.1	0.2
Electricity	-0.1 index points	2.0	1.3	0.1	0.2
Road	-0.1 index points	1.3	1.1	0.1	0.2
Rail	-0.1 index points	3.6	1.2	0.1	0.2
Air	-0.1 index points	1.4	1.1	0.1	0.2
Post	-0.1 index points	2.7	0.9	0.1	0.2
Telecommunications	-0.1 index points	1.4	0.6	0.1	0.2
Overall	-0.1 index points	2.1	0.6	1.0	1.7
Openness					
FDI restrictions	-0.5 index points	1.5	0.7	0.0	0.1
Tariff barriers	-2 ppt.	5.8	1.5[1]	0.0	0.1
R&D incentives					
R&D tax subsidies	+0.1 index points	0.1	0.1	0.8	1.9
R&D direct subsidies	+10 ppt.	0.1	0.0	0.0	0.1
Human capital					
PISA score	+10 points	496.4	21.0[2]	0.1	1.1
Average years of schooling (15-24 cohort)	+1 year	12.6	1.0	1.1	5.2

1. Excluding Mexico and Poland.
2. Excluding Mexico and Turkey.

Table 3. The effects of "ten per cent" reforms on GDP per capita

(% change) Average across OECD countries

	After 10 years	Steady state
Labour market policies		
Average replacement rate	1.5	2.2
Employment protection legislation (EPL)	0.3	0.6
Maternity leave weeks	0.0	0.1
Childcare benefits	0.0	0.0
Childcare support	0.0	0.0
Standard retirement age	0.9	1.7
Implicit tax on continued work	0.1	0.1
Average weekly normal hours and overtime	0.4	0.4
Taxation		
Average tax wedge	1.4	2.1
Marginal tax	0.5	0.5
Share of consumption and property taxes	0.4	0.7
Product Market Regulation - REGREF		
Gas	0.4	0.7
Electricity	0.3	0.6
Road	0.2	0.4
Rail	0.5	0.9
Air	0.2	0.4
Post	0.4	0.7
Telecommunications	0.2	0.4
Overall	2.3	3.8
Openness		
FDI restrictions	0.0	0.0
Tariff barriers	0.0	0.0
R&D incentives		
R&D tax subsidies	0.1	0.2
R&D direct subsidies	0.0	0.0
Human capital		
PISA score	0.3	5.1
Average years of schooling (15-24 cohort)	0.3	6.5

Table 4. The effects of "one standard deviation" reforms on GDP per capita

(% change) Average across OECD countries

	After 10 years	Steady state
Labour market policies		
Average replacement rate	5.2	8.5
Employment protection legislation (EPL)	1.1	2.1
Maternity leave weeks	0.3	0.4
Childcare benefits	0.0	0.0
Childcare support	0.0	0.0
Standard retirement age	0.3	0.6
Implicit tax on continued work	0.7	1.3
Average weekly normal hours and overtime	0.4	0.4
Taxation		
Average tax wedge	4.4	7.0
Marginal tax	1.2	1.2
Share of consumption and property taxes	0.7	1.8
Product Market Regulation - REGREF		
Gas	1.5	2.4
Electricity	1.6	2.6
Road	1.5	2.4
Rail	1.8	2.9
Air	1.4	2.3
Post	1.5	2.5
Telecommunications	1.1	1.8
Overall	5.7	8.7
Openness		
FDI restrictions	0.1	0.2
Tariff barriers	0.1	0.1
R&D incentives		
R&D tax subsidies	0.8	1.9
R&D direct subsidies	0.0	0.0
Human capital		
PISA score	0.5	2.6
Average years of schooling (15-24 cohort)	0.3	5.3

Table 5. Steady-state effects of "unit" reforms on GDP per capita by countries

	Labour Market Policies								Taxation		
	Average replacement rate	Employment protection legislation	Maternity leave weeks	Childcare benefits	Childcare support	Standard retirement age	Implicit tax on continued work	Average weekly normal hours and overtime	Average tax wedge	Marginal tax wedge	Share of consumption and property taxes
size of the shock	-10 ppt.	-1 point	+10 weeks	-1 ppt.	+ 10 ppt.	+1 year	-10 ppt.	+1 hour	-10 ppt.	-10 ppt.	+10 ppt.
AUS	3.6	2.7	0.3	0.1	0.0	0.2	0.4	...	5.6	1.1	2.5
AUT	3.9	3.4	0.2	0.1	0.0	0.2	0.6	0.1	6.1	1.1	2.5
BEL	5.3	2.7	0.3	0.2	0.0	0.3	0.7	0.1	8.2	1.1	2.5
CAN	3.2	2.7	0.2	0.1	0.0	0.2	0.4	0.1	4.9	1.1	2.5
CHE	3.2	3.4	0.2	0.1	0.0	0.2	0.4	0.1	4.9	1.2	2.5
CZE	5.1	3.8	0.1	0.1	0.0	0.4	0.9	0.1	7.9	1.0	2.5
DEU	4.4	3.6	0.2	0.1	0.0	0.2	0.6	0.1	6.9	1.1	2.5
DNK	3.7	2.9	0.1	0.1	0.0	0.2	0.5	0.1	5.8	1.1	2.5
ESP	4.3	3.2	0.2	0.1	0.0	0.3	0.8	0.1	6.7	1.0	2.5
FIN	3.8	4.3	0.1	0.1	0.0	0.2	0.5	0.1	6.0	1.1	2.5
FRA	4.8	2.5	0.1	0.1	0.0	0.3	0.6	0.1	7.4	1.1	2.5
GBR	3.7	3.0	0.2	0.1	0.0	0.2	0.4	0.1	5.8	1.1	2.5
GRC	4.9	1.5	0.3	...	0.0	0.3	0.8	0.1	7.6	1.1	2.5
HUN	5.9	3.8	0.2	0.2	0.0	0.4	1.0	0.1	9.2	1.1	2.5
IRL	3.5	3.3	0.2	0.1	0.0	0.2	0.5	0.1	5.5	1.1	2.5
ISL	2.7	2.5	0.2	0.1	0.0	0.1	0.3	...	4.1	1.1	2.5
ITA	5.5	3.0	0.3	0.2	0.0	0.4	0.9	0.1	8.6	1.0	2.5
JPN	4.1	3.1	0.2	0.1	0.0	0.3	0.7	...	6.3	1.0	2.5
KOR	4.9	3.6	0.3	0.1	0.0	0.3	0.8	...	7.5	1.1	2.5
LUX	3.9	2.4	0.2	0.1	0.0	0.2	0.5	0.1	6.1	1.2	2.5
MEX	...	1.7	0.3	0.2	0.0	0.3	0.6	...	8.1	1.2	2.5
NLD	...	2.5	0.2	0.1	0.0	0.2	0.4	0.1	5.2	1.1	2.5
NOR	3.7	2.0	0.2	0.1	0.0	0.2	0.4	0.1	5.7	1.1	2.5
NZL	3.3	2.9	0.2	0.1	0.0	0.2	0.4	...	5.1	1.1	2.5
POL	7.4	2.6	0.3	0.2	0.0	0.5	1.1	0.1	11.5	1.1	2.5
PRT	4.0	2.6	0.2	0.1	0.0	0.3	0.6	0.1	6.1	1.1	2.5
SVK	5.9	3.9	0.2	0.2	0.0	0.4	0.9	0.1	9.2	1.1	2.5
SWE	3.5	3.2	0.1	0.1	0.0	0.2	0.4	0.1	5.4	1.1	2.5
TUR	15.9	3.0	1.1	0.5	0.0	0.7	1.7	...	24.7	1.1	2.5
USA	4.4	0.5	0.3	0.1	0.0	0.2	0.5	0.1	6.8	1.2	2.5
OECD avg.	4.7	3.0	0.2	0.1	0.0	0.3	0.6	0.1	7.3	1.2	2.5

Notes: ".." denotes missing data on the policy variable.

