Session 3

TAXATION, REGULATION AND PUBLIC SERVICES

HOW COSTLY ARE THE PUBLIC SECTOR INEFFICIENCIES? AN INTEGRATED FRAMEWORK FOR ITS ASSESSMENT

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This paper provides a theoretical framework which integrates the conventional methodology for measuring the productive efficiency and the monetary assessment of social welfare changes associated with public sector performance. Two equivalent measures of social welfare changes generated by an improvement (or worsening) in productive efficiency are deduced using duality theory. The first one is obtained from the cost function, while the second one arises directly from the production function. Moreover, the paper induces the application of the theoretical framework proposed to empirical analysis.

1 Introduction

Nowadays, an essential issue to be analyzed in depth is the relationship between the productive efficiency of public sector and the potential budgetary savings associated with its improvement. Especially for advanced economies in which the current crisis effects are affecting the public finances in a more evident way. Quantifying these budgetary savings strongly constitute an alternative fiscal policy tool which goes beyond the traditional view of a fiscal consolidation (cut spending or tax hikes). This measure is not only helpful for short-term consolidation but also it is required to guarantee a sound long-term growth path.

Since the late eighties, the measurement of productive efficiency has received an increasing interest within the public economics area. This trend is even more evident for some specific sectors typically provided by the public sector: health, education, etc.. This growing literature has mainly focused on developing quantitative methodologies (usually grouped into parametric and non-parametric methods) from which we may achieve empirical measures of (technical, allocative or overall) efficiency with which a number of units – assumed to be homogeneous – have produced the public good(s) and service(s). Thus, all these measures usually provide us one scenario to compare their performance.

Without doubt these contributions measuring the productivity of public services are very useful to improve the management of public resources. However, there is lack of literature connecting these results with the potential budgetary gains that may arise from a reduction of public sector inefficiency.

In this vein, the OECD (2011) has recently highlighted the transcendence of implementing reforms addressed to increase the efficiency of public spending, specially for governments that are currently facing outstanding budgetary imbalances. In particular, the OECD refers to the need to improve the productivity of the public spending on education and health. In the first case, it is estimated that the gradual adoption of best practices in primary and secondary education could save resources around 0.5 per cent of GDP (with country range from 0.2 to 1.2 per cent), without

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compromising the current educational targets. In the case of health, the resources released by improvements in productive efficiency could be even higher, around 2 per cent of GDP (range by country, between 0.4 and 4.8 per cent).

Moreover, the monetary gains are enormous in terms of social welfare. In this respect, it is important to account not only budgetary savings but also the monetary gains in terms of income and wealth derived from consuming a better education and health. Furthermore, from the marginal cost of public funds perspective, we should also consider the reduction in deadweight losses caused by distortionary taxes which provide these resources released.

The aim of this paper is to provide a theoretical framework which allows consistently integrate the conventional methodology for measuring the productive efficiency and the monetary assessment of social welfare changes associated with the public sector performance, defined in the basis of the output of any public activity. In particular, we deduce two measures of social welfare changes generated by an improvement (or worsening) in productive efficiency associated with the procurement of a public good. The first measure is obtained from the cost function, or in other words, from the supply side, while the second one arises directly from the production function. According to duality theory, both measures are equivalent and deducted from the same set of information.

The rest of the paper is organized as follows. In the second section, we introduce our theoretical framework, upon the basis of the conventional measures of efficiency (Farrell's radial approach). In the third section, we present our integrated approach which combines different dimensions typically involved in policy-makers decisions (welfare changes, measures of inefficiencies, etc.). Finally, the fourth section concludes.

2 The model

2.1 Recent concerns on Public Sector Efficiency (PSE)

The monitoring of public sector activity and the potential derivation of measures of the Public Sector Efficiency (PSE) clearly justify the increasing interest observed on analyses related to the Public Sector Performance (PSP, hereinafter). This section briefly discusses the recent evolution of literature focused on the relevant concept, the Public Sector Efficiency (PSE, hereinafter), which refers to the efficient allocation and production of the public good and services. The existing literature comprises alternative approaches to measure -and to evaluate- the PSP and, consequently, the PSE. A non exhaustive description of how this literature has evolved is next. Firstly, a growing number of studies (Afonso *et al.*, 2005; Borge *et al.* 2008; and Clements, 2002, among others) translated the traditional approach used to analyze the productive efficiency of firms to the case of public sector units (countries, municipalities, schools, hospitals, etc.) with the aim of obtaining empirical measures of the PSE for a set of units and rank them. Secondly, some studies (Borge *et al.* 2008, among others) have also explored the identification of determinants of these empirical measures. An alternative perspective is considered by other authors (see Afonso *et al.*, 2010; and Casiraghi *et al.*, 2009, among others) in order to include the distributional concerns traditionally linked to the public sector activity into the efficiency analysis.

All in all, it can be observed that some caveats are still present. First, most of these analyses have focused on the productive efficiency or technical efficiency (ψ). Thus, they have leaven out of the analysis issues related to the allocative efficiency (γ), a relevant component of the overall efficiency (η). This latter measure is our main interest in this paper. Second, the distributional concerns has not been yet fully incorporated to the analysis, although it is a component mostly involved in policy-makers decisions.

Our paper aims to fulfill all these caveats by combining the elements presented; (i) empirical measures of efficiency, (ii) welfare impact and distributional concerns, (iii) a monetary valuation of inefficiencies measured.

2.2 The public sector

This section introduces the notation used in subsequent sections and models the Public Sector Performance according to a framework which could be adapted to very different analysis.

Our model can be briefly described as follows. The public sector produces a vector of goods and services $X = (x^1, \ldots, x^H)$ which we consider excludable unlike pure public goods.[1] Each x^h is produced by a public agency with the corresponding production function for the case of single output, such that:

$$x^h = f(Y) \tag{1}$$

where $Y = (y_1, \ldots, y_n)$ is a vector of n inputs including fixed capital required for the activity and $f \in S = .\ \{(Y, X) : Y \text{ can produce } X\}$ with S the set of technologies.

The unitary price for each of these n inputs are included in the vector $W = (w_1, \ldots, w_n)$. Consequently, the total cost of producing x^h (c^h) is defined as:

$$c^h(x^h) = \sum y_i w_i \tag{2}$$

Assuming $H = 1$, for the sake of clarity in the presentation, this theoretical framework allows us to introduce the notation used in posterior sections by defining formally all the standard concepts of efficiency – mentioned above – from the inputs-oriented perspective.[2] First, given the minimum quantity of inputs needed for producing the level of output X (Y^*), technical efficiency (ψ) is defined as the ratio between Y and Y^*, such that:

$$\psi = \frac{\|Y^*\|}{\|Y\|} \tag{3}$$

Second, given the combination of inputs producing X at the minimum cost (Y^{**}), the allocative efficiency (γ) is defined as the following ratio:

$$\gamma = \frac{\|Y^{**}\|}{\|Y^*\|} \tag{4}$$

Third, the overall efficiency can be defined as the product of expressions (3) and (4):

$$\eta = \frac{\|Y^{**}\|}{\|Y\|} \tag{5}$$

Finally, we derive the corresponding expression for η in terms of production costs:[3]

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1 Rivalry and excludability are assumed to consistently reflect changes in the demand observed for each public good.

2 Analogous definitions can be found in the literature according to the output-oriented measures (see Coelli, 2005) for a detailed comparison of both approaches). There are no divergences in the analyses carried out from both perspectives. Therefore, one of them can be excluded.

3 See Coelli (2005) for a detailed description.

$$\eta = \frac{c^{**}}{c} \tag{6}$$

where c and c^{**} are, respectively, the actual level of production costs and the production costs corresponding to Y^{**}, the efficient combination of inputs when producing X, from the technical and the allocative perspective.

3 PSE analysis: an integrated approach

3.1 *The "expenditure-efficiency" function*

The framework described above can be observed from a different perspective, facing the dual version of the same problem. Under these circumstances, the production of public good (x) and its level of output ($\hat{x}$) may be explained by the expenditure function assumed in production ($c(\hat{x})$), and the degree of overall efficiency ($\eta(\hat{x})$). In other words, an "expenditure-efficiency" function (Φ) which is implicit in the conventional production function of productive factors once the vector of input prices (W) is given:

$$x = f(Y)\big|_W \rightarrow x = \phi(c,\eta)\big|_W \tag{7}$$

First of all, from (6), we can express the budgetary cost of producing a quantity of public good from the vector of inputs (Y^{**}) and the degree of overall efficiency reached in the productive process, η:

$$c(\hat{x}) = \eta^{-1} \sum\nolimits_{i=1}^{n} y_i^{**} w_i \tag{8}$$

Secondly, by applying the inverse function theorem to the optimal technology f_{**} (that determining the overall efficiency condition, Y^{**}), the optimal quantities of each input (y_i^{**}) to produce $\hat{x}$ are obtained. Note that these values only depend on factor prices and technological parameters of the production function:

$$y_i^{**} = f_{**}^{-1}(\hat{x}, W), i \in \{1,2,\ldots,n\} \tag{9}$$

Next, by combining (8) and (9), and solving for $\hat{x}$ we derive the expenditure-efficiency function, Φ, as proposed:

$$\hat{x} = \phi(c(\hat{x}),\eta)|_W \tag{10}$$

To translate this general notation to our model, $c(.)$ would be the amount of resources allocated for the provision of the public good, and η the degree of efficiency with which the public agency produces this good.

3.2 Changes in the PSE, welfare impact and monetary valuation

This section presents an integrated approach which allows us to integrate the different dimensions involved in the evaluation of the Public Sector Performance; (i) changes in the degree of efficiency, (ii) welfare impacts linked to public policies, and (iii) monetary valuation of effects. The latter may facilitate the understanding of the inefficiency costs. Moreover, an improvement in the degree of efficiency will help to provide the same public good or service but with a lower level of spending.

For the sake of clarification, we detail our assumptions. First, in the following analysis it is assumed that any change in the degree of efficiency is exogenous. However, as Gibbons (2005) discusses, the existence of internal disturbances in the organizations (misscoordination, lack of incentives, etc.) may be the source of inefficiencies. Second, the social welfare generated by consumption of public good (x) is measured in monetary value in the conventional way, that is, by computing the area under the curve of demand for the good and substracting the cost of the inputs used in its production.[4] Additionally, to obtain accurate measurements of changes in consumer welfare we assume the demand functions involved to be compensated.[5] All in all, this theoretical framework contributes to measure welfare impacts linked to changes (improvements/worsening) in the degree of efficiency (η) with which the public good is produced. This analysis translates Myrick-Freeman and Harrington (1990) framework to our model.

Therefore, using our "expenditure-efficiency" function defined in (10), we have the following social welfare function:

$$\Omega = \Omega(Y, W, \eta) = \int_0^x p(u)du - \sum_{i=1}^n y_i w_i \tag{11}$$

where $p(\cdot)$ is the compensated demand function specified in its inverse form.

From equation (11) one can derive the first order conditions with respect to each inputs used (y_i), such that:

$$\frac{\partial \Omega}{\partial y_i} = p(x)\frac{\partial x}{\partial y_i} - w_i = 0, i = 1,..., n \tag{12}$$

which determine the input demand functions $y_i^{**}(w_i, \eta)$ for all i. It should be noted here that these values are precisely those corresponding to the optimal vector of production factors, Y^{**}. It allows us to compute the optimal output level of public good for a given level of productive efficiency:

$$x^{**}(\eta) = \varphi\left(y_i^{**}(w_i, \eta), \eta\right) \tag{13}$$

Likewise, we could define the social welfare function associated with the production of this public good by considering the overall productive efficiency (η) as a main argument:

$$\Omega(\eta) = \varpi\left(y_i^{**}(w_i, \eta), \eta\right) \tag{14}$$

Applying the envelope theorem to the algebraic analysis described above, we obtain the following proposition:

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4 Note that, as we did in the previous sections, hereinafter the notation is simplified to a single public good x to highlight the underlying intuitions.

5 See Willig (1976) for a discussion on the accurate measurement of these areas.

Proposition 1: *The net welfare gain is the value of the marginal contribution, in monetary terms, brought about by a reduction (or increase) of overall inefficiency in the production function, so that:*

$$\frac{\partial \Omega(\cdot,\eta)}{\partial \eta} = p(x^{**})\frac{\partial x^{**}(\cdot,\eta)}{\partial \eta} - \sum_{i=1}^{n} w_i \frac{\partial y_i^{**}(\cdot,\eta)}{\partial \eta} = p(x^{**})\varphi_n\left(y_i^{**}(w_i,\eta),\eta\right) \tag{15}$$

Some interesting implications are next. First, this result defines a relationship between the production function and the changes in welfare computed in the light of modification of the degree of efficiency. Second, it can be observed that, under full productivity of all inputs, the value generated by an infinitesimal improvement in productive efficiency is explained by the increase in the output generated. Third, from a different perspective, this gain could be seen as an approximation (φ_n) to the optimal technology (y_i^{**}).