Table 5. Steady-state effects of "unit" reforms on GDP per capita by countries *(cont.)*

	Product Market Regulation								Openness		R&D Incentives		Human Capital	
	REGREF-Gas	REGREF-Electricity	REGREF-Road	REGREF-Rail	REGREF-Air	REGREF-Post	REGREF-Telecom	REGREF	FDI restrictions	Tariff barriers	R&D tax subsidies	R&D direct subsidies	PISA score	Average years of schooling
size of the shock	-0.1 point	-0.1 point	-0.1 point	-0.1 point	-0.1 point	-0.1 point	-0.1 point	-0.1 point	-0.5 points	-2 ppt.	+0.1 points	+10 ppt.	+10 points	+1 year
AUS	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.2	0.0	0.1	1.5	0.1	1.0	5.1
AUT	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.2	0.0	0.1	1.9	0.0	1.0	4.8
BEL	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.1	0.0	0.0	1.9	0.1	1.0	5.0
CAN	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.3	0.0	0.1	1.1	0.2	1.0	4.9
CHE	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.5	0.0	...	...	...	1.0	5.0
CZE	0.3	0.3	0.3	0.3	0.3	0.3	0.3	1.8	0.0	0.0	0.7	0.0	0.9	4.5
DEU	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.1	0.1	0.1	...	0.1	1.0	4.8
DNK	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.1	0.1	0.1	1.3	0.1	1.1	5.4
ESP	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.3	0.1	0.1	0.6	0.0	1.0	4.9
FIN	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.3	0.0	0.1	...	0.0	1.1	5.3
FRA	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.3	0.1	0.1	0.5	0.0	1.1	5.4
GBR	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.1	0.2	0.1	1.7	0.1	1.1	5.7
GRC	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.1	0.0	0.1	7.9	...	1.0	4.8
HUN	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.7	0.0	0.0	1.1	0.1	0.9	4.7
IRL	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.7	0.0	0.0	1.6	...	1.0	4.8
ISL	…	0.2	0.2	…	0.2	0.2	0.2	1.5	0.0	...	...	0.1	1.1	5.6
ITA	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.3	0.1	0.1	1.6	0.1	1.0	4.9
JPN	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.6	0.1	0.2	1.6	0.2	0.9	4.5
KOR	0.5	0.5	0.5	0.5	0.5	0.5	0.5	3.4	0.1	0.0	1.1	0.0	0.9	4.4
LUX	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.0	...	0.0	...	0.1	1.1	5.3
MEX	0.7	0.7	0.7	0.7	0.7	0.7	0.7	4.5	0.0	0.0	...	0.4	1.4	7.0
NLD	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.1	0.1	0.1	2.3	0.2	1.0	5.2
NOR	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.1	0.6	0.9	0.1	1.1	5.4
NZL	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.7	0.1	0.1	...	0.1	1.1	5.3
POL	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.3	0.1	0.0	7.9	0.2	1.0	5.0
PRT	0.3	0.3	0.3	0.3	0.3	0.3	0.3	1.9	0.1	0.1	0.7	0.2	1.2	6.0
SVK	0.3	0.3	0.3	0.3	0.3	0.3	0.3	1.8	...	...	...	0.1	0.9	4.6
SWE	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.1	0.1	0.1	...	0.0	1.1	5.3
TUR	0.6	0.6	0.6	0.6	0.6	0.6	0.6	4.3	0.0	...	0.9	0.2	1.4	7.1
USA	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.0	0.1	0.1	2.4	0.0	1.1	5.6
OECD avg.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.7	0.1	0.1	1.9	0.1	1.1	5.2

Notes: ".." denotes missing data on the policy variable.

45. Based on the "one standard deviation" simulation (Table 4) – which standardises reforms relative to current variation in policies across countries – the broad-brush relative impact of the different policy instruments in raising GDP per capita can be characterised as follows, in descending order:

- Substantial steady-state effects (comprised between 7 and 9%) are obtained from regulatory reforms to strengthen competition in product markets, cuts of average unemployment benefit replacement rates, as well as from reducing of average tax wedges.

- Fairly strong steady-state effects (between 2 and 5%) are associated with reforms to raise the quantity (average number of years of education across the adult population) and quality (PISA scores of 15-year-olds) of education, as well as with reforms that relax employment protection legislation.

- Significant effects (from 0.5 to 1.9%) are recorded for raising R&D tax subsidies, increasing the share of consumption and property taxes in total taxes, reducing the implicit tax on continued work at older ages, cutting marginal tax wedges and raising the standard retirement age.

- Weak effects (around 0.4%) are registered for easing working time regulations and lengthening maternity leave.

- Negligible effects (0.2% or less) are obtained for external openness instruments (FDI restriction and tariff barriers), direct R&D subsidies as well as child and childcare benefits.

3.2 Timing and adjustment to the steady state

46. The time it takes to reach the steady state differs across policy areas:

- Labour market and tax reforms are assumed to work relatively fast, with an annual convergence rate of 10% for reforms operating via employment, and instantaneous adjustment for reforms affecting hours worked.
- Productivity-enhancing reforms converge on steady state productivity levels at a rate of 5% per year in the average OECD country (see Box 1).
- Human capital reforms take around 50 years to be realised for all cohorts and even longer to have their full effects on GDP per capita on the assumption that policy can only influence the length of education and PISA scores for the 15-24 age cohort.[39]

47. The speed of adjustment differs across countries for productivity-enhancing reforms because adjustment speeds are directly linked to the stance of product market regulations. Relatively stringent product market regulations delay adjustment and competition-friendly regimes speed up adjustment (see Box 1). Thus, in a country with stringent product market regulations (*e.g.* Greece and France) adjustment is slow, with a convergence rate of only 3% or less per year. On the other hand, in the country with the most competition-friendly regulatory regime (United Kingdom), convergence to steady-state productivity levels takes place at the rate of 8% annually.

48. In the simulations, product market reforms speed up the adjustment in addition to increasing steady-state GDP per capita. Bringing forward in time the gains from productivity-enhancing reforms is thus an important benefit of product market reforms.

39. The profile of the adjustment also differs across countries depending on their demographic structure. Countries with large young cohorts relative to older cohorts will obtain gains faster, though the full effects will take up to 50 years.

4. *"Going for Growth"* simulation: raising below-average policy stances to the OECD average

49. This section presents simulations designed to aid the cross-checking of the policy priorities selected for the *Going for Growth* exercise. Policy settings in individual countries have been moved to the OECD mean when they were less growth-friendly than in the OECD on average, providing a picture of the size of output gains to each country from reforms to different policies. The results can then be used to identify, for each country, the policy reforms with the estimated greatest impact on material living standards.

4.1 Selection of policy priorities

50. As discussed in Box 4, the first stage in selecting potential *Going for Growth* policy priorities consists of identifying potential policy priorities, based on correspondence between performance and policy weaknesses. This process typically generates a larger number of potential policy priorities than the three priorities actually selected. In order to assess which of the potential priorities could have the largest impact among the possible policy priorities, simulations of the impact of reforms may help in the process of discriminating among the potential priorities and selecting the three that are likely to have the strongest effect on GDP per capita.

Box 4. How policies are currently chosen for *Going for Growth*

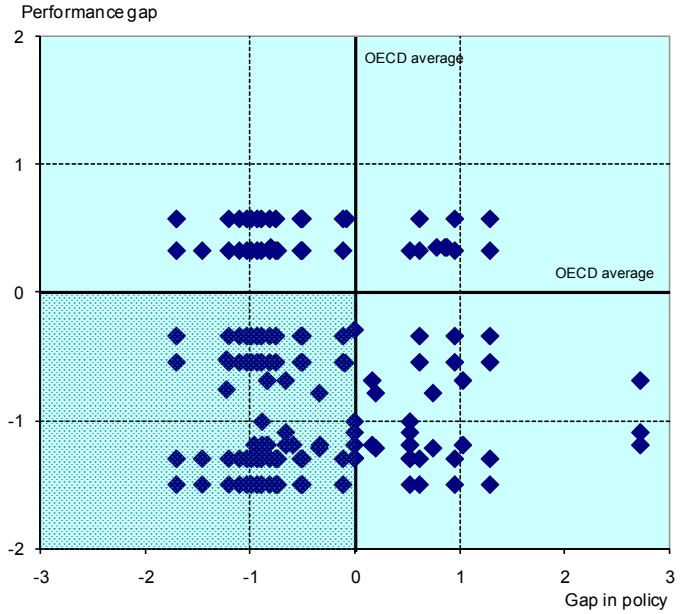
The OECD Going for Growth structural surveillance exercise seeks to identify five policy priorities likely to boost GDP per capita for each OECD member country and the European Union. Three of these policy priorities are identified based on internationally comparable OECD indicators of policy settings and performance. The additional two priorities are meant to capture any potential policy imperatives in fields not covered by indicators drawing instead on country-specific knowledge. Even so, these priorities are often supported by indicator based evidence.

For the selection of the three indicator-based policy priorities, the starting point is a detailed examination of labour utilisation and productivity performance so as to uncover specific areas of relative strength and weakness. Each performance indicator is juxtaposed with corresponding policy indicators, in the most relevant areas, to determine where performance and policy weaknesses appear to be linked. This evaluation process is carried out for each of the approximately 50 areas where OECD policy indicators provide coverage.

As an example, the figure below shows, for a fictitious country, a scatter plot of pairings of policy indicators (on the horizontal axis) with corresponding performance indicators (on the vertical axis). Since many of the approximately 50 indicators are associated with more than one performance area, there are potentially about 150 pairings to be examined. The indicators of policy and performance are standardised by re-scaling them so that each has a mean of zero and a standard deviation of one, with positive numbers representing positions more growth-friendly than the OECD average. The scatter plot is thus divided into four quadrants, depending on whether a country's policy-performance pairing is below or above the average policy or performance score.

How policies are currently chosen for Going for Growth (cont.)

Example of selection of candidates for Going for Growth priorities



Candidates for recommendations thus fall into the lower left quadrant, when policy indicators and corresponding performance are *both* below average. In most countries there are more than three unique policy areas that qualify as potential priorities (for instance, New Zealand had 7 candidates in the 2009 exercise). When there are more than three candidate policy priorities, the list has been narrowed using a combination of criteria: (1) the anticipated quantitative effects of reforms in the policy area on GDP per capita, (2) the normalised distance of the policy stance from the benchmark (the average), and (3) recent trends in policy and performance. However, this task relies heavily on judgment, given the absence of an explicit accounting for the relative effects of reform in specific areas on GDP per capita. One motivation of the framework presented in this paper is to allow a cross-check on this ranking procedure based on a more systematic approach rooted in econometric evidence where it is available, and to allow for a fuller range of dynamics to be taken into account in evaluating and comparing the impact of reforms across policy areas.

51. For this purpose, the effects of raising below-average policy settings in all potential priority areas to the OECD average are simulated to obtain the long-run impact on GDP per capita. The impact of each simulated policy reform depends on the distance of policy settings from the OECD average and the strength of the unit effect (see Table 2). Hence, the simulated effects may not be large when policy settings are far from average practice if the unit effect of reforms in the particular area is small, such as for childcare benefits or some R&D-specific policies.

52. The three policy areas identified on the basis of the simulations as having the largest impact on GDP per capita for each country are shown in Table 6. The magnitude of the effects varies widely by country, with those countries with the least growth-friendly policies having considerable potential gains from reforming policy settings to reach the OECD average. However, some countries with more growth-friendly policies have smaller estimated gains, or in some cases, fewer than three potential policy priorities among the policy areas covered in the simulation framework.

53. The exercise shows that some commonalities exist across countries, with half of them having simulation framework-based priorities in either general and/or sectoral product market regulation, or concerning the average and/or marginal tax wedge. This, however, also reflects the limited coverage of the simulation framework in terms of policies. The exercise also suggests that some groups of countries have distinct sets of policy priorities:

1. Mexico, Portugal and Turkey would gain substantially from policies that raise human capital, whereas for other countries the effect is much lower.
2. Hungary, Korea and Mexico could realise large gains in performance by reducing the restrictiveness of product market regulation.
3. Belgium, France, Germany, Greece, Hungary, Italy, and Turkey have average labour tax wedges that could be reduced to considerable benefit, with reductions in Belgium's marginal rates also yielding significant gains.