Next, the dual version of this result is achieved. To do this, from (13) one can define the costs functions related to this production as a function of the optimal level of public good, the vector of inputs associated with the optimal technology and the degree of productive efficiency reached, so that:

$$c = c\left(x^{**}(\eta),\eta\right) \tag{16}$$

Accordingly, we can rewrite (11) as:

$$\Omega = \Omega\left(x^{**},\eta\right) = \int_0^{x^{**}} p(u)du - c\left(x^{**},\eta\right) \tag{17}$$

From this perspective, the social welfare, considered as the difference between consumer's surplus and producer's quasi-rents, is maximized for the level of optimal output determined by the equality between price and marginal cost:

$$p(x^{**}) = \frac{\partial c\left(x^{**},\eta\right)}{\partial x} \tag{18}$$

Again, combining (17) and (18), the following proposition emerges:

Proposition 2: *The net welfare gain (loss) is the value of the marginal contribution, in monetary terms, brought about by the reduction (increase) of production cost as a consequence of an improvement (worsening) of the degree of overall inefficiency:*

$$\frac{\partial \Omega\left(x^{**},\eta\right)}{\partial \eta} = -\frac{\partial c\left(x^{**},\eta\right)}{\partial \eta} \tag{19}$$

Proof Given (17), we compute the total derivative with respect to the degree of efficiency (η). That is:

$$\frac{d\Omega\left(x^{**},\eta\right)}{d\eta} = \frac{\partial \Omega\left(x^{**},\eta\right)}{\partial x}\frac{\partial x^{**}}{\partial \eta} + \frac{\partial \Omega\left(x^{**},\eta\right)}{\partial \eta} \tag{20}$$

where:

$$\frac{\partial \Omega\left(x^{**},\eta\right)}{\partial x} = p\left(x^{**}\right) - \frac{\partial c\left(x^{**},\eta\right)}{\partial x} \tag{21}$$

and:

$$\frac{\partial\Omega\left(x^{**},\eta\right)}{\partial\eta} = p\left(x^{**}\right)\frac{\partial x^{**}}{\partial\eta} - \left(\frac{\partial c\left(x^{**},\eta\right)}{\partial x}\frac{\partial x^{**}}{\partial\eta} + \frac{\partial c\left(x^{**},\eta\right)}{\partial\eta}\right) \tag{22}$$

Firstly, as a consequence of (18), we could identify $\frac{d\Omega(x^{**},\eta)}{d\eta}$ and $\frac{\partial\Omega(x^{**},\eta)}{\partial\eta}$.

Next, from (22), grouping conveniently and using again (18), we obtain the proposition.

Corollary: *An improvement in the degree of overall inefficiency always involves an increase in social welfare.*

Again, some interesting conclusions can be derived. First, this result defines a relationship between the costs function and the changes in welfare computed when the degree of efficiency is modified. Second, these results can be understood as follows. The infinitesimal improvements in productive efficiency obtained lead to a reduction in the cost of production and, consequently, they are welfare enhancing. Third, combining Propositions 1 and 2 we obtain that the two welfare measures proposed must coincide due to the duality in the relationship between the production function and the cost function, which is underlying in (equality).

To conclude with this subsection, some interesting lessons could be extracted regarding the application of this approach to empirical analyses. First, the final results would lead to monetary valuations of the changes in the overall efficiency, which becomes a very interesting tool from the policy-makers perspective. Second, our approach integrates elements related to efficiency and others related to the equity, which allows to explore this classical trade-off (next subsection will explore this point in depth). Third, this approach requires an estimate of the production function and the cost function as well, which may limit its application when information on the production procedure and/or the production costs is limited.

3.3 Distributional issues

In this subsection, we analyze how the welfare gains from increased efficiency affect consumers of public goods and public sector itself as the producer. In this respect, we first identify the efficiency gains effects on consumer's welfare. Let Ω^C be the measure of consumer surplus used (usually equivalent or compensatory variation), so that:

$$\Omega^C = \int_0^{x^{**}} p(u)du - p(x^{**})x^{**}(\eta) \tag{23}$$

Then, the consumer's marginal gain is:

$$\frac{\partial\Omega^C}{\partial\eta} = -\frac{\partial p(x^{**})}{\partial x}\frac{\partial x^{**}(\eta)}{\partial\eta}x(\eta) \tag{24}$$

Alternatively, if we consider equation (13):

$$\frac{\partial p(x^{**})}{\partial x} = \frac{\partial p}{\partial x^{**}}\frac{\partial x^{**}}{\partial\eta} \tag{25}$$

Now, from the producer's perspective, we repeat a similar strategy. First, we define the producer's surplus in terms of η:

$$\Omega^S = p(x^{**})x^{**}(\eta) - \sum_{i=1}^{n} y_i^{**} w_i \tag{26}$$

where y_i^{**} is determined by the n input demand functions, $y_i^{**}(w_i, \eta)$.

Again, the producer's marginal gain can be obtained by differentiating the previous expression:

$$\frac{\partial \Omega^S}{\partial \eta} = -\frac{\partial c(x^{**}, \eta)}{\partial \eta} + \frac{\partial p(x^{**})}{\partial x}\frac{\partial x^{**}(\eta)}{\partial \eta}x(\eta) \tag{27}$$

In the light of the previous expressions, the following proposition can be demonstrated:

Proposition 3: *An improvement in the degree of overall inefficiency always lead to an increase in consumer's welfare. By contrast, this welfare gain is not guaranteed in the case of producers of public goods.*

Proof: On the one hand, for consumers, this proof can be reduced to check the signs of the expressions mentioned above. As $\frac{\partial p(x^{**})}{\partial x} \leq 0$ and $x(\eta) > 0$, depending on the sign of $\frac{\partial x^{**}(\eta)}{\partial \eta}$ the consumer's net welfare gain will be positive or negative. The optimal vector of inputs (from the technological and the minimization of costs' perspective) is taken as given in (13). As a consequence, a reduction of inefficiency may, in principle, lead to a decreased level of output – in equilibrium. To clarify this latter statement, we differentiate the first order conditions mentioned above, in equation (18), to achieve the following expression:

$$\frac{\partial p(x^{**})}{\partial x}\frac{\partial x^{**}(\eta)}{\partial \eta} = \frac{\partial^2 c(x^{**}, \eta)}{\partial x^2}\frac{\partial x^{**}(\eta)}{\partial \eta} + \frac{\partial^2 c(x^{**}, \eta)}{\partial x \partial \eta} \tag{28}$$

Grouping conveniently:

$$\frac{\partial x^{**}(\eta)}{\partial \eta} = \frac{\frac{\partial^2 c(x^{**},\eta)}{\partial x \partial \eta}}{\frac{\partial p(x^{**})}{\partial x} - \frac{\partial^2 c(x^{**},\eta)}{\partial x^2}}$$

On the one hand, looking at the denominator, it is straightforward to establish that $\frac{\partial p(x^{**})}{\partial x} - \frac{\partial^2 c(x^{**},\eta)}{\partial x^2} < 0$. On the other hand, any improvement in η lead to reductions in costs. Thus, $\frac{\partial^2 c(x^{**},\eta)}{\partial x \partial \eta} < 0$ and, consequently, $\frac{\partial x^{**}(\eta)}{\partial \eta}$ is always positive.

All in all, we have proved that consumer's welfare increases can be derived from the response in the production costs to an improvement in overall efficiency.

On the other hand, for producers, using the price-elasticity of public good demand, defined as $\varepsilon = \frac{p(x^{**})}{x\frac{\partial p(x^{**})}{\partial x}}$, which is negative by definition, we can prove that $\frac{\partial \Omega^S}{\partial \eta}$ will only be negative if and only if $\frac{\partial x^{**}(\eta)}{\partial \eta} > \varepsilon \frac{\frac{\partial c(x^{**},\eta)}{\partial \eta}}{p}$.

That is, the difference between the social welfare change and the variation in the consumer surplus.

From Proposition 3, the distribution of welfare gains derived from an improvement in the degree of efficiency may be established. Our results indicate that the determinants are the optimal output response to this increase and the price-elasticity of demand. In short, three different possibilities are achieved:

$$\text{(i) } 0 < \frac{\partial x^{**}(\eta)}{\partial \eta} < \varepsilon \frac{\frac{\partial c(x^{**},\eta)}{\partial \eta}}{p} \Leftrightarrow \frac{\partial \Omega^C}{\partial \eta} > 0, \frac{\partial \Omega^S}{\partial \eta} > 0 \tag{29}$$

$$\text{(ii) } \varepsilon \frac{\frac{\partial c(x^{**},\eta)}{\partial \eta}}{p} < \frac{\partial x^{**}(\eta)}{\partial \eta} \Leftrightarrow \frac{\partial \Omega^C}{\partial \eta} > 0, \frac{\partial \Omega^S}{\partial \eta} < 0 \tag{30}$$

In order to show a different perspective of the conclusions described so far, we consider now an example to illustrate (and reinforce) the underlying intuitions. Moreover, some implications for the empirical application of this approach are discussed.

We consider a scenario in which the overall efficiency to produce the public good x improves between two moments in time, from η_0 to η_1. To quantify the value of social welfare generated by the change in the degree of efficiency, we may choose to integrate, alternatively, one of the two welfare change measures presented in Propositions 1 and 2, respectively, and use $[\eta_0, \eta_1]$ as integration interval:

$$\Delta\Omega = \int_{\eta_0}^{\eta_1} p(x^{**})\varphi_n\left(y_i^{**}(w_i,\eta),\eta\right) = -\int_{\eta_0}^{\eta_1} c(x^{**},\eta) \tag{31}$$

From the empirical point of view, the direct quantification of $\Delta\Omega$ from any of the two alternatives shown in (31) requires to determine the changes in the equilibrium output and in the optimal combination of inputs caused by the change in the degree of productive efficiency. This informational requirement should be added to those previously mentioned when estimating the production and/or cost function.

On the contrary, this computation may be simplified when information on production levels of public good before and after to the change analysed is available. To do this, using (11), we simply need to calculate the difference between initial and final social welfare values:

$$\Delta\Omega = \int_0^{x_1} p(u)du - c(x_1,\eta_1) - \int_0^{x_0} p(u)du + c(x_0,\eta_0) \tag{32}$$

By using this quantification, it can be observed how the potential welfare gains resulting from improved efficiency come from the displacement of the supply curve (as there is a reduction in the cost function). In other words, marginal cost of producing public good goes from $\frac{\partial c(x,\eta_0)}{\partial x}$ to $\frac{\partial c(x,\eta_1)}{\partial x}$.

Following to Myrick-Freeman and Harrington (1990), we can obtain an alternative expression for (32) by incorporating the change experienced by the cost function.

To do this, we use the line integral of its gradient along any path between (x_0, η_0) and (x_1, η_1), and integrate along the line connecting them, such that:[6]

$$\Delta\Omega = \int_{x_0}^{x_1} p(u)du - \int_{\eta_0}^{\eta_1} \frac{\partial c(x_0,\eta)}{\partial \eta} d\eta - \int_{x_0}^{x_1} \frac{\partial c(x_1,\eta)}{\partial x} dx \quad (33)$$

Figure 1 shows the net social welfare gain expressed in (33) (the shaded area marked ΔΩ). For the sake of simplicity, we assume linearity for all the curves involved; both compensated public good demand, and marginal cost functions (pre- and post-).

According to the analysis presented above, we could additionally define welfare changes experienced by consumers and the public sector as public good supplier. On the one hand, consumers enhance their welfare by increasing the area under the compensated demand curve, as a consequence of the equilibrium price decrease, from p_0 to p_1.

Figure 1

Net Social Welfare Gain

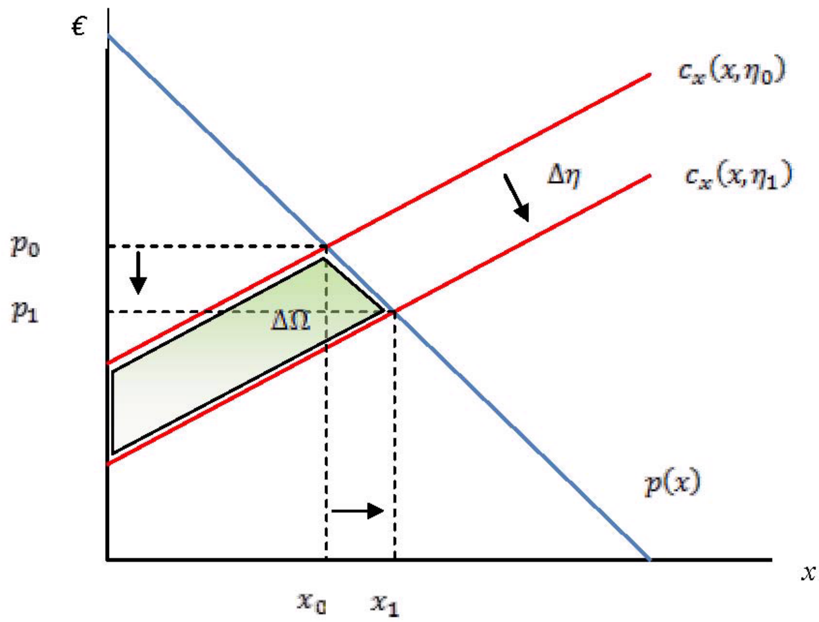

Figure 2 shows the consumers' welfare gain, which is represented by the total upper shaded area. On the other hand, the net change in producer's welfare results from compensating for the decrease in their initial surplus due to the lower resulting price (the patterned upper shaded area) with the new surplus caused by the reduction of costs charted in the new marginal cost function (the lower shaded area marked $\Delta\Omega^S$).