Table 6. Framework-based policy priorities and their impacts on GDP per capita[1]

AUS	Share of consumption & property taxes	(0.2%)	REGREF Postal services	(0.1%)	FDI restrictions	(0.1%)
AUT	Share of consumption & property taxes	(2.0%)	Marginal tax second earner	(1.5%)	Employment protection legislation	(0.7%)
BEL	Average tax wedge	(11.2%)	Average replacement rate	(5.6%)	Marginal tax second earner	(2.3%)
CAN	REGREF Postal services	(0.6%)	Share of consumption & property taxes	(0.6%)	R&D direct subsidies	(0.1%)
CHE	Average replacement rate	(5.9%)	Share of consumption and property taxes	(1.6%)	REGREF	(0.9%)
CZE	Employment protection legislation	(3.4%)	REGREF Postal services	(1.3%)	Standard retirement age	(1.2%)
DEU	Average tax wedge	(7.0%)	Average replacement rate	(3.4%)	Employment protection legislation	(3.0%)
DNK	Average weekly normal hours and overtime	(0.2%)				
ESP	Average tax wedge	(3.6%)	Average years of schooling	(2.5%)	PISA score	(2.1%)
FIN	Average replacement rate	(6.0%)	Average tax wedge	(4.7%)	Marginal tax second earner	(1.2%)
FRA	Average tax wedge	(9.6%)	Average replacement rate	(3.0%)	Implicit taxes on continued work	(0.1%)
GBR	REGREF Postal services	(0.2%)				
GRC	Average tax wedge	(9.3%)	Implicit taxes on continued work	(5.5%)	PISA score	(3.2%)
HUN	Average tax wedge	(14.0%)	Implicit taxes on continued work	(3.1%)	Standard retirement age	(0.7%)
IRL	Average replacement rate	(7.2%)	REGREF	(1.5%)	Marginal tax second earner	(1.0%)
ISL	REGREF Electricity	(1.4%)	Average years of schooling	(1.1%)	REGREF Road	(0.2%)
ITA	Average tax wedge	(8.4%)	PISA score	(2.9%)	Share of consumption and property taxes	(1.9%)
JPN	Average replacement rate	(7.5%)	Share of consumption and property taxes	(2.3%)	REGREF Air	(0.6%)
KOR	REGREF	(3.4%)	REGREF Rail	(0.9%)	REGREF Gas	(0.8%)
LUX	Average replacement rate	(5.9%)	Implicit taxes on continued work	(2.6%)	Employment protection legislation	(1.4%)
MEX	Average years of schooling	(14.4%)	PISA score	(12.1%)	REGREF	(4.5%)
NLD	Employment protection legislation	(1.4%)	Share of consumption and property taxes	(0.8%)	R&D direct subsidies	(0.1%)
NOR	Share of consumption and property taxes	(1.9%)	Marginal tax second earner	(0.6%)	REGREF Telecom	(0.3%)
NZL	REGREF Air	(0.5%)	R&D direct subsidies	(0.03%)	REGREF Rail	(0.01%)
POL	Average years of schooling	(5.0%)	Average tax wedge	(0.8%)	REGREF	(0.6%)
PRT	Average years of schooling	(14.0%)	Employment protection legislation	(5.3%)	PISA score	(3.3%)
SVK	Average years of schooling	(1.5%)	Employment protection legislation	(1.3%)	Standard retirement age	(1.1%)
SWE	Average tax wedge	(5.1%)	Average replacement rate	(4.3%)	Employment protection legislation	(2.3%)
TUR	Average tax wedge	(21.1%)	Average years of schooling	(14%)	PISA score	(9.3%)
USA	Share of consumption and property taxes	(1.9%)	REGREF Postal services	(0.3%)		

1. Table shows the three policy reforms with the greatest impact on GDP per capita according to simulations where below-average policy settings, combined with corresponding performance weakness, are aligned to the OECD average.

4.2 Comparison with Going for Growth 2009

54. Table 7 shows the overlap between the recommendations from the accounting framework and those selected as priorities in the 2009 exercise. As described in Sections 2 and 3, about half of the set of 50 policy indicators used in the *Going for Growth* exercise are available as policy indicators in the simulation framework equations.

55. There is substantial overlap between the recommendations from the 2009 *Going for Growth* and those that result from simulating the framework. Over one-third of the selected priorities are the same in both (three countries have fewer than three candidates). And the overlap is even larger if adjustment is made for differing levels of aggregation in the policy priorities as between *Going for Growth* and the framework. This point is most apparent in the case of the product market regulation indicators, where some sub-indicators of product market regulation appear alongside each other in the three priorities identified using the model framework, as shown in Table 5. The high level of disaggregation of such policy indicators together with the constraint on the number of priorities reduces the extent to which the framework can be used as a cross-check on the selected 2009 priorities. If the priorities related to product market regulation had been consolidated into a single recommendation, almost half of the policy priorities from the framework would be the same as in the 2009 *Going for Growth* exercise. Note however that unlike the empirical framework, the *Going for Growth* priority selection procedure is not a "one-size-fits-all" process: A given reform is identified as a priority only if the corresponding indicator is below the average *and* if there is a performance problem, while only the former criterion is used to identify priorities in the empirical framework. Finally, a number of the remaining 2009 *Going for Growth* priorities go beyond and are therefore outside the scope of the framework.

Table 7. Country priorities in *Going for Growth* 2009

	Indicator-based priorities in Going for Growth 2009			***Additional simulation* framework-based priorities**
AUS	Disability benefit schemes	**Competition in network industries**	Performance of early education	Consumption & property taxes, Barriers to foreign ownership
AUT	Barriers to entry in network industries	Implicit taxes on continued work	Graduation rates from tertiary educ.	Consumption & property taxes, Marginal tax second earner, EPL
BEL	Implicit taxes on continued work	**Tax wedge on low-income**	Regulation on the retail sector	Average replacement rate, Marginal tax second earner
CAN	**Barriers to competition in network industries**	Barriers to foreign ownership	Barriers to professional services	Consumption & property taxes, R&D direct subsidies
CHE	**Competition in network industries**	Producer support to agriculture	Full-time LF participation for women	Average replacement rate, Consumption & property taxes
CZE	Graduation rates from tertiary education	Administrative burden for businesses	**EPL for regular workers**	Standard retirement age
DEU	**Tax wedge on labour income**	Regulatory barriers to competition	Improve education outcome	Average replacement rate, EPL
DNK	Marginal taxes on labour income	Disability benefit schemes	Competition framework	Average weekly normal hours
ESP	**Secondary education**	Collective agreements	EPL for regular workers	Average tax wedge
FIN	**Tax wedge on labour income**	Early retirement pathways	Unemployment benefit system	Average replacement rate, Marginal tax second earner
FRA	Minimum cost of labour	EPL	Barriers to competition	Average tax wedge, Average replacement rate, Implicit taxes on continued work
GBR	Disability benefit schemes	Educ. achievement of young	Public infrastructure (transportation)	REGREF Postal services
GRC	**Implicit taxes on continued work**	Barriers to entry in network industries	**Tax wedge on labour income**	PISA score
HUN	**Tax wedge on labour income**	**Work incentives**	Business regulation	Standard retirement age
IRL	**Work incentives**	**Competition in telecom and transport**	R&D spending and innovation	Marginal tax second earner
ISL	**Education outcomes**	Producer support to agriculture	Barriers to entry for firms	REGREF Road, Electricity
ITA	Barriers to competition	Education outcomes	**Tax wedge on labour income**	PISA score, Consumption & property taxes
JPN	**Regulation in network industries**	Producer support to agriculture	EPL for regular workers	Average replacement rate, Consumption & property taxes
KOR	**Regulation in network industries**	Producer support to agriculture	EPL for regular workers	
LUX	**Disincentives for the unemployed**	Achievement in primary and secondary education	**Implicit taxes on continued work**	Employment protection legislation
MEX	**Achievement in primary and secondary education**	**Barriers to entry in network industries**	**Barriers to foreign ownership**	
NLD	**EPL for regular workers**	Marginal effective tax rates	Disability benefit schemes	Consumption & property taxes, R&D direct subsidies
NOR	Public ownership	Disability benefit schemes	Producer support to agriculture	Consumption & property taxes, Marginal tax second earner, REGREF Telecom
NZL	**Barriers to competition in network industries**	Educational achievement at tertiary level	**Effectiveness of R&D support**	
POL	**Barriers to entrepreneurship**	Efficiency of education	Benefit and tax system	Average years of schooling, Average tax wedge
PRT	**Upper-secondary and tertiary attainment**	Administrative burdens on business	**EPL**	
SVK	**Education outcomes**	Regulatory barriers to competition	Work incentives for female workers	EPL, Standard retirement age
SWE	Marginal taxes on labour income	Disability benefit schemes	**EPL**	Average tax wedge, Average replacement rate
TUR	Minimum cost of labour	**Improve educational achievement**	EPL	Average tax wedge
USA	Achievement in primary and secondary education	Health care costs	Producer support to agriculture	Consumption & property taxes, REGREF Postal services

Notes: A policy is in **bold** if it is identified as a priority in both the indicator-based country priorities in *Going for Growth* 2009 and the framework simulations.

4.3 The GDP per capita gains as a result of reforms

56. The simulation results suggest that raising all potential policy candidates to the OECD average could raise GDP per capita by 26% in the typical (median) country.[40] About one-fifth of the long-run overall impact – around 5 percentage points – comes from product market regulation policies. Another one-fifth of the impact comes from reforms of the average tax wedge. Significant gains would also be obtained from reforms of average replacement rates and human capital.

5. Conclusion

57. The simulation framework presented in this paper draws on a wide range of existing OECD studies to evaluate the effect of policy reform on GDP per capita, taking into account a variety of different policies and economic effects. The framework presented is flexible enough to be extended to include other policies and additional linkages with GDP in the future. Despite its many limitations, and even though the picture presented cannot be entirely comprehensive due to limitations on data and empirical work, this tool allows a rough quantification of the GDP effects of policy reforms. It thus provides a basis for the OECD to cross-check the structural policy recommendations made as part of the *Going for Growth* exercise, although the latter would have to continue to be identified primarily through the use of other tools and judgment.

40. For each selected potential policy reform, the typical country is defined for illustrative purposes as the country with the median GDP-per-capita impact. The 26% increase refers to the sum across all potential policy reforms.

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ANNEX A. DETAILED SPECIFICATION AND COEFFICIENTS

1. Detailed specification and coefficients

58. Table A.1 gives a complete list of coefficients used in each equation, where each is expressed using the same scale as the results reported in the underlying study. Coefficients that are not statistically significant at standard critical values are omitted. The standard errors, which in some cases have been recovered from the reported *t*-statistics, provide an indication of the uncertainty around each parameter estimate.

2. Calibration of the Model

59. This section discusses in detail a number of issues that arise in the interpretation of OECD studies and their application in the calibration of the model. These cover the derivation of the labour productivity equation and the impact of reforms through raising the employment rate.

2.1. The labour productivity equation

60. The main issues in calibrating the effects of a policy on labour productivity are applying estimates from an original specification in terms of output per head, calibrating steady-state labour productivity, and constructing some of the policy and intermediate variables that determine labour productivity.

2.1.1 Translating output per head into labour productivity effects

61. The underlying productivity equation used in the empirical framework is derived from a GDP-per-capita equation that has been employed in the *Growth Study* (OECD, 2003) and Boulhol *et al.* (2008). The steady state for output per person, $y'^{*} = Y / L$, is:[41]

$$\text{(A.1)} \quad \ln y_t'^{*} = \lambda_i' + \ln A'_t + \gamma'.\mathrm{X} + \frac{\alpha}{1-\alpha} s_k + \frac{\beta}{1-\alpha} hc - \frac{\alpha}{1-\alpha} \ln\left(g' + n' + d\right)$$

41. Measured in 2000 PPPs and relative to the working-age population (15-64 years). Note that the steady state around which the model is solved here differs slightly from that in the OECD Growth Study (OECD, 2003) in that it is based on a steady state defined in terms of the stability of output relative to technology, $y_t = Y_t / A_t$, instead of the stability of output relative to efficiency units of labour, $y_t = Y_t / (A_t . L_t)$.