As a consequence, combining this graphical evidence with propositions presented above, we conclude that:

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6 See Myrick-Freeman and Harrington (1990) for further details on the underlying method, which is out of the scope of this paper.

i) for any $\eta > 0$, $\Delta\Omega = \Delta\Omega^C + (\Delta\Omega^S - \nabla\Omega^S) > 0$;

ii) we have not any guarantee implying that $(\Delta\Omega^S - \nabla\Omega^S) > 0$.

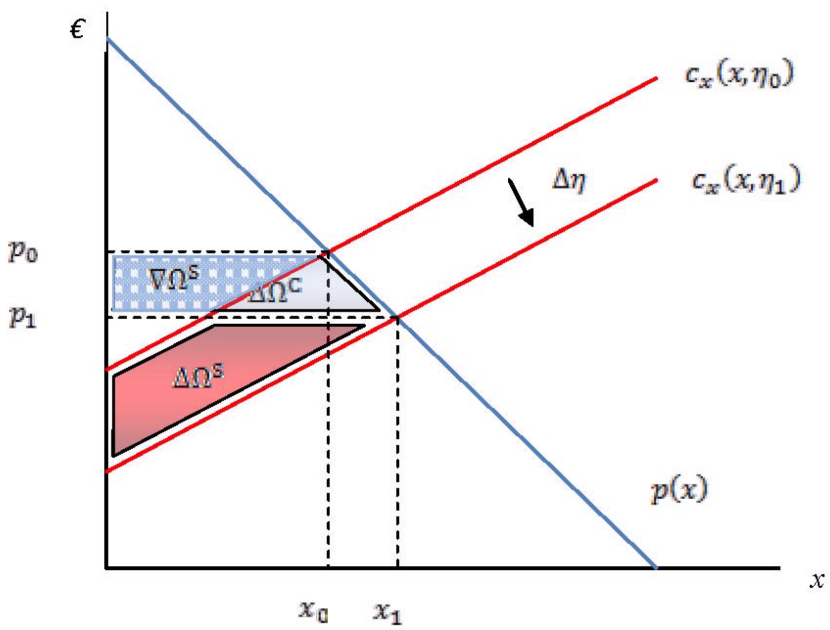
4 Concluding remarks

In the light of the current economic situation, the near future points to intense (supra-/intra-) national social debates on the monitoring of public sector performance (health, education, etc.).

Particularly, advances economies are currently facing issues related to the reorganization of their welfare state. Within this framework, quantifying these budgetary savings strongly constitute an alternative fiscal policy tool which goes beyond the traditional view of a fiscal consolidation (cut spending or tax hikes). This measure is not only helpful for short-term consolidation but also it is required to guarantee a sound long-term growth path.

Figure 2

Consumers' Welfare Gain



In this respect, important policy implications are derived from our results. First, this paper has presented an integrated approach which combines different dimensions involved in the usual policy-makers decisions (efficiency in the production of the public good, welfare impacts and monetary valuation). This proposal satisfies additional features in comparison to the usual methodologies extensively used so far. Mainly, our approach would allow to translate measures of (in)efficiencies into to a monetary value. Second, our proposal may be adapted to be used within a wide variety of empirical applications monitoring and/or evaluating the public sector performance. In this respect, we have identified the information requirements. Finally, we have derived some analytical results which help to understand the underlying intuitions and their linkages.

Finally, this paper links and integrates two different fields growing in parallel so far. On the one hand, empirical analyses monitoring the public sector performance from the production side and, on the other hand, studies analyzing the welfare implications of public policy-makers. For instance, this approach may provide guidance to the design of fiscal consolidation programs, so that they are compatible with a more efficient use of public resources.

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GROWTH IMPLICATIONS OF STRUCTURE AND SIZE OF PUBLIC SECTORS

Hans Pitlik[*] *and Margit Schratzenstaller*[*]

The relationship between government size and growth has received an enormous attention in the economics literature, and the recent financial crisis has forced this topic back on the agenda. A highly controversial debate in this respect is whether large governments are harmful for growth. Endogenous growth theory provides us with the view that tax structure and the composition of public expenditure may be important for growth, perhaps even more than total tax or expenditure levels. Government size and structure are, however, also reflected in the level and structure of market regulations, which may substitute or complement fiscal intervention.

The study provides an overview of the growth friendliness of fiscal and regulatory structures in a cross-section of EU15- and EU12-members and highly developed OECD countries. Peripheral European (transition) countries are also included, whenever respective data are available. Our analysis is based on several measures capturing the expenditure and the tax side of the budgets, as well as regulatory policies. It is shown that the size and the structure of fiscal and regulatory regimes and, hence, the expected long run-growth impact of government activities, still differ markedly across countries.

1 Introduction

The relationship between government size and growth has received an enormous attention in the economics literature. One of the main questions in this respect is, "are large governments harmful for growth?" While Neoclassical Theory sees only an insignificant role for fiscal policy to impact on the long-run rate of economic growth, Endogenous Growth Theory provides us with the view that fiscal policy can generate permanent effects on the steady state growth rate of output, and not just temporary effects, *i.e.*, on the transitional dynamics towards a higher output level. A number of theoretical models predict that tax structure and the composition of public expenditure may be important for growth, probably even more than total tax or spending levels (e.g., Lucas, 1988; Barro, 1990; Barro and Sala-i-Martín, 1992). Moreover, a non-negligible literature discusses the potential growth effects of international openness or the regulatory regimes on factor and goods markets, which could be seen as a further dimension of public sector size and structure.

Together with the availability of more and better data, both in the cross-section and over time, empirical research on the determinants of economic growth increased remarkably over the last 20 years. Although there is still a substantial model uncertainty leading to a lack of robustness of empirical growth analyses (e.g., Nijkamp and Poot, 2004; Ciccone and Jarocinski, 2010), it is now widely acknowledged that properly designed fiscal and regulatory policies can play an important role in supporting economic growth (e.g., Tanzi and Zee, 1997; Kneller, Bleaney and Gemmell, 1999; Bleaney, Gemmell and Kneller, 2001; Fölster and Henrekson, 2001; Zagler and Durnecker, 2003; Angelopoulos, Economides and Kammas, 2007; Ghosh and Gregoriou, 2008; Romero-Ávila and Strauch, 2008; Gemmell, Kneller and Sanz, 2011). A survey of both older and recent studies, as well as an interpretation of results is available in Bergh and Henrekson (2011).

In this respect it should be emphasized that many empirical analyses focus on developed countries (OECD or EU15), with some notable exceptions (Campos and Coricelli, 2002; Fidrmuc,

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This paper is a considerably shortened version of Pitlik and Schratzenstaller (2011).

2003; Bose, Haque and Osborn, 2007; Pushak, Tiongson and Varoudakis, 2007; Baldacci *et al.*, 2008; Bayraktar and Moreno-Dodson, 2010) which concentrate on transition economies and developing countries, respectively. The suitable design of growth-enhancing policies will nevertheless differ substantially across different countries. Accounting for the stage of economic development, the political and institutional environment and (probably) historical legacies of a country, a one-size-fits-all-fiscal and/or regulatory policy in order to promote growth is almost certainly not appropriate. Moreover, the recent Financial Crisis and the Great Recession might lead to a somehow revised view on the role of the state in supporting growth and long-run economic development (Griffith-Jones, Ocampo and Stiglitz, 2010; Blanchard, Dell'Ariccia and Mauro, 2010).

Against this background the purpose of the present paper is to provide a very brief overview of the literature on the growth impact of fiscal (*i.e.*, tax and expenditure) as well as regulatory policies. The main part of the article addresses the question to what extent European and OECD countries (or country groups) suit to concepts of growth-friendly fiscal and regulatory policies.

We proceed as follows. Section 2 is devoted to government expenditure structures. Following a brief discussion of the categorization of public spending categories into "productive" and "unproductive" types, we analyze the development of several spending categories. In a next step we investigate the growth friendliness of expenditure structures. Section 3 presents the tax structures and their evolution over time in a sample of European countries, using adequate macroeconomic and microeconomic indicators. We evaluate the growth friendliness of tax structures and their evolution based on the "tax and growth"-hierarchy derived by the OECD. In Section 4 we turn to the regulation issues. The growth impact of regulatory regimes is less well documented and even more controversially debated than the fiscal size and structure of government. Nevertheless, several empirical investigations support the view that stricter regulation of goods and factor markets is detrimental to economic development. Recent theoretical and empirical research emphasizes the notion of complementarities between institutions and policies in order to enhance growth. Section 5 therefore aims to provide an overall assessment of economic policy regimes and their growth friendliness in a comparative way. Of special interest in this respect is whether there are systematic deficiencies of certain countries (country groups) in providing a combination of growth-friendly economic policies. We will also consider the possibility that some countries provide more (less) regulation (or more/less taxes and expenditure) as a compensation for a lack of (more) reforms in another policy area. Section 6 concludes.

2 Government expenditure

2.1 Productive vs. unproductive public spending: theoretical background

The connection between government spending and growth is probably one of the most controversially debated topics in economics. In theory the relationship is ambiguous. On the one hand, government expenditure is deemed an indispensable prerequisite for economic development. The protection and enforcement of private property rights and contracts appear to be the most important factors for economic prosperity and growth. A well-functioning legal system (including expenditure for the courts) and enforcing public order and safety (including the police and the armed forces) are a precondition for economic specialization and the operation of markets (e.g., Hayek, 1960; Buchanan, 1975; North, 1990).

In addition to these essential functions of government, a number of further public goods are considered as potentially growth-enhancing. The operation of a high-quality physical infrastructure as well as basic educational services clearly fall under this category, given that governments will produce or provide these goods more efficiently than markets. At least according to Welfare

Economics, market-failures from public goods, information asymmetries, (network) externalities, and natural monopolies, can be corrected by different categories of public spending (and also by taxation or regulation measures, all subject to cost-benefit-considerations), thus potentially leading to a more efficient allocation of scarce resources through additional government health expenditure, spending on environmental issues, etc.

Beyond such core allocative functions the Musgravian tradition of Public Finance (Musgrave, 1959) advocates a distributional role as well as a stabilization function of government spending. Although not evidently linked with the goal of enhancing economic growth, government spending on these two functions nevertheless has an impact on growth performance, which may be either positive or negative. Higher government spending and a larger public sector may be better able to stabilize the economy if it is hit by macroeconomic shocks (e.g., Fatás and Mihov, 2001), which might also be conducive to longer-run growth (e.g., Ramey and Ramey, 1995; Martin and Rogers, 2000). Higher social transfer spending may not only improve the distribution of income and wealth, and thus satisfy political equity considerations, but may also improve the functioning of labor markets and – under certain circumstances – reduce social conflict in society and thereby enhance growth (e.g., Perotti, 1996).

On the other hand, the debate about the appropriate role and size of the state has also shown that in general an ever increasing government sector, as measured by total spending, will slow down or inhibit growth for a number of (partially interconnected) reasons:

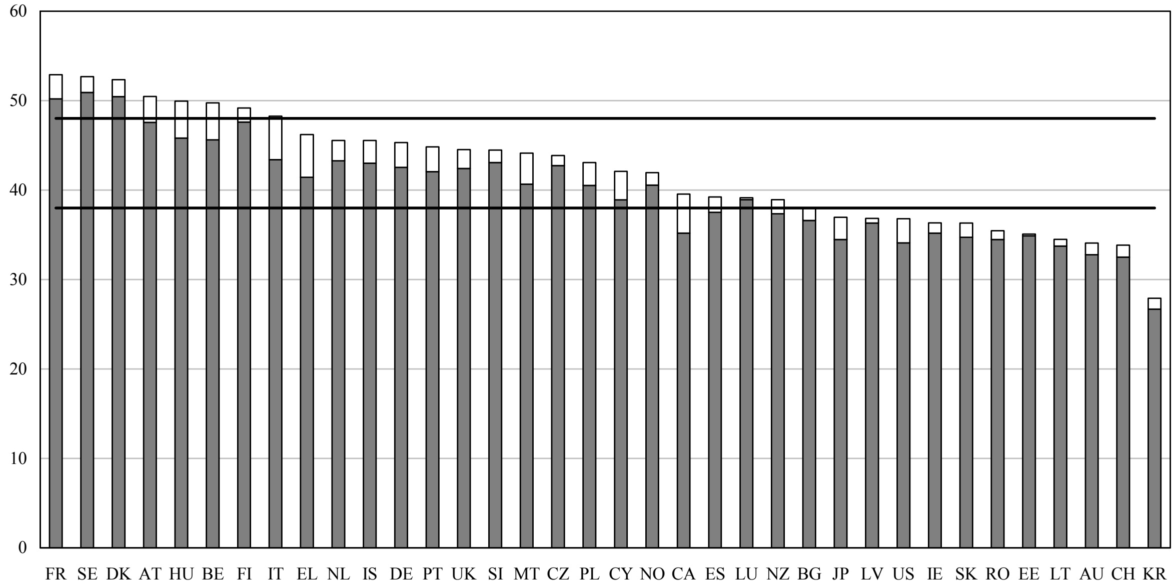
- disproportionally increasing distortionary effects of higher levels of taxation to fund increasing expenditures are detrimental for growth, probably also depending on the tax structure. This will be discussed in more detail in Section 3;
- long-run growth effects of most (if not all) public spending categories are subject to diminishing marginal returns, *i.e.*, at higher expenditure levels the marginal productivity of additional public spending is expected to decline. Also, the stage of development of a country will matter. Highly developed countries probably require a different expenditure composition as compared to less developed or transition economies;
- several types of expenditures yet create disincentives for the recipients (households as well as enterprises), leading to a crowding out of productive private spending and a reduction of economic efforts of beneficiaries, which, in turn, impedes growth;
- inside the public bureaucracy resources are often wasted and/or used inefficiently, due to lack of appropriate incentives. Public sector governance will play a crucial role in this respect, as inefficient provision of public services is more likely if institutions are weak. This effect will exacerbate if expenditure levels are high.