Table A.1. Coefficient values in the calibrated model

Dependent variable	Explanatory variable	Mnemonic	Coefficient	Std. Error	Alternative values		Source
GDP per population15-64, (log)	(log) REGREF	REGREF	-0.035	*0.019*	-0.038		Boulhol *et al.* (2008)
interpreted as output per	(log) Trade openness (atrd)	ATRD	0.037	*0.012*	0.045		OECD (2007) Table A5.2
hour worked	(log) Average years of schooling (hc)	HC	0.611	*0.147*	0.307		(of Annex 5)
	(log) Nominal investment/GDP share (k)	K	0.333	*0.015*	0.351		
	(log) BERD business R&D/GDP	BERD	0.042	*0.013*	-0.07 to 0.16		
	EPL regular workers	EPL	-0.174	*0.057*	-		Bassanini *et al.* (2009)
	Share of consumption and property taxes	TAXSHARE	0.25	*0.12*	0.25 to 0.93		Arnold (2008)
Dynamic Adjustment	Average effect	φ	-0.09	*0.023*	-0.09 to -0.23		OECD (2007)
	Interaction effect:	α	0.02	*0.01*	0.009, 0.01		Conway *et al.* (2006)
Nominal ICT share in	REGREF	REGREF	-0.02	*0.003*	-0.006 to -0.009		Conway *et al* . (2006)
total investment, (0~1)	Average years of schooling	HC	0.02	*0.005*	-0.001 to 0.021		Table 2A
Human capital	PISA	PISA	0.025	-	-		based on OECD (2004)
Δ BERD, (%)	REGREF, unit increase	REGREF	10.73	-	-		Jaumotte and Pain (2005)
(change in spending)	EPL regular workers, unit increase	EPL	3.48	-	-		Table 7
	Tax subsidies to R&D	BINDEX	-0.48	-	-		
	Diriect subsidies to R&D	RD_SUB	0.01	-	-		
Average hours worked, females (log)	(log) Marginal tax on second earner	RMTX	-0.805	*0.25*	-0.757 to -0.805		OECD (2008)
							Table A4.7
Average hours worked, males (log)	REGREF	REGREF	-0.009	*0.004*	-0.006, -0.012		Column 5
	Average of weekly normal hours and of weekly normal hours and overtime	AWR	0.006	*0.001*	0.004		Column 6
Employment rate 1524	EPL	EPL	-2.35	*0.588*	-5.44, -2.35		Bassanini and Duval (2006)
(%)	Tax wedge, %	TW	-0.34	*0.050*	-0.67, -0.34		Table 3
	Average net replacement rates over 5 years (arr), %	ARR	-0.24	*0.050*	-0.29 to -0.24		Column 1 and 2
	REGREF	REGREF	-	-			Table 2.1
Employment rate, males 2554	EPL	EPL	-	-			Column 1
(%)	Tax wedge, %	TW	-0.3	*0.036*			
	Average net replacement rates over 5 years (arr), %	ARR	-0.17	*0.023*			
					Full-time	Part-Time	
	REGREF	REGREF	-1.6	*0.696*	-0.75	-0.86	Table 2.1
Employment rate, females 2554	EPL	EPL	-	-			Column 2, 'aggregate'
(%)	Tax wedge, %	TW	-0.5	*0.147*	-0.12	-0.38	
	Average net replacement rates over 5 years (arr), %	ARR	-0.32	*0.096*	-0.14	-0.17	
	Weeks of paid leave	LEAVEWEEKS	0.06		-0.02, 0.11		Table 2.1
	Weeks of paid leave	LEAVEWEEKS	0.0003		-0.00, 0.06		
	Child benefits	CHILDBEN	-0.24	*0.089*	-0.31, 0.07		
	(log) Childcare	CHILDCARE	0.05	*-0.018*	-		Jaumotte, 2003
Employment rate, females 2554	(log) Average years of schooling for women	HC	0.5	*-0.125*	-		Table 8, column 1
(log)	(log) Relative marginal tax second earners	RMTX	-0.02	*0.109*	-		
Employment rate, 5564	EPL	EPL	1.9	*0.691*	1.44, 1.59		Table 2.2
(%)	Tax wedge, %	TW	-0.33	*0.048*	-0.33, -0.31		Columns 1 and 3
	Average net replacement rates over 5 years (arr), %	ARR	-0.23	*0.027*	-0.25, -0.19		
	Implicit tax on continued work, (%)	IMPLICIT	-0.15	*0.045*	-0.14, 0.10		Column 3
	Standard retirement age	SRET	0.65	*0.303*	0.57, .065		
Goods exports, % GDP, (log)	(log) Human capital dissimilarity	HC	0.54	*0.193*	-		Nicoletti et al, (2003)
	(log) Business sector R&D as share of GDP, %	BERD	0.208	*0.026*	-		Table 4b, column 1
	(log) Tariff barriers	TARIFF	-0.137	*3.690*	-		
	(log) Tax wedge, %	TW	-0.399	*0.072*	-		
	(log) REGREF	REGREF	-0.253	*3.850*	-		
Services exports, % GDP, (log)	(log) EPL, (0~100)	EPL	-0.011	*1.850*	-		Table 4b, column 2 & 3
	(log) Tax wedge, %	TW	-0.608	*-0.159*	-		(mean of 2 values)
	(log) Human capital dissimilarity	HC	-0.6015	-	-		
	(log) FDI Restrictions	$FDI^{restrict}$	-0.399	*3.030*	-		
Memo							
GDP per hour worked, (log)	Employment rate, pp	empr	0.42		0.36, 0.8		Bourlès and Cette (2005)
	(log) Average hours worked	hrs	0.4		0.3, 0.62		

Note: % indicates percentage variables scaled on 0-100 and 0~1 indicates scaled as a proportion of one. Standard errors expressed as (approximately) the average of values across different specifications. Alternative values expressed as range if they imply multiple values based on the original study.

where $\lambda_i^{'}$ stands for a country-specific fixed effects; s_k and *hc* are investment in physical capital and human capital (in log), respectively; *g*' and *n*' are the growth rates of *A*' and *L*' (working-age population) in that order; and d is the depreciation rate of capital. The term $\gamma'.X$ stands for the (endogenous) policy-driven component of TFP, where the first term is a vector of parameters giving the response on labour productivity and the second is a vector of corresponding policies and intermediate effects. Finally, α and β are the factor shares of physical and human capital, respectively. In this expression, the technology term *A'* is a composite term that (implicitly) accounts for both total factor productivity *and* labour utilisation of the working-age population *L'*, without explicitly identifying either.[42]

62. The translation from the output-per-person estimates to appropriate parameters for the labour productivity equation is done as follows. The coefficients α and β are identical across the equations as they are 'deep' parameters of the production function. The depreciation rate is the same in the two specifications. The technology term *A* in the labour productivity relationship is part of the composite term *A'* in the output-per-person framework. In principle, it can be identified using labour utilisation. The human capital term is the same under both specifications. The sum of the growth rates of technology and labour inputs are also identical: $n' + g' = n + g$. Therefore, the only difference between the specifications in this respect lies in the intercept term.

63. The effect of policy on labour productivity (γ) will be smaller than on output per head to the extent that the effects operate through changes in labour utilisation. In general, it is assumed that the policy affects TFP rather than labour utilisation. This seems reasonable for variables such as R&D. In these cases, the coefficients from the output per head specification are directly applied to labour productivity. Provided the effects are not accounted for elsewhere, this assumption would still lead to the correct impact on GDP per capita even if it is likely to overstate the size of effects through productivity relative to labour utilisation.[43]

2.1.2 Steady-state labour productivity

64. The level of exogenous TFP is reflected in a parameter θ, which also takes into account the intercept term λ and all remaining terms such as depreciation and is defined as $\theta = \lambda + \ln A - \frac{\alpha}{1-\alpha}\ln(g+n+d)$. It would be difficult to recover the value of these terms from the underlying estimates so θ is therefore calibrated by assumption. This term is set to be the same across all

42. The original equation is of the form:

$$\Delta \log Y'_{i,t} = -\phi_i\left(\log Y'_{i,t-1} - \alpha_1 \log K_{i,t} - \alpha_2 hc_{i,t} - \alpha_3 \Delta \log P_{i,t} - \sum_{j=4}^{m}\alpha_j \log X_{i,t} - \eta_{0,i}t - \lambda_i\right)$$
$$+ \beta_{1,i}\Delta \log K_{i,t} + \beta_{2,i}\Delta \log H_{i,t} + \beta_{3,i}\Delta^2 \log P_{i,t} + \sum_{j=4}^{m}\beta_{j,i}\Delta \log X_{i,t} + \varepsilon_{i,t}$$

where the subscript *i* and *t* denote country and time respectively. *K* is physical capital proxied by the ratio of nominal total investment over nominal GDP. *P* is the working-age population, and *t* is a common linear time trend.