Summing up, the theoretical link between government expenditure and economic growth is rather complex. At least, the relationship between public spending and growth appears to be of a non-linear type, depending on factors like type of expenditure under consideration, initial spending level, internal efficiency of public provision, and the level and structure of taxation. In any case there is a theoretical optimum in which a certain level of public expenditure maximizes economic growth, given the disincentive effects of taxation and the level of bureaucratic efficiency. Empirically, these nonlinear effects between spending levels and economic growth are not easy to test because governments do not necessarily prioritize core productive functions of government responsibility over other forms of intervention. Ultimately, as a clear-cut theoretical relation cannot be derived, it is a matter of empirical testing whether and which types of government spending should be classified as "productive" or "unproductive".

Figure 1

Aggregate Government Expenditure Shares

(averages 2004-08; percent of GDP)



Source: EUROSTAT, OECD, and WIFO calculations.

2.2 *Size and structure of government spending*

2.2.1 *Aggregate expenditure*

The most commonly used measure for government size is its expenditure share over GDP. As noted above, there is some evidence that high aggregate spending levels can be an impediment for growth. At least, even if empirical results are sometimes not robust, no recent study finds a positive relationship between long-run growth and high total public expenditure levels.

To get a first impression on the level of government spending, we employ a sample of 36 OECD- and EU27-countries,[1] and display 5-year-averaged values over the years 2004-08 in Figure 1.[2] A 5-year-period is chosen in order to smooth out effects of the business cycle on spending levels. 2009 is not included as during that year most countries' spending-over-GDP ratios are biased upwards, due to a rapid GDP decline plus fiscal stimulus programs as a response to the recent Financial Crisis and the Great Recession.[3] The average 5-year spending level in the sample was 42.1 per cent of GDP, with a minimum of 27.9 per cent (Korea) and a maximum of 52.9 per cent (France). Primary spending levels amounted on average to 39.9 per cent of GDP, with

1 The sample includes all 27 EU-members plus all OECD-members that are not members of the EU27, except for Mexico, Israel, Chile and Turkey, both due to a lack of data and structural dissimilarities.

2 If not noted otherwise, we always refer to general government figures. Of course, the degree of decentralization of a country's fiscal responsibilities may also have an effect on the growth effects of government spending. These issues are, however, not dealt with in this paper. See, e.g., Schaltegger and Torgler (2006).

3 Except for Malta and Iceland all countries in the sample increased primary spending over GDP between 2008 and 2009. In Iceland, primary spending already in 2007 exploded from 39.7 to 54.2 per cent of GDP (2008). A simple regression shows that spending increases were somewhat larger in countries with an initially smaller spending level in 2008.

a maximum of 50.9 per cent (Sweden) and a minimum 26.7 per cent in Korea. Interest payments reached on average 2.2 per cent, but Greece and Italy already faced an interest burden of 4.8 per cent of GDP over 2004-08. In any case, interest payments are considered as least productive spending type, as they are exclusively related to past political decisions, and reduce the margin for strategic future-oriented spending of governments currently in office.[4]

Somewhat arbitrarily, we can divide the sample of 36 countries into three sub-samples according to average aggregate spending levels over 2004-08. The group of big spenders consists of countries with a mean expenditure-to-GDP-ratio above 48 per cent.[5] The small government group is made up of countries with average spending levels below 38 per cent of GDP, approximately the mean spending level minus one standard deviation.[6] The medium-spending group consists of countries with a mean expenditure share between 38 and 48 per cent over 2004-08.[7]

2.2.2 Productive vs. non-productive government spending

Preliminaries

The core of endogenous growth models with public spending is that not (only) the total volume of government expenditure is relevant for growth but its composition and, thus, the allocation between expenditure types which are growth enhancing (productive), growth depressing or neutral (non-productive) with respect to economic growth. From the viewpoint of these theories it is in particular the components of government spending that enter directly or as intermediate public inputs the production function of private enterprises which are expected to have a positive impact on a country's growth performance (Barro, 1990; Gemmell, Kneller and Sanz, 2011).

Although the theoretical concept is quite clear it is, however, not so obvious which types of government spending should be counted as productive. Empirical research supports a substantial positive impact of some spending components on growth, but there is still no agreement on which categories. In their survey of the relevant literature Bayraktar and Moreno-Dodson (2010) guess that "[o]ne possible explanation for the mixed results in the literature is sample selection. What we expect is that public spending can improve growth performance of countries only if they are able to use these expenditures productively". This means that the productivity of several public spending types, *i.e.*, their growth-promoting effects, depends critically on the institutional and economic environment of a country.

Another important point of the ongoing debate on productive and non-productive public expenditure is that one should take a more functional perspective. What matters is not the formal economic categorization of several spending types into consumption or investment spending per se, but for which function the money is used. Wages and salaries which are – by definition – a substantial part of government consumption can be employed for highly productive uses (e.g., educational issues) but also for unproductive purposes (e.g., salaries for outdated bureaucracies).

In Table 1 we report a categorization which is based on Gemmell, Kneller and Sanz (2011) with several adaptations and modifications based on European Commission (2002), Barrios and Schaechter (2008) and Bayraktar and Moreno-Dodson (2010). The assignments shown in Table 1

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4 The correlation between primary spending and interest spending is only weakly positive (+0.27 in the sample over the years 2001-10).

5 This group is composed of France, Sweden, Denmark, Austria, Hungary, Belgium, Finland and Italy.

6 Korea, Switzerland, Australia, Lithuania, Estonia, Romania, Slovakia, Ireland, the USA, Latvia, Japan and Bulgaria all belong to the small-spender group.

7 Greece, the Netherlands, Iceland, Germany, Portugal, the United Kingdom, Slovenia, Malta, Czech Republic, Poland, Cyprus, Norway, Canada, Spain, Luxembourg and New Zealand (listed from higher to lower shares).

Table 1

Components of Productive and Non-productive Government Spending

Expenditure Type (Theoretical)	Expenditure Type (SNA, COFOG)	Remarks on Productive Impact
Productive		
Core public services	General public administration	Basic services for organization of democracy and public administration
	Public order and safety	Includes spending on police, courts etc.
	Defense	Growth effects disputed, dependent on external threats (?)
Infrastructure spending	Public investment in Economic Affairs	Investment in transport and communication as well as other infrastructure services
	Housing and community services	Predominantly spending for local infrastructures (e.g., water supply)
	Environmental protection	Growth effects disputed
Merit goods/Externalities	Education	Increases productivity of labor, but could also be provided privately in principle
	Health	Increases productivity of labor, but could also be provided privately in principle
Non-productive		
Redistribution	Economic services	Sectoral subsidies, often with sclerotic effects, although some forms of horizontal subsidies (R&D-spending) are productive
	Social protection	Basic social protection may be productive if it improves labor market functions and reduces social tensions
Other	Recreation, culture, religion	Possible indirect positive impact on growth via health channel
Interest payments	Interest payments	Exclusively past-related spending

Source: WIFO compilation, based on Gemmell, Kneller and Sanz (2011). Supplemented by European Commission (2002), Semmler *et al.* (2007); Barrios and Schaechter (2008); Bayraktar and Moreno-Dodson (2010).

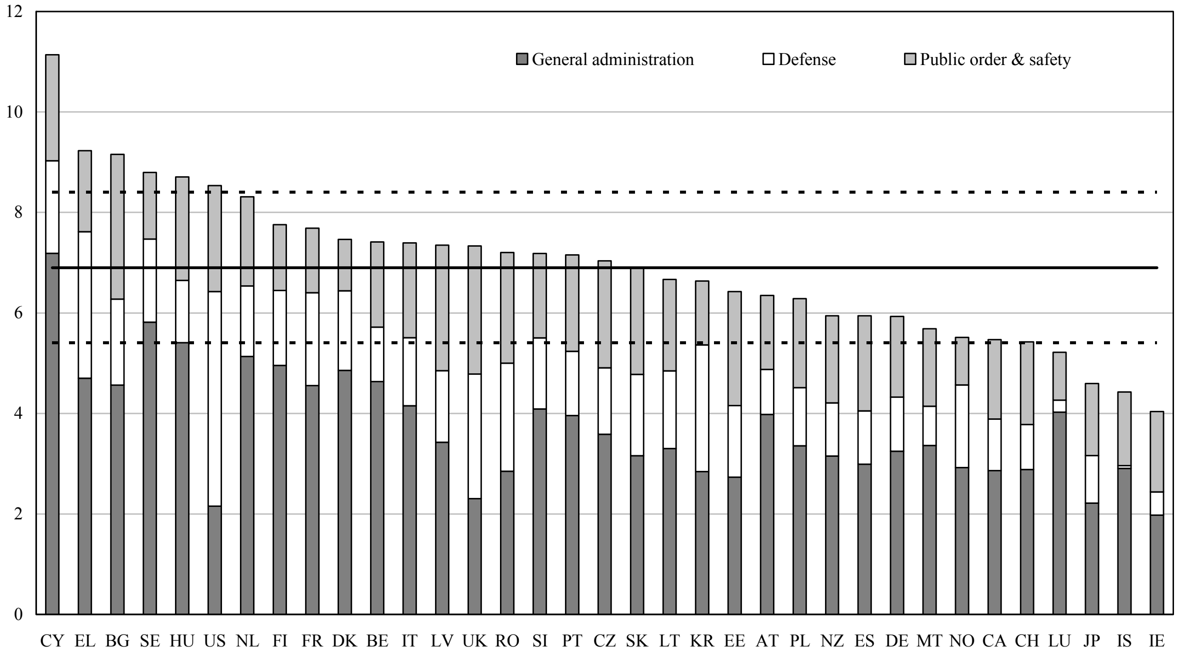
are based on results of macroeconomic research on the impact of fiscal policies. Microeconomic evidence may lead to partly different conclusions.

Core public services

Expenditures for core public services consist of spending for general administration, public order and safety, and defense. Their growth impact stems from the fact that a minimum of public administration services is required in all (democratic) systems, as well as institutions of enforcing law, order and public safety, probably also against external threats.

Figure 2

Government Spending on Core Public Services
(averages 2004-08; percent of GDP)



Source: EUROSTAT, OECD, and WIFO calculations.

Average expenditures on core public services in 35 countries amount to 6.9 per cent of GDP over the years 2004-08.[8] The smallest expenditure ratios (less than 5 per cent of GDP) are found in Ireland, Iceland and Japan; Cyprus, Greece, Belgium, Sweden, Hungary and the USA observe the highest spending on core services in relation to GDP (see Figure 2). In relation to total spending (over the years 2004-08), expenditure on core services on average equal 16.9 per cent, with a range between 9.8 per cent (Iceland) and 26.5 per cent of total spending in Cyprus.

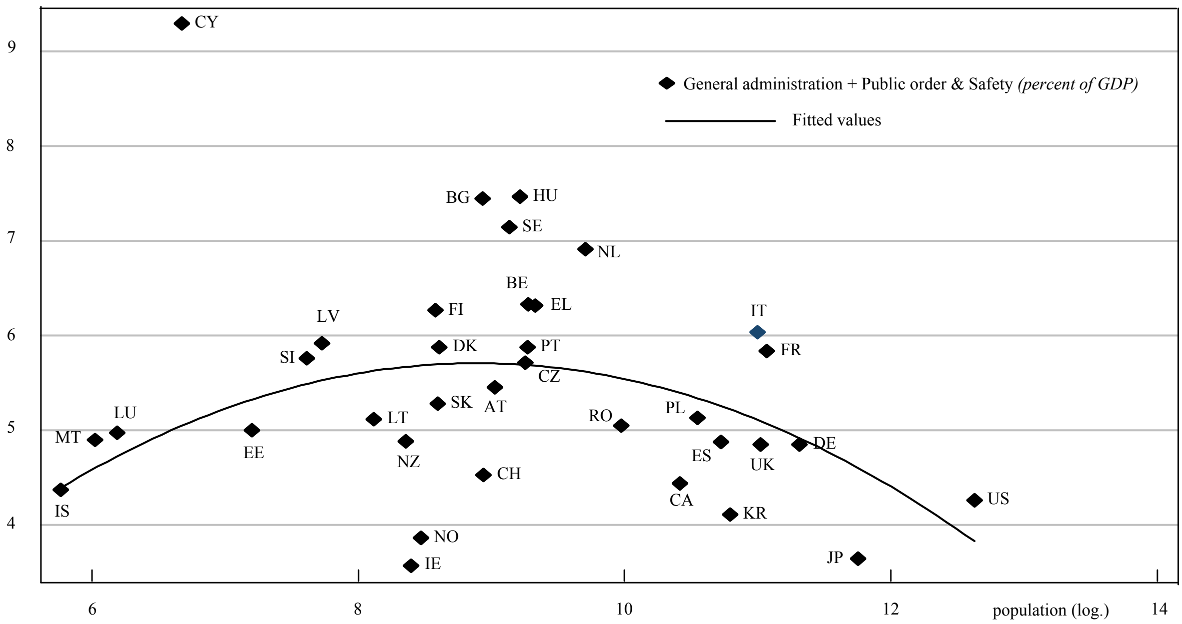
Subtracting defense spending, Figure 3 illustrates no clear evidence that expenditure on general administration and public order and safety are characterized by economies of scale. Neglecting the obvious outlier Cyprus, a hump-shaped relation between population size (in logs) and core public service spending appears to exist, with smaller expenditure ratios in very small and very large countries.

A high quality physical infrastructure is a productivity-enhancing input in private production processes and thus a major driver of a country's growth performance (e.g., Aschauer, 1989; Romp and de Haan, 2007; Crafts, 2009; Egert, Kozluk and Sutherland, 2009). Public infrastructure capital includes utilities and devices for transport and communication, energy and water supply etc. Government spending for infrastructure purposes is frequently approximated by gross fixed investment in the government sector. However, such a statistical recording entails a number of difficult-to-solve problems (e.g., Alegre *et al.,* 2008).

[8] Source: COFOG-databases of EUROSTAT and OECD. Interest spending that is allocated to COFOG-division 1 (General Public Administration) is deducted. For New Zealand, Canada, and Japan, data are only available until 2005/2006/2007. Hence, we calculated an average for shorter time periods. Data for Switzerland include only the years 2007 and 2008, as earlier data are unavailable. Data for Australia are not available.

Figure 3

Government Expenditure on General Administration, Public Order & Safety vs. Population Size
(averages 2004-08; percent of GDP)



Infrastructure spending

Hence, we decided to use a somewhat different classification: According to our definition, infrastructure spending encompasses total government expenditure (current *and* investment spending) in COFOG divisions 5 (Environmental protection) and 6 (Housing and community amenities) plus gross government investment in division 4 (Economic affairs). In our view, this classification captures best of what should be subsumed under the heading of infrastructure spending, which is not necessarily identical to investment expenditure.

Mean infrastructure spending defined along these lines is on average 2.8 per cent of GDP in the sample (averaged over 2004-08).[9] The range is between 1.4 per cent (Denmark) and 5.2 per cent (Czech Republic). The high spending group also includes Korea, Ireland, Japan, and Romania, whereas Austria, Switzerland, the USA, Finland and Belgium all belong to a group with low infrastructure spending (Figure 4). In relation to total government spending, infrastructure expenditure make up on average 7 per cent. Smallest shares of less than 3 per cent of total spending are observed in Denmark and Austria; the highest shares in Korea (16.1 per cent) and Ireland (12.1per cent).

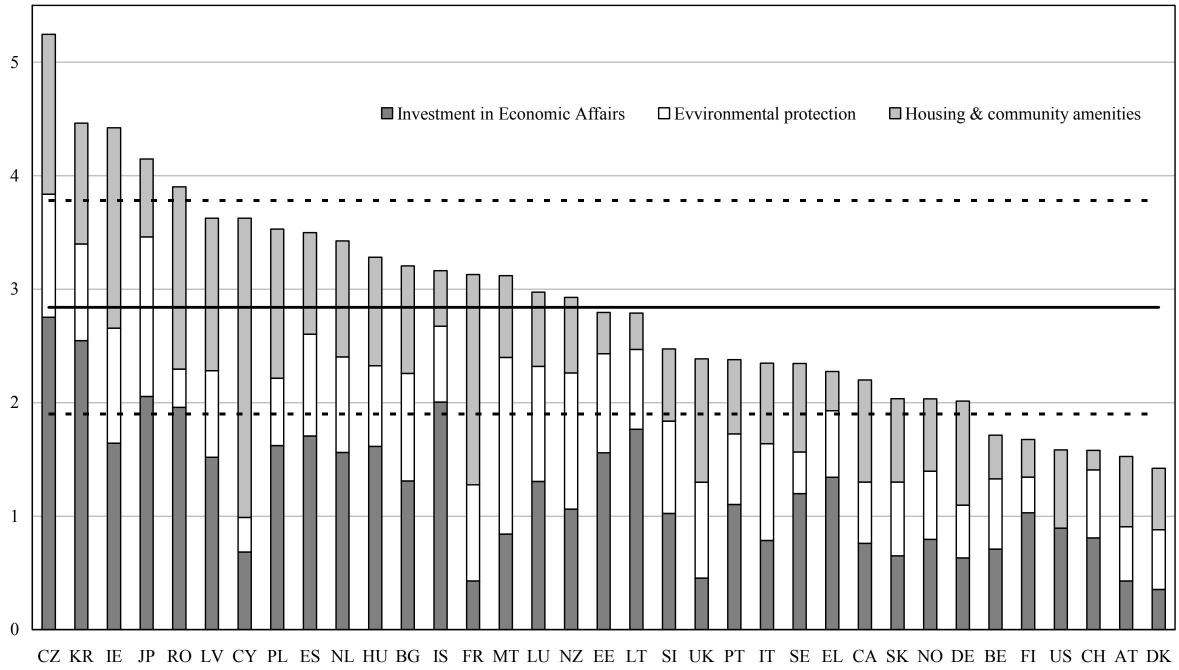
Figure 5 plots infrastructure investment levels over 2004-08 against real GDP per capita (in international US-Dollars (logs) in 2003.[10] A strong negative relation indicates that countries in a catching-up process tend to have higher infrastructure expenditures, whereas countries that already have a high GDP per capita, and presumably a higher quality public capital stock, observe smaller spending in relation to GDP. Smaller government spending on infrastructure may therefore

[9] With respect to data availability and gaps in the data, see footnote 10.

[10] Data are from the Penn World Tables 7.0.

Figure 4

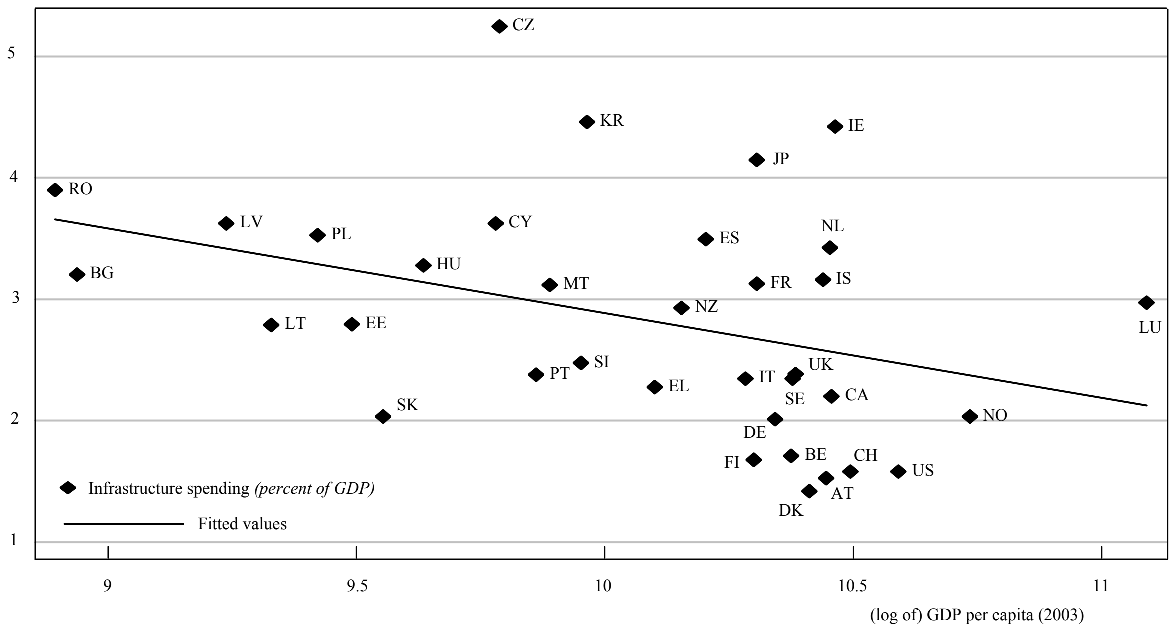
Government Spending on Infrastructure
(averages 2004-08; percent of GDP)



Source: EUROSTAT, OECD, and WIFO calculations.

Figure 5

Government Spending on Infrastructure versus GDP per capita 2003

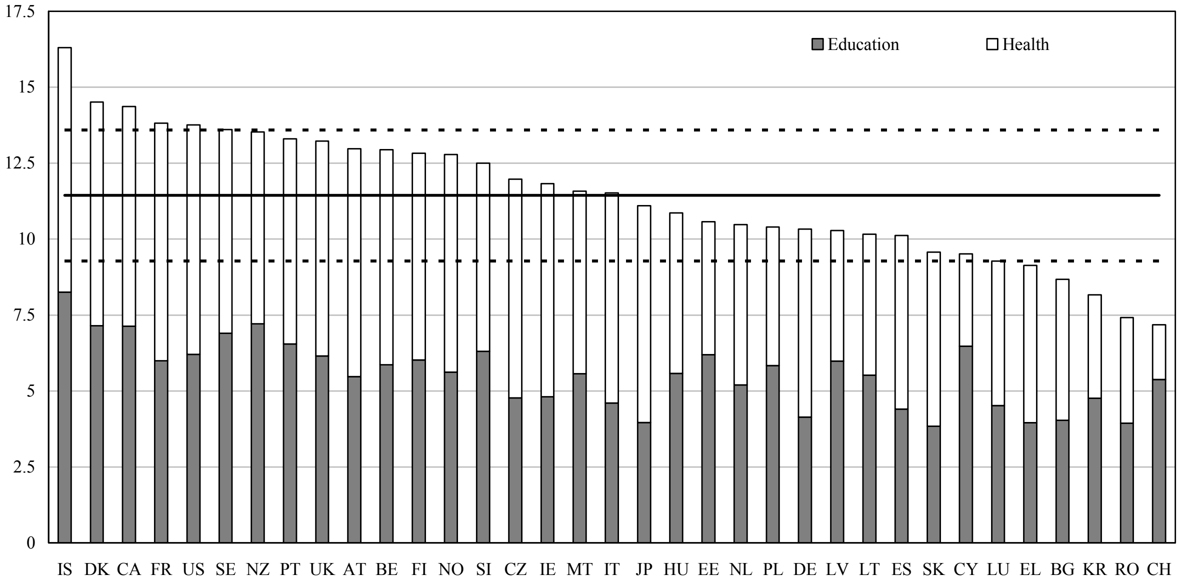


Source: Penn World Tables 7.0, EUROSTAT, OECD, and WIFO calculations.

Figure 6

Government Spending on Education and Health

(averages 2004-08, percent of GDP)



Source: EUROSTAT, OECD, and WIFO calculations.

also be a sign of diminishing returns to public capital (see also Kamps, 2006).[11] Empirical evidence for such a saturation effect is, however, not very strong (Välilä, Kozluk and Mehrotra, 2005), but some country data may be severely biased by off-budget investment that is accounted for as private sector spending.

Spending on merit goods/externalities: education and health

A substantial share of government expenditure of modern Welfare States is devoted to spending on merit goods. The two most prominent examples are education and health spending. With respect to the growth effects of both spending categories the impact of human capital investment is common wisdom now (e.g., Bassanini and Scarpetta, 2002; Baldacci *et al.*, 2008). If public spending on education and health care improve human capital then this should show up in a better growth performance. Especially for economies that operate at the technology frontier human capital investment through education and health care improvements are of crucial importance (e.g., Aghion, 2008).

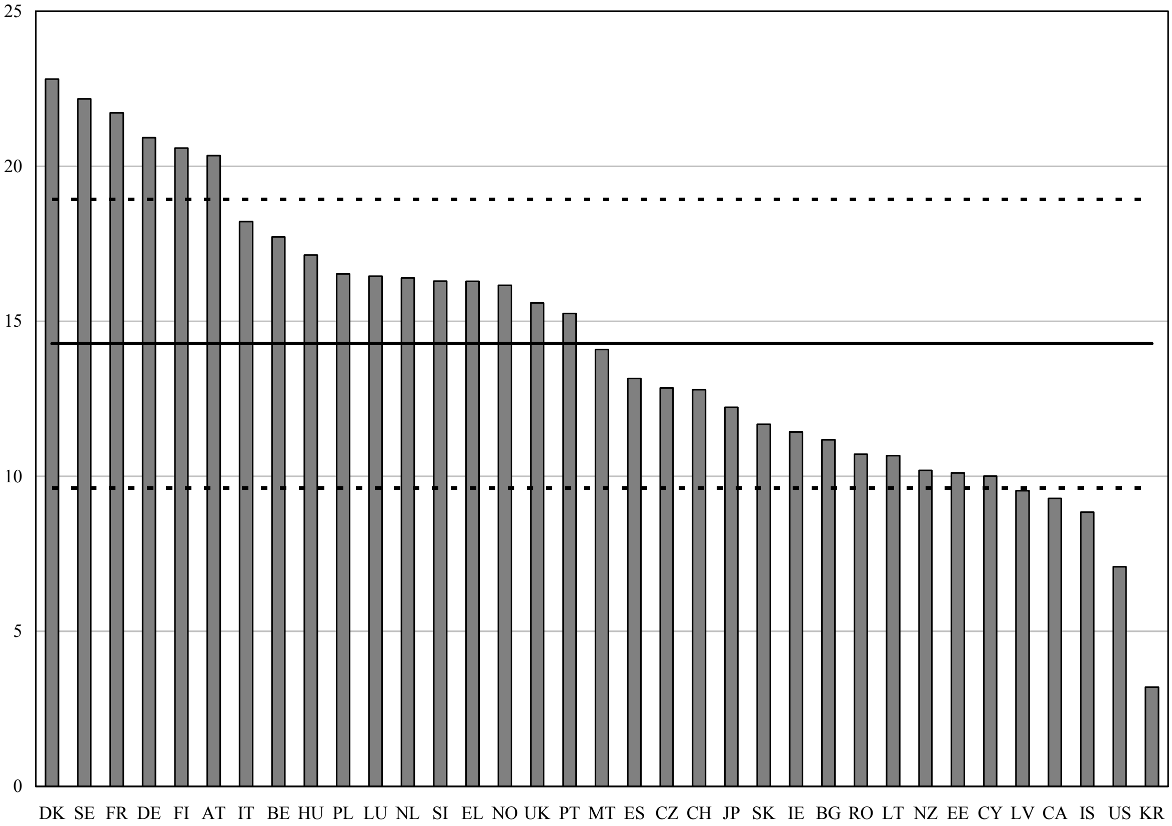
Redistributive spending

The impact of transfer payments on growth is theoretically ambiguous. On the one hand, redistributive spending may be long-run growth-enhancing if it helps to support and maintain social

[11] In some countries new modes of financing infrastructures by Public-Private-Partnerships or outsourcing may also have contributed to a decline in government investment figures. For an empirical analysis of economic and political factors affecting government investment spending in Europe, see Kappeler and Välilä (2008) or Pitlik (2010).