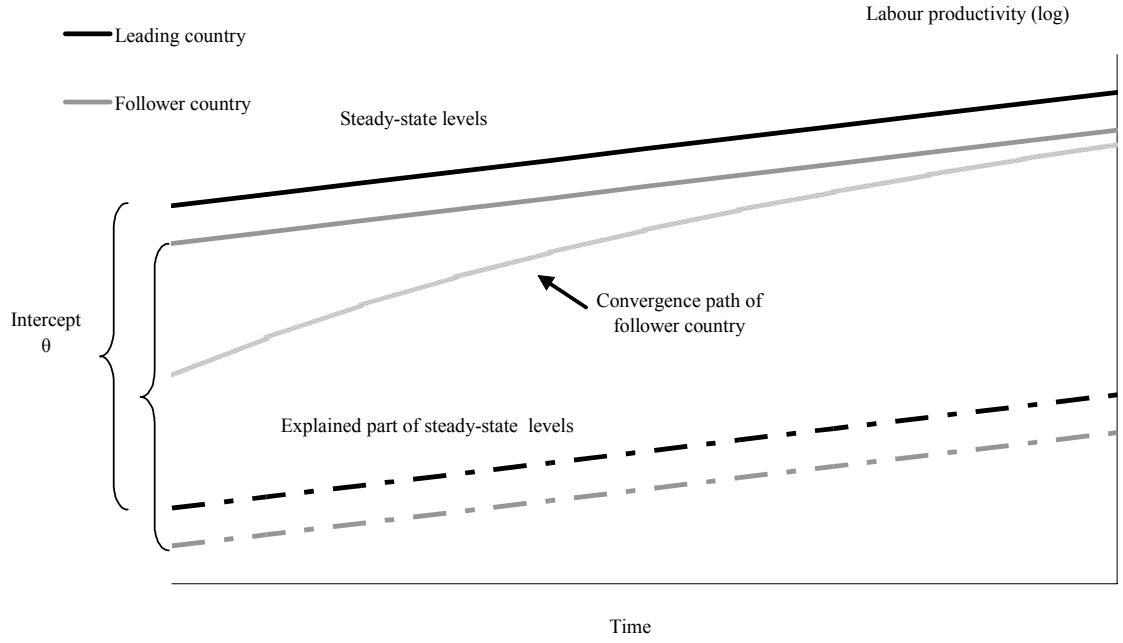
43. It could be argued that the effect of product market regulation (REGREF) on employment found in several OECD studies (Bassanini and Duval, 2006; Nicoletti and Scarpetta, 2005) is also accounted for by the direct effect of REGREF on output per person found in OECD growth regression analysis (Boulhol *et al.*, 2008). However, the estimated direct effect on productivity is relatively small and it is therefore assumed that this is an additional effect to that found on employment.

countries,[44] consistent with the assumption that all countries have access to the same technology and the stronger condition that there are no genuine country-specific fixed effects. The level of θ is set assuming that the United States is currently at its steady-state level of labour productivity:

$$\text{(A.2)} \qquad \overline{\theta} = lp_{US} - \gamma.X_{us} - \tfrac{\alpha}{1-\alpha} s_{K,US} - \tfrac{\beta}{1-\alpha} hc_{US}$$

where $\hat{lp}^{*}_{US}$ is the part of the US labour productivity that can be explained by policies and structural factors, such as the share of investment in physical capital in total value-added, and lp_{US} is the actual level of labour productivity in the United States. The United States is chosen to set this assumption about the level of exogenous TFP because it has relatively high actual labour productivity, suggesting that it is close to the frontier, and as its relatively favourable policy settings imply that its level of steady-state productivity may be close to what is feasible given good policy settings. Under these assumptions, most other countries have actual labour productivity that is below both their current and the US steady-state level.

Figure A.1. Labour productivity: Illustration of the role of theta



65. The role of θ is illustrated in Figure A.1. θ is set to be invariant to policy shocks so that reforms have their full effect on raising the level of steady-state labour productivity. That is, θ shifts the explained part of steady-state labour productivity levels, yielding steady-state labour productivity levels. Also, the steady state of labour productivity is assumed to increase from TFP growth. The figure also depicts how a country lagging in steady-state and actual labour productivity levels (*i.e.* a follower country) adjusts to its own steady state along a convergence path. The evolution of labour productivity along the convergence path is fast when the gap to the steady state is larger and dwindles as it approaches the steady-state level. In the long run, there is conditional convergence, with the gap in levels depending on differences in policy stances and other structural factors.

44. An alternative assumption would be to set θ differently for all countries, such that all countries had the same steady-state labour productivity (irrespective of structural and policy factors).

2.1.3 Determinants of labour productivity

66. This sub-section discusses some determinants of labour productivity whose role is less straightforward than for others: trade, ICT investment and human capital accumulation. In addition, the calibration of the rate of adjustment of labour productivity to its steady state and the role of policy factors in this process is discussed.

2.1.3.1 Trade openness

67. The impact of changes in the share of exports in GDP is used to calculate changes in trade openness as measured by the indicator *atrd*. This measure is constructed as the part of trade openness – measured here as the sum of imports and exports as a share of GDP – that cannot be explained by country size.[45] Therefore, incremental improvements in openness can simply be added to this indicator. While changes in nominal exports are determined by policy factors in the framework, imports are assumed to rise in line with GDP. Consequently, the change in *atrd* is derived using the following approximation:[46]

$$\text{(A.3)} \quad \Delta atrd = \left(X + \Delta X + M + \Delta GDP \cdot \frac{M}{GDP} \right) \Big/ \left(GDP + \overbrace{\Delta X \cdot \frac{X}{GDP}}^{=\Delta GDP} \right) - \frac{(X+M)}{GDP}$$

where X is the initial level of exports, ΔX is the change in exports, and M is the level of imports.

68. The underlying estimates from Nicoletti *et al*. (2003) are bilateral trade equations but the transformed least squares methodology (TLS) allows the interpretation that these represent the 'average' effect with respect to a partner that represented the average of other countries.[47] The results can therefore be interpreted as aggregate results (against a partner with a 100% share).[48]

2.1.3.2 ICT investment and physical capital accumulation

69. The effect of policy on the share of nominal ICT investment in total investment is expressed as a change in total physical investment as share of GDP using the following approximation. It is assumed that there is no substitution between ICT and non-ICT investment: any ICT investment comes *in addition* to other forms of investment, as the experience of recent decades shows no obvious decline in non-ICT

45. This is constructed starting with trade openness measured as (*Nominal Exports* + *Nominal Imports*)/*Nominal GDP*. The log of trade openness is then regressed on the log of population. The estimated residuals from this linear regression form the indicator *atrd*.

46. Note that this approximation is weak in a few cases (*e.g.* Belgium, Luxembourg, the Netherlands and Slovakia) where exports are larger than GDP.