Figure 7

Government Spending on Social Protection
(averages 2004-08; percent of GDP)



Source: EUROSTAT, OECD, and WIFO calculations.

peace, correct labor market failures or enters as input in private production. Lindert (2004), for example, claims that social welfare spending is almost a "free lunch" without (net) growth deterring effects. Properly designed capital transfers to enterprises may also stimulate growth by promoting private investment. On the other hand, redistributive spending will inhibit growth as it generates disincentives for potential recipients, or stimulate socially unproductive rent seeking (e.g., Murphy, Shleifer and Vishny, 1991). Empirical evidence shows mixed results, although studies that find negative effects of government transfers on economic growth appear to dominate (see e.g., Romero-Ávila and Strauch, 2008, but see also Afonso and Furceri, 2010). Government spending that is predominantly redistributive is generally categorized as non-productive.

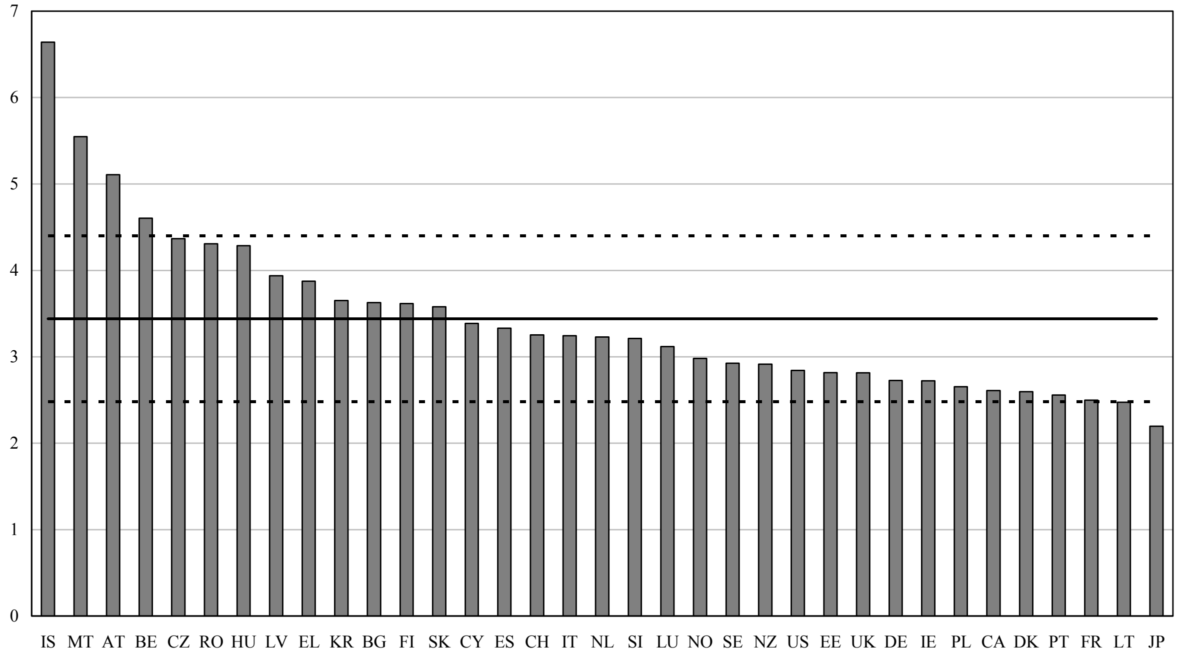
Figure 7 displays spending on social protection affairs. It includes cash benefits as well as transfers-in-kind and government services for social protection purposes.[12] Spending on these issues is 20 per cent of GDP or more in Denmark, Sweden, France, Germany, Finland and Austria, whereas Korea, the USA, Iceland, Canada and Latvia spend less than 10 per cent of GDP on social protection. Average government expenditure in the sample is 14.3 per cent of GDP.

[12] Note that this classification does not include health care spending as in the European System of integrated Social Protection Statistics (ESSPROS) categorization of social protection spending.

Figure 8

Government Spending on Economic Affairs

(infrastructure investment deducted; averages 2004-08; percent of GDP)



Source: EUROSTAT, OECD, and WIFO calculations.

A second type of redistributive spending takes the form of sectoral aid for private enterprises. Figure 8 illustrates that average government support over the years 2004-08 was by far highest in Iceland, amounting to almost 7 per cent of GDP. This is, however, due to Iceland's special aid during the banking crisis of 2008, which boosted spending from 3.7 per cent of GDP (2007) to 16.9 per cent.[13] Malta and Austria offer support slightly above 5 per cent of GDP. The average spending level in the sample is 3.4 per cent of GDP. Relatively little support is given by Japan, with slightly more than 2 per cent of GDP.

2.2.3 The overall growth friendliness of government spending

So far, our investigations show that governments in our sample follow very different spending patterns. In particular, we observe clear differences considering the "budget mix" of productive and non-productive expenditure. Table 2 sheds some light on this. In order to investigate the "overall" growth friendliness of a country's spending patterns we simply calculate the share of productive expenditure types (according to our definitions) in total government spending. We use again averages over the years 2004-08 in order to reduce the impact of temporary fluctuations due to singular events. As the general productivity of defense spending is the most controversially debated topic, we differentiate between two definitions of productive expenditures, the first including, and the second excluding military spending. The countries are ranked in order of productive spending without defense.

13 If the 2008 figure is not used for calculation of the mean, then the Iceland figures drop to 4.1 per cent of GDP.

Table 2

Total Spending and Productive Spending Shares
(averages 2004-08)

Country	Code	Total *(percent of GDP)*	Productive *(percent of total exp.)*	Productive (w/o defense) *(percent of total exp.)*
Korea	KR	27.9	69.1	60.1
New Zealand	NZ	38.9	60.0	57.2
Ireland	IE	36.3	56.0	54.7
Latvia	LV	36.8	57.7	53.8
Cyprus	CY	42.1	57.7	53.3
United States	US	36.8	64.9	53.3
Canada	CA	39.6	55.7	53.1
Iceland	IS	45.5	53.1	53.0
Lithuania	LT	34.5	56.9	52.4
Estonia	EE	35.1	56.4	52.4
Czech Republic	CZ	43.9	55.3	52.3
Japan	JP	36.9	53.8	51.2
Bulgaria	BG	38.0	55.3	50.8
Portugal	PT	44.8	51.0	48.1
Spain	ES	39.2	49.9	47.1
Slovenia	SI	44.5	49.8	46.6
Slovakia	SK	36.3	51.0	46.6
Romania	RO	35.5	52.1	46.0
United Kingdom	UK	44.5	51.6	46.0
Netherlands	NL	45.5	48.8	45.7
Norway	NO	41.9	48.5	44.5
Malta	MT	44.1	46.2	44.4
Poland	PL	43.1	46.9	44.3
Luxembourg	LU	39.1	44.6	44.0
Sweden	SE	52.7	47.0	43.9
Hungary	HU	49.9	45.7	43.3
France	FR	52.9	46.6	43.1
Finland	FI	49.2	45.3	42.3
Belgium	BE	49.8	44.4	42.2
Denmark	DK	52.3	44.7	41.7
Italy	IT	48.3	44.1	41.2
Switzerland	CH	33.8	44.0	41.2
Austria	AT	50.5	41.4	39.6
Greece	EL	46.2	44.7	38.4
Germany	DE	45.3	40.3	38.0

Source: WIFO calculations based on Eurostat and OECD.

Figure 9

Total Spending and Productive Spending Shares (Without Defense Spending) in Total Spending
(averages 2004-08, percent of GDP)

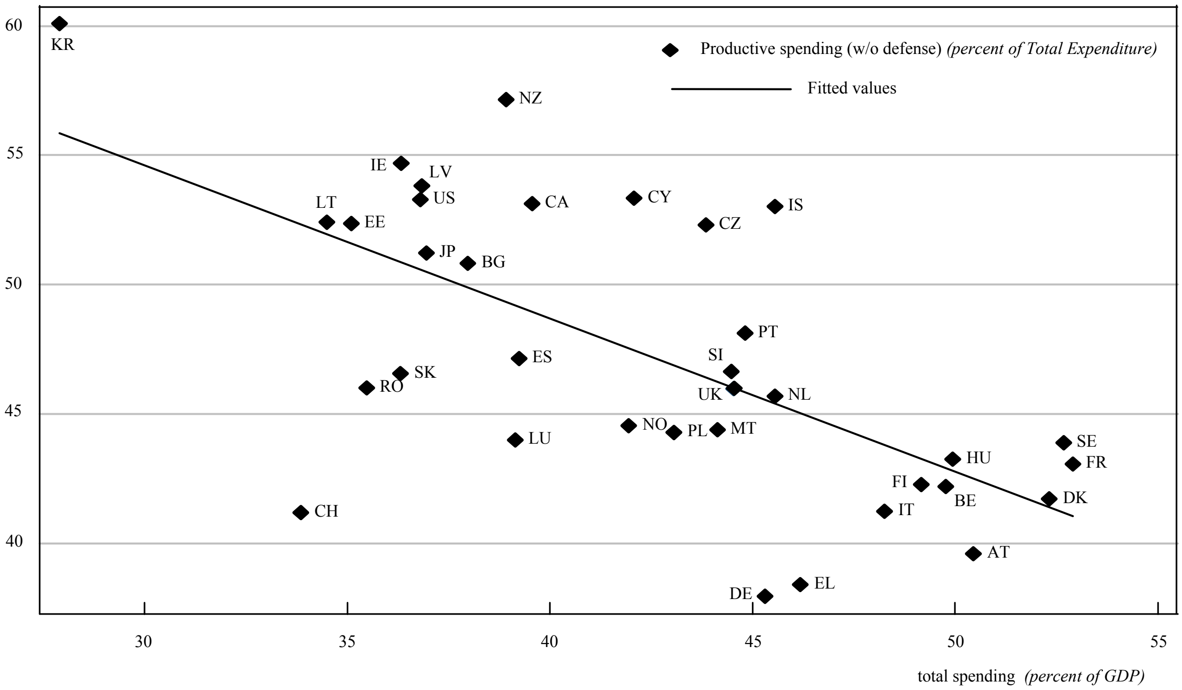


Figure 9 illustrates that there is in general a negative relation between total government spending and productive expenditure shares (without military spending).[14] This is an indication that expansion of government size is mainly due to non-productive spending items.

3 Taxation

The highest budget share of productive spending items is observed for Korea, according to both definitions. Almost 70 per cent of general government expenditure is allocated to productive uses if defense is included, and still more than 60 per cent if defense spending is counted as non-productive. New Zealand and Ireland follow, with a productive spending budget share of 57.2 per cent and 54.7 per cent, respectively. At the lower end of the ranking we find Germany, Greece and Austria with productive budget shares of slightly less than 40 per cent, if military expenditures are excluded. The largest change of productive spending shares when defense spending is included is observed for the USA (+11.6 percentage points), Korea (+9), Greece (+6.3) and Romania (+6.1).

Taxes are the most important revenue source for governments to finance their expenditures. Particularly with the advancement of endogenous growth models implying – in contrast to neoclassical growth theory – that tax policy is able to impact on the long-run growth level itself and not only on the growth rate during the transition of the economy to the steady-state growth rate, the

[14] Results are almost identical if defense spending is included.

relationship between taxes and economic growth has attracted increasing attention. Against the background of the significant increases of public deficits and debt many countries affected by the recent financial and economic crisis are experiencing, the growth friendliness of tax increases to consolidate public budgets currently is of particular interest and an important element of the policy recommendations of the supranational organisations (e.g., European Commission, 2010a, or OECD, 2010a).

3.1 Growth-friendly tax systems: Theoretical background

Physical and human capital, labor supply and technological progress are the crucial determinants of long-run economic growth. To the extent to which taxes influence these growth determinants, they impact on long-run growth. While taxes on capital may dampen savings of private households and firms' investments as well as their innovative activities, taxes on labor may decrease labor supply and demand and adversely affect incentives to invest in human capital. These distortionary effects and disincentives for economic activities of private households and firms may be aggravated by an increasing international integration of goods and factor markets, as a comparatively high tax burden may drive economic activities abroad or may be detrimental for a country's attractiveness for foreign investment or qualified labor (Afonso *et al.*, 2005, Handler *et al.*, 2005).

As, however, the existing theoretical models trying to depict the relationships between taxes and growth or growth-relevant factors, respectively, do not always yield clear-cut results,[15] an increasing number of econometric analyses attempt to tackle this complex question empirically. Therefore in the last three decades an ever-increasing number of empirical studies investigated the influence of taxation on economic growth.[16]

3.2 Growth-friendly tax systems: empirical results

Initially empirical analyses focused on the growth effects of the total level of taxation. However, they only partially support the theoretical expectation of a significant (negative) relationship between the total tax burden and economic growth: Endogeneity problems, the neglect of growth-enhancing expenditures financed by tax revenues, the disregard of taxation structures as well as statistic/conceptual problems in defining the tax ratio limit the explanatory power of the existing empirical studies (Arnold, 2008; Myles, 2009; European Commission, 2010A). The only safe conclusion that may be drawn from the existing empirical evidence is that a high tax ratio does not impact positively on growth (Afonso *et al.,* 2005).

Lately the potential growth impact of the tax structure has attracted more attention than the pure level of the tax burden. The starting point of this more recent empirical work is the assumption – also warranted by theoretical considerations – that different tax categories affect growth with differing intensity and via different channels. In the meantime, a rather large body of empirical analyses has emerged. Most authors focus on growth-relevant effects of specific taxes in a more or less isolated perspective, only few studies examine the growth implications of different tax categories in a comparative perspective.[17]

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[15] For example, it is not clear *ex ante* whether an increase of labor taxes increases or decreases labor supply, as it will have both an income and a substitution effect running in the opposite direction.

[16] For recent overviews over relevant empirical work see Schratzenstaller (2007), European Commission (2008) or Myles (2009).

[17] Mostly these studies analyse the growth effects of distortionary versus non-distortionary taxes, e.g., Bleaney, Gemmell and Kneller (2001) or Kneller, Bleaney and Gemmell (1999).

Of the latter, a rather recent study by a group of economists associated with the OECD (Johannson *et al.*, 2008) has achieved some prominence and gained considerable attention also among policy-makers. Based on a macroeconomic perspective, a hierarchy of individual taxes with respect to their growth friendliness is derived. Taxes on property have the least growth-dampening effect, followed by taxes on consumption (including environmental taxes in particular). In comparison, personal income taxes (including social security contributions and payroll taxes) are more harmful, and corporate income taxes are most detrimental to growth. This suggests that tax systems relying more on property and consumption taxes display more favourable growth properties than those strongly based on personal and corporate income taxes.

A crucial advantage and the innovative aspect of this approach is that it does not direct an isolated focus on the effects of single tax categories but on the effects of a (revenue-neutral) trade-off between them. However, that the macroeconomic tax structure is of limited use as an indicator for the effective tax burden on individual tax bases, because it does not account for the structure of the overall tax base. Moreover, marginal tax rates shaping incentives for economic decisions of private households and firms are neglected. Thus, an analysis of the tax structure of a given country also include macroeconomic effective tax rates reflecting the distribution of total tax revenues as well as microeconomic (marginal and average) tax rates influencing individual behaviour of private households and firm decisions. Moreover, a complementary look at studies examining growth-relevant effects of individual tax categories certainly is useful to gain deeper insights regarding the concrete channels via which individual tax categories may directly or indirectly impact on economic growth. Two aspects are of particular interests in this respect: namely, the influence of corporate income taxes on firm decisions and of labor taxes on labor supply.

While labor taxes can be assumed to influence various individual decisions shaping the quality and quantity of labor supply (employment in the shadow economy or in non-taxed sectors of the economy, investment in human capital, occupational choices, individual work effort and productivity, etc.), their effect on labor market participation and hours worked has been investigated most intensely and with the most robust results. These can be summarized as follows:[18]

- the influence of labor taxes differs for different demographic groups and educational levels due to differing wage elasticities of labor supply;
- for some groups – e.g., mothers with young children – labor taxes strongly impact on the decision about participation and hours worked;
- the participation decision is rather tax sensitive in the group of lone mothers and men with low qualifications;
- participation as well as hours worked of men in general and highly-qualified men in particular hardly react to labor tax variations.

Corporate income taxes influence firm behaviour in various respects. In a rather recent review of the rich empirical evidence, including a meta analysis of studies investigating the influence of taxation on international investment, de Mooij and Ederveen (2008) authors reach the conclusion that the largest tax-base elasticities can be found in empirical studies on profit shifting. Also marginal investment displays a significant elasticity with respect to EMTR, and even more so discrete location decisions.

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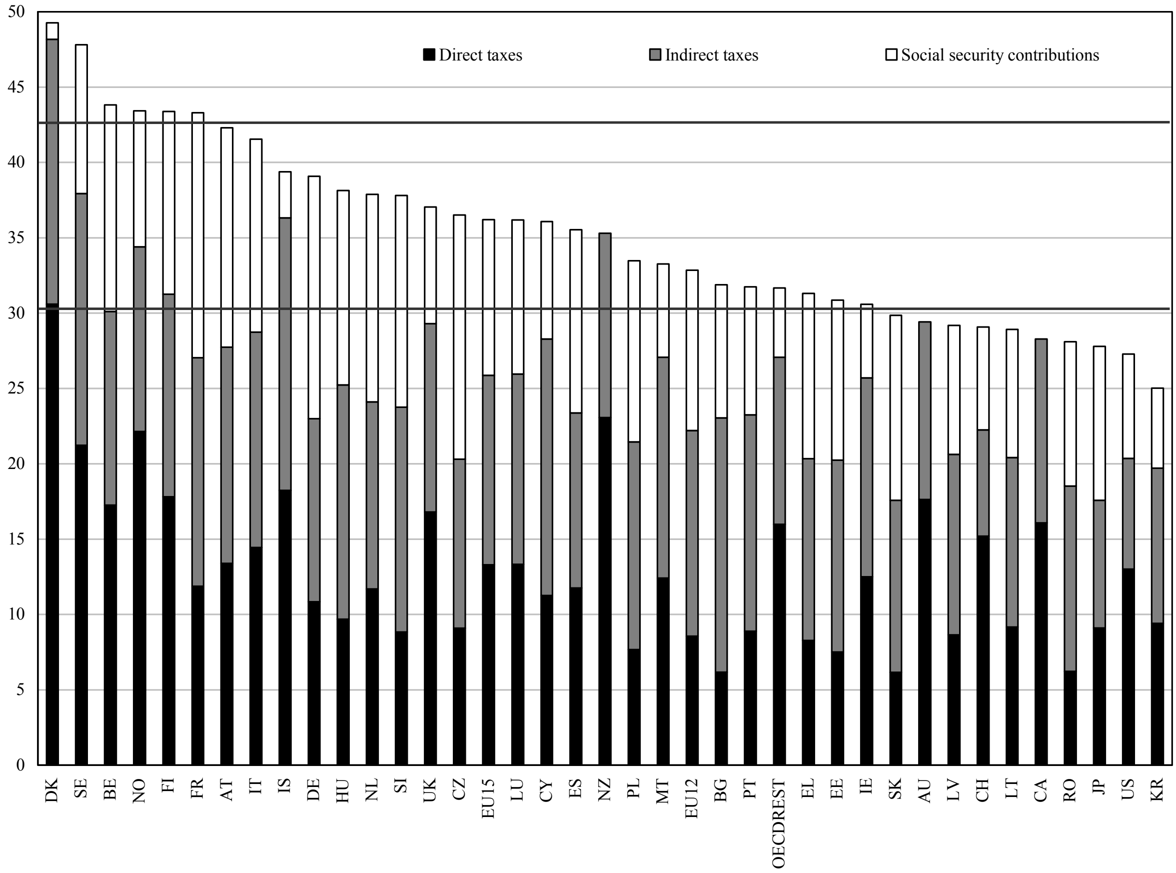
18 For the following short summary see the extensive literature reviews by Meghir and Phillips (2008) or Task Force of the Monetary Policy Committee of the European System of Central Banks (2008).

Figure 10

Tax-to-GDP Ratios

(averages 2004-08, percent of GDP)



Sources: European Commission (2011), OECD (2010), *Revenue Statistics 2010*, and WIFO calculations. EU12: new members. OECD: sample countries which are not EU members.

3.3 *Size and structure of taxation*

As already indicated, there are different types of indicators that may be used to measure and evaluate the growth friendliness of tax systems. While the macroeconomic tax structure (*i.e.*, the shares of individual tax categories in total tax revenues or over GDP) can give a first impression concerning (potentially unfavourable) overall tax structures, macroeconomic effective tax rates are required to measure the distribution of the overall tax burden on the respective macroeconomic tax bases. Incentives influencing growth-relevant decisions by firms and individuals are affected by effective microeconomic tax rates.

3.3.1 *Total tax burden and macroeconomic tax structure*

Figure 10 shows the total tax burden (including social security contributions) in percent of GDP (the most common indicator for the overall tax level) for the sample of 36 countries as five-year averages for the period 2004 to 2008. We group – somewhat arbitrarily – the countries regarded in high-tax countries (tax burden above 42 per cent of GDP),[19] in low-tax countries (tax burden below 30 per cent of GDP)[20] and in a group with a medium tax burden (between 30 per cent and 42 per cent of GDP).[21] The country-specific values cover a wide range, from 25 per cent of GDP in South Korea to 49.3 per cent of GDP in Denmark. The average tax level for the rest-OECD countries included in our sample amounts to 31.7 per cent of GDP, for the EU15 countries the average is 36.2 per cent and for the EU12 countries 32.8 per cent.

In a first rough categorization, total tax revenues can be grouped into three main categories: indirect taxes, direct taxes, and social security contributions. Related to GDP, direct taxes dominate on average for the rest-OECD countries in our sample, with 16 per cent; indirect taxes reach 11.1 per cent (see Figure 10). Social security contributions are of considerably smaller significance, with 4.6 per cent of GDP on average for the rest-OECD countries regarded. In the EU12 indirect taxes are clearly dominating on average, with 13.6 per cent of GDP, followed by social security contributions with 10.6 per cent and direct taxes with 8.6 per cent of GDP. In the EU15 the shares of the respective tax categories are comparatively balanced, with direct taxes reaching 13.3 per cent, indirect taxes 12.6 per cent, and social security contributions 10.3 per cent of GDP.

Figure 10 also shows that the shares of these main tax categories in GDP vary considerable between countries. Averaged over the period 2004 to 2008, direct taxes reach 6.2 per cent of GDP in (the flax tax countries) Bulgaria, Romania and the Slovak Republic on the low end, and 30.6 per cent of GDP in Denmark on the high end. Indirect taxes range from 7.1 per cent of GDP in Switzerland to 18.1 per cent in Iceland. While social security contributions make up for 1.1 per cent of GDP in Denmark only, they amount to 16.3 per cent of GDP in France.

3.3.2 Macroeconomic effective tax rates

Macroeconomic or implicit effective tax rates relating total revenues stemming from one tax category to the corresponding tax base and thus reflecting the effective tax burden on individual tax bases are calculated regularly by Eurostat for the EU27 countries plus Iceland and Norway. Eurostat calculates implicit effective tax rates for labor, energy, consumption, and on capital (which are divided further in implicit tax rates on capital and business income and on corporate income). Table 3 contains implicit tax rates for 2000 and 2008 in comparison. On average, implicit tax rates for all macroeconomic tax bases decreased in the EU15. In the EU12, on the other hand, only implicit tax rates on labor and corporate income decreased, while they increased on consumption, energy, and capital.

A closer look at developments in individual countries reveals that they are differently affected by these general trends: Firstly the extent to which tax burdens have changed during the last decade varies considerably across countries. Secondly, about one third of the EU countries regarded are moving against the general trends with regard to implicit tax burdens on labor, capital, and corporate income; in about one fourth of the EU countries analyzed here the implicit tax rate on energy and in half the EU countries the implicit consumption tax rate went down.

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19 This corresponds approximately to the mean tax ratio plus one standard deviation (41.4 per cent); the resulting group of 8 high-tax countries includes Denmark, Sweden, Belgium, Norway, Finland, France, Austria, and Italy.

20 This corresponds approximately to the mean tax ratio minus one standard deviation (29.1 per cent); the 10 low-tax countries are the Slovak Republic, Australia, Latvia, Switzerland, Lithuania, Canada, Romania, Japan, the United States and South Korea.

21 This is the biggest group with 18 countries, consisting of Iceland, Germany, Hungary, the Netherlands, Slovenia, the United Kingdom, the Czech Republic, Luxembourg, Cyprus, Spain, New Zealand, Poland, Malta, Bulgaria, Portugal, Greece, Estonia, and Ireland.