47. See page 94 of the paper.

48. In the original model, these are represented by the gap in human capital with other countries. Here it is assumed that only the home country raises human capital through policy so that the gap increases in the same measure.

investment where ICT investment has been strong.[49] The approximation assumes that the change in the ICT share of GDP is negligible:[50]

$$(A.4)\quad ICT_{share,t+1} = \frac{Invest_{ICT,t} + \Lambda}{Invest_{tot,t} + \Lambda} \approx \left(\frac{Invest_{ICT,t}}{Invest_{tot,t}} + \frac{\Lambda}{Invest_{tot,t}} \right)\left(1 - \frac{\Lambda}{Invest_{tot,t}} \right)$$
$$\approx (ICT_{share,t} + (\Delta S_{K\,t+1} / S_{Kt}))\left(1 - \Delta ICT_{share,t+1}\right)$$

where Λ stands for a rise in ICT investment and, when divided by total investment, is equal to $\Delta S_{K\,t+1} / S_{Kt}$. This implies that overall change in S_K is:

$$(A.5)\quad \Delta S_{Kt} = \frac{\Delta ICT_{share,t}}{1 - \Delta ICT_{share,t}} s_{Kt-1}$$

70. In the model, capital is homogenous so that a proportional increase in the steady-state capital stock is equal to the increase in the investment to capital ratio following the upwards shift in the rate of investment. The higher capital stock raises potential output. However, ICT capital differs from other forms of capital. In particular, the depreciation rate is much higher on average than the other types of equipment so that a higher share of ICT investment in the total would also imply a higher rate of average depreciation. As a result, the relationship between capital and investment would change and no longer be proportional:

$$(A.6)\quad \Delta K_t = I_t - \left(d + \Delta d\right) K_{t-1} \qquad \text{where } I = S_K Y$$

The effect of higher investment on the level of capital might be attenuated by the rise in depreciation, although this effect is not included in the model.[51] Neither does the framework address potentially higher output elasticity of ICT investment which might explain why this type of investment takes place despite its higher depreciation rate.

71. The assumption that investment is constant over time in the absence of any reforms may be unrealistic. For example, a country with a very high investment share implies a very high steady-state level of labour productivity, but this may not be that warranted if the share would change as the economy matures. Indeed, diminishing returns to capital should spontaneously drive down the investment share, but this is not incorporated in the framework.

2.1.3.3 Human capital accumulation

72. The baseline data for human capital, measured as the average number of years of schooling, are constructed from disaggregated data. First, the average years of schooling for the cohorts currently aged 25-34, 35-44, 45-54 and 55-64 are taken from *Education at a Glance* (OECD, 2006). Then, an estimate of the average years of schooling of the current and future 15-24 cohorts is derived. This is based on allocating the population into three categories of education:

49. Indeed, overall investment rose most during the 1990s in countries were ICT investment increased the most. This relationship is also true in cross-section: high ICT investment countries tend to have high non-ICT investment as well.

50. This is preferable to assuming that the ICT share of total investment is constant: the share of nominal investment on ICT is now substantial but the share in overall GDP remains low.

51. It is not obvious how to make this correction without assumptions about depreciation and the share of different types of capital good in the capital stock.

$$\text{(A.7)} \qquad \omega_{1524} = \sum_{k=1}^{k=3} sh_{k,1524} yrs_k$$

where k runs over the groups with the highest level of education attained: lower-secondary, upper-secondary and tertiary education. Each group is associated with a number of years of schooling (yrs).[52] Finally, these estimates are aggregated to derive a path for overall human capital of the population aged 25-64. In practice, this can be used to generate forecasts at 10-year intervals (as today's 25-34 year olds will be 35-44 in 10 years' time) and the data are then interpolated using a moving average for intervening years to generate annual data.[53]

73. Policy is allowed to change directly the average years of schooling of the 15-24 cohort only (or equivalently the shares of different types of students). The human capital measure begins at 25 so the effect of any change in educational attainment will not affect the indicator until the better educated cohort reaches that age, which actually occurs at different ages for each level of education (8, 12 and 16 years on average). It is assumed for simplicity that the change is immediate for those currently aged 20 across all categories, so that for the 25-34 cohort, the human capital $HC^{25\text{-}34}$ variable begins to respond after 5 years and the effect is fully incorporated after 15 years. On the one hand, this transition may be too slow because *HC* does not respond to the immediate effect of younger workers being better qualified. On the other hand, it may be too rapid as it allows policy changes to have an immediate effect on educational attainment of 20-year-olds.

74. The necessary changes in the proportions of each type of student are derived to achieve a given change in human capital, assuming that the share of those with primary education falls and each of the other categories gains the same proportion of additional students. A half year increase in average years of schooling is broadly equivalent to an 8 percentage point fall in the share of students with primary education.[54]

75. The marginal effect of educational quality – as measured by PISA scores – on human capital is calibrated using the assumption that this factor is equivalent to no more than half a year of additional schooling for this sample. This is also roughly equivalent to shifting 2.5% of the population from primary to secondary education.[55] This is similar to assuming that there is some equivalence between the impact of PISA scores and additional schooling on labour productivity and other variables when this is appropriately scaled. As the cross-sectional correlation between *HC* and *PISA* is low, it seems reasonable to interpret these as having separate effects on productivity.

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52. These data are missing for a number of countries and the average of the existing data is used to fill the gaps.

53. This method gives a result that is not identical to the standard human capital series, even if it is very similar, but the cross-sectional correlation between the resulting series is around 0.8 and the average absolute difference is around 0.5 years of schooling (representing a small proportion of average years of schooling).

54. The required change in the share of students with primary education, μ, is obtained by solving the following equation: μ*((12.3-7.75) + (15.6-7.75))*/2=0.5. The numbers 7.75, 12.3 and 15.6 are the OECD averages of the number of years of schooling for primary, secondary and tertiary education graduates, respectively. This is inevitably imprecise because the data are not easy to compare across countries, with each type of schooling corresponding to a different number of years and accounting for a different proportion of the population.

55. Assuming the number of years of schooling is close to the OECD average of around 7.75 years for primary education and 12.3 for secondary education: $0.5 \approx 0.025*12.3 - 0.025*7.75$.

2.1.3.4 Adjustment to steady-state labour productivity

76. In theory, the speed of adjustment to the steady-state labour productivity level can be derived from other parameters in the model and should not be estimated separately.[56] In practice, this approach is known to generate unreasonable values.[57] The adjustment coefficient is therefore set to 0.09 based on a plausible value from Boulhol *et al.* (2008). This method implies reasonable growth rates of labour productivity both for existing labour-productivity gaps and those from the calibrated simulation model.

77. The effect of product market regulation (REGREF) taken from these estimates is introduced heuristically. In particular, the estimated reduced form coefficient from Boulhol *et al.* (2008) may tacitly already reflect some effects of product market regulation and hence there is a risk of double counting. However, this is ignored given the difficulties in estimating reasonable values for the adjustment coefficient and hence the main basis for using their estimate is simply that it seems reasonable on average.

78. Furthermore, the estimate of Conway *et al*. (2006) of the effect of product market regulation on the rate of convergence refers to aggregate business sector labour productivity (per employee) and is derived from a framework where productivity growth depends on growth of the leader, the rate of convergence to the leader's productivity, a direct effect of product market regulation on productivity *growth* and the interaction effects discussed here.[58] The calibration assumes that it is valid to impose these estimates despite the differences in the underlying frameworks.

56. This parameter applies equally to the rate of convergence of output per worker and labour productivity per hour worked.

57. It also requires solid assumptions about *g* and *d*.

58. Nicoletti and Scarpetta (2003) estimate a framework based on TFP but only report industry-level results that do not provide clear guidance for the aggregate parameters.

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