Table 3

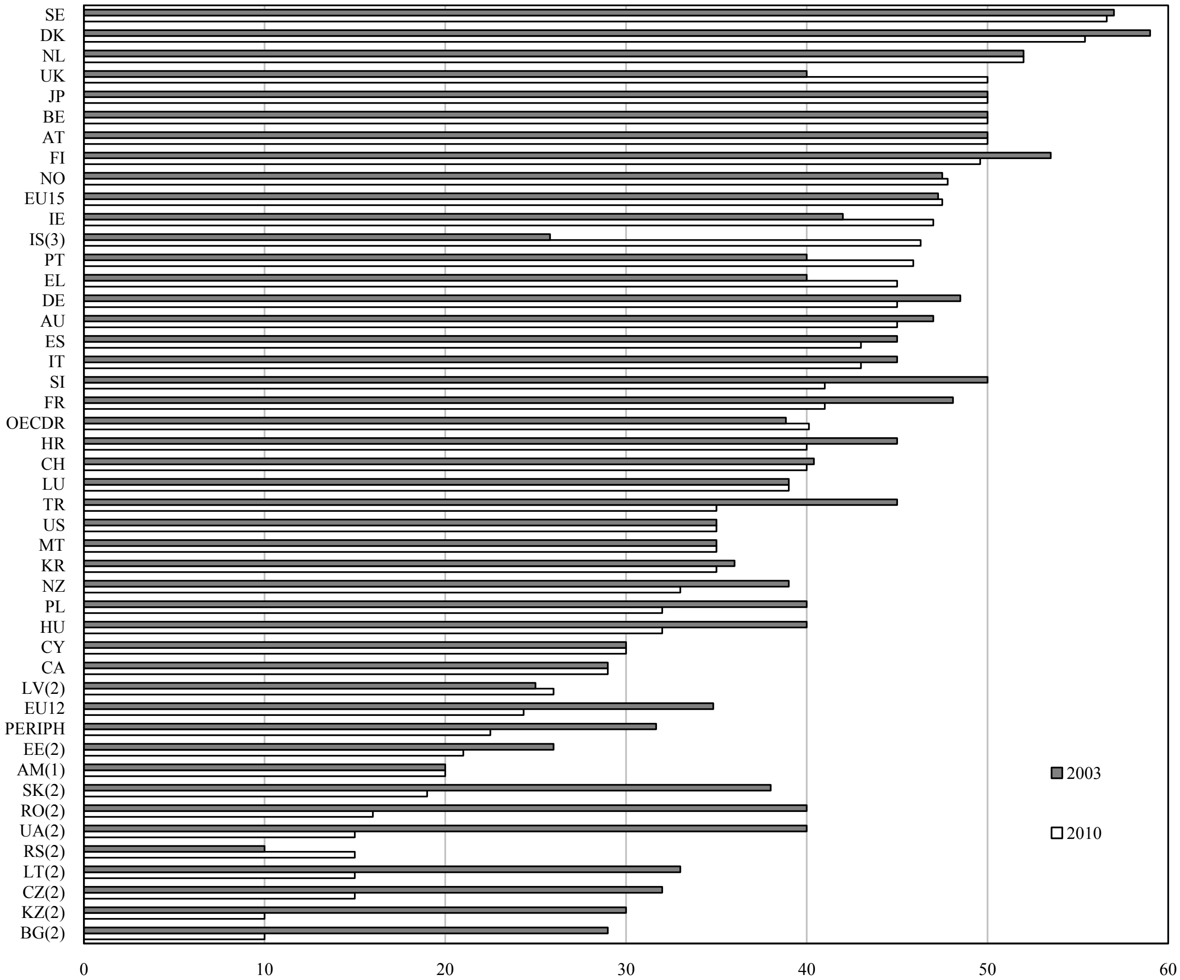
Implicit Tax Rates on Labor, Consumption, Energy, Capital, Corporate Income, EU 27, 2000-08

Country	Labor			Consumption			Energy[1]			Capital			Corporate Income		
	2000	2008	Δ 2000-08	2000	2008	Δ 2000-08	2000	2008[2]	Δ 2000-08	2000[3]	2008[4]	Δ 2000-08	2000[5]	2008[6]	Δ 2000-08
BE	43.6	42.6	–1.0	21.8	21.2	–0.6	92.4	97.1	4.7	29.6	32.7	3.1	24.4	21.4	–3.0
BG	38.7	27.6	–11.1	19.7	26.4	6.8	36.4	71.7	35.3	-	-	-	-	-	-
CZ	40.7	39.5	–1.2	19.4	21.1	1.7	55.2	127.1	71.9	20.9	21.5	0.6	26.2	25.7	–0.5
DK	41.0	36.4	–4.5	33.4	32.4	–1.0	300.8	267.8	–33.1	36.0	43.1	7.1	23.0	24.9	1.9
DE	40.7	39.2	–1.6	18.9	19.8	0.9	192.7	193.8	1.1	28.4	23.1	–5.3	-	-	-
EE	37.8	33.7	–4.1	19.5	20.9	1.5	32.2	71.5	39.3	6.0	10.7	4.8	4.1	8.3	4.3
IE	28.5	24.6	–3.9	25.7	22.9	–2.8	140.5	153.1	12.5	14.9	15.7	0.8	10.0	7.6	–2.4
EL	34.5	37.0	2.5	16.5	15.1	–1.4	117.3	102.0	–15.3	19.9	15.8	–4.1	29.0	18.6	–10.4
ES	28.7	30.5	1.9	15.7	14.1	–1.6	137.8	114.6	–23.2	29.8	32.8	3.0	30.7	34.0	3.3
FR	42.0	41.4	–0.6	20.9	19.1	–1.8	173.2	160.7	–12.5	38.3	38.8	0.4	29.6	29.1	–0.5
IT	42.2	42.8	0.6	17.9	16.4	–1.5	248.7	187.4	–61.3	29.5	35.3	5.8	19.2	31.5	12.3
CY	21.5	24.5	2.9	12.7	20.6	7.8	43.1	110.0	66.9	23.7	36.4	12.6	28.6	37.3	8.7
LV	36.7	28.2	–8.4	18.7	17.5	–1.2	48.3	48.4	0.1	11.2	16.3	5.1	8.6	15.2	6.6
LT	41.2	33.0	–8.2	18.0	17.5	–0.4	58.0	78.5	20.5	7.2	12.4	5.2	3.9	11.1	7.1
LU	29.9	31.5	1.6	23.0	27.1	4.1	164.3	173.3	9.0	-	-	-	-	-	-
HU	41.4	42.4	1.0	27.5	26.9	–0.6	79.7	98.0	18.3	17.1	19.2	2.0	28.7	19.9	–8.8
MT	20.6	20.2	–0.4	15.9	20.0	4.1	142.2	197.0	54.9	-	-	-	-	-	-
NL	34.5	35.4	0.9	23.8	26.7	2.9	154.4	189.8	35.3	20.8	17.2	–3.7	18.5	11.9	–6.6
AT	40.1	41.3	1.2	22.1	22.1	0.0	141.8	150.2	8.4	27.7	27.3	–0.3	27.1	26.1	–1.0
PL	33.6	32.8	–0.8	17.8	21.0	3.2	58.9	108.0	49.0	20.5	22.5	2.0	37.1	20.0	–17.1
PT	27.0	29.6	2.7	18.9	19.1	0.2	111.8	143.4	31.6	33.6	38.6	5.0	25.5	22.6	–2.9
RO	33.5	29.5	–4.0	17.0	17.7	0.7	58.2	26.2	–32.0	-	-	-	-	-	-
SI	37.7	35.7	–2.0	23.5	23.9	0.4	118.3	121.7	3.4	15.7	21.6	5.9	19.6	27.4	7.7
SK	36.3	33.5	–2.8	21.7	18.4	–3.3	42.4	84.6	42.2	22.9	16.7	–6.2	40.2	20.7	–19.4
FI	44.1	41.3	–2.7	28.5	26.0	–2.5	108.7	114.5	5.8	36.1	28.1	–7.9	30.4	19.3	–11.1
SE	46.0	42.1	–3.8	26.3	28.4	2.2	182.0	190.1	8.1	43.2	27.9	–15.3	41.0	23.2	–17.8
UK	25.3	26.1	0.7	18.9	17.6	–1.4	249.5	180.2	–69.3	44.7	45.9	1.2	31.0	22.2	–8.8
EU 15	36.5	36.1	–0.4	22.1	21.9	–0.3	167.7	161.2	–6.5	30.9	30.2	–0.7	26.1	22.5	–3.6
EU 12	35.0	31.7	–3.3	19.3	21.0	1.7	64.4	95.2	30.8	16.1	19.7	3.6	21.9	20.6	–1.3

[1] Energy taxes in Euro per tons of oil equivalent (TOE), base year: 2000; [2] Iceland 2006; Greece, France, Malta 2007; [3] Ireland 2002; [4] Greece 2006, Norway 2007; [5] Ireland 2002; [6] Greece, Portugal 2006.
Source: European Commission (2010b), and WIFO calculations.

Figure 11

Personal Income Tax Rate, 2003-10



Source: KPMG (2010). (1) Introduction of flat tax in 2011; (2) Flat tax; (3) Introduction of flat tax in 2007, abolished in 2010.

3.3.2 *Microeconomic tax rates*

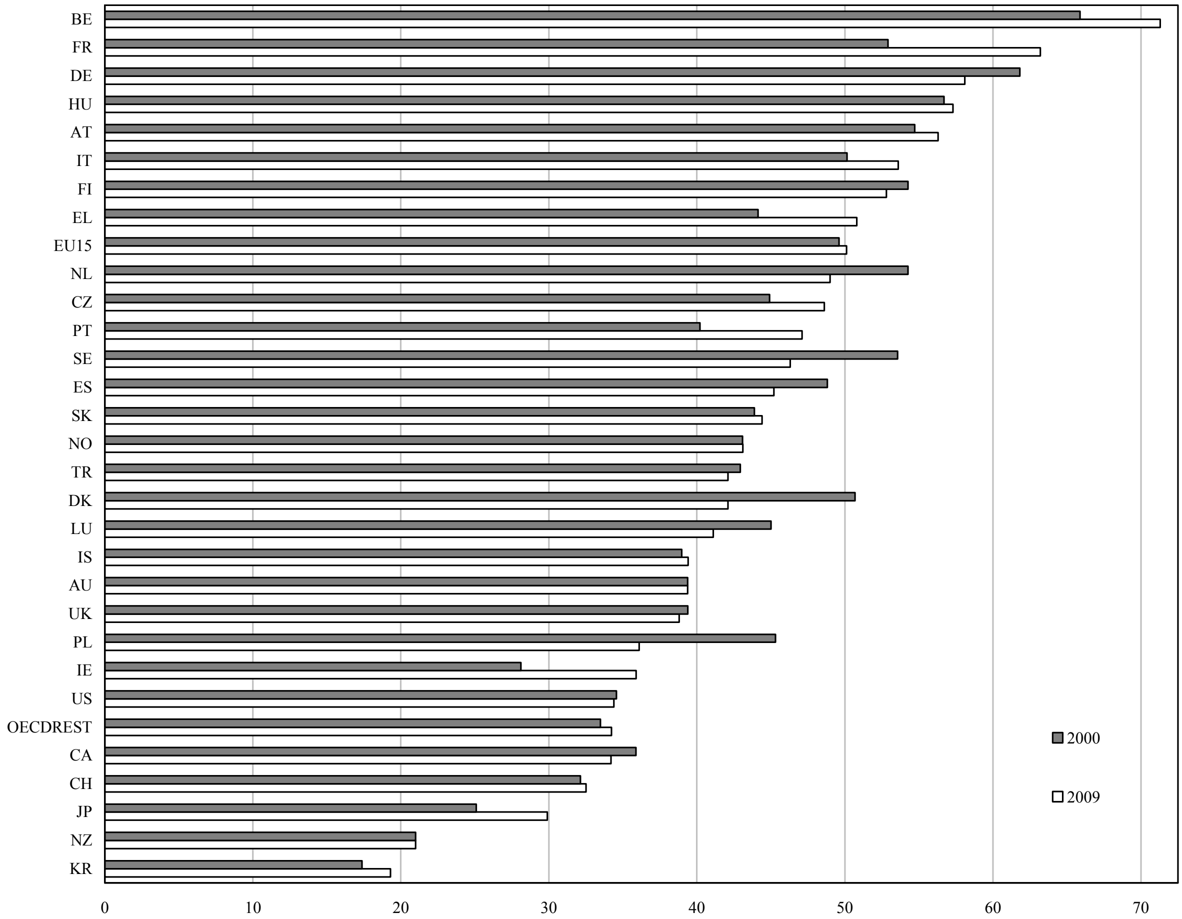
Evaluations of the effects of taxes on labor supply and investment need to be based on microeconomic tax rates. Ideally, these should be forward looking, as the tax burden of the past is of limited relevance for future decisions of economic agents about, for example, investment or labor supply.

3.3.2.1 *Microeconomic tax rates on labor*

We start with a look at top income tax rates for our sample of 36 countries, which we enrich by 6 peripheral European countries (Croatia, Ukraine, Kazakhstan, Armenia, Republic of Serbia, Turkey). Between 2003 and 2010, a clear downward trend of personal income tax rates can be observed for the EU12 and the peripheral European countries, where the average top income tax rate went down from 34.8 per cent in 2003 to 24.3 per cent in 2010 and from 31.7 to 22.5 per cent,

Figure 12

Marginal Tax Wedge, 67 per cent of Gross Labor Income, 2000-09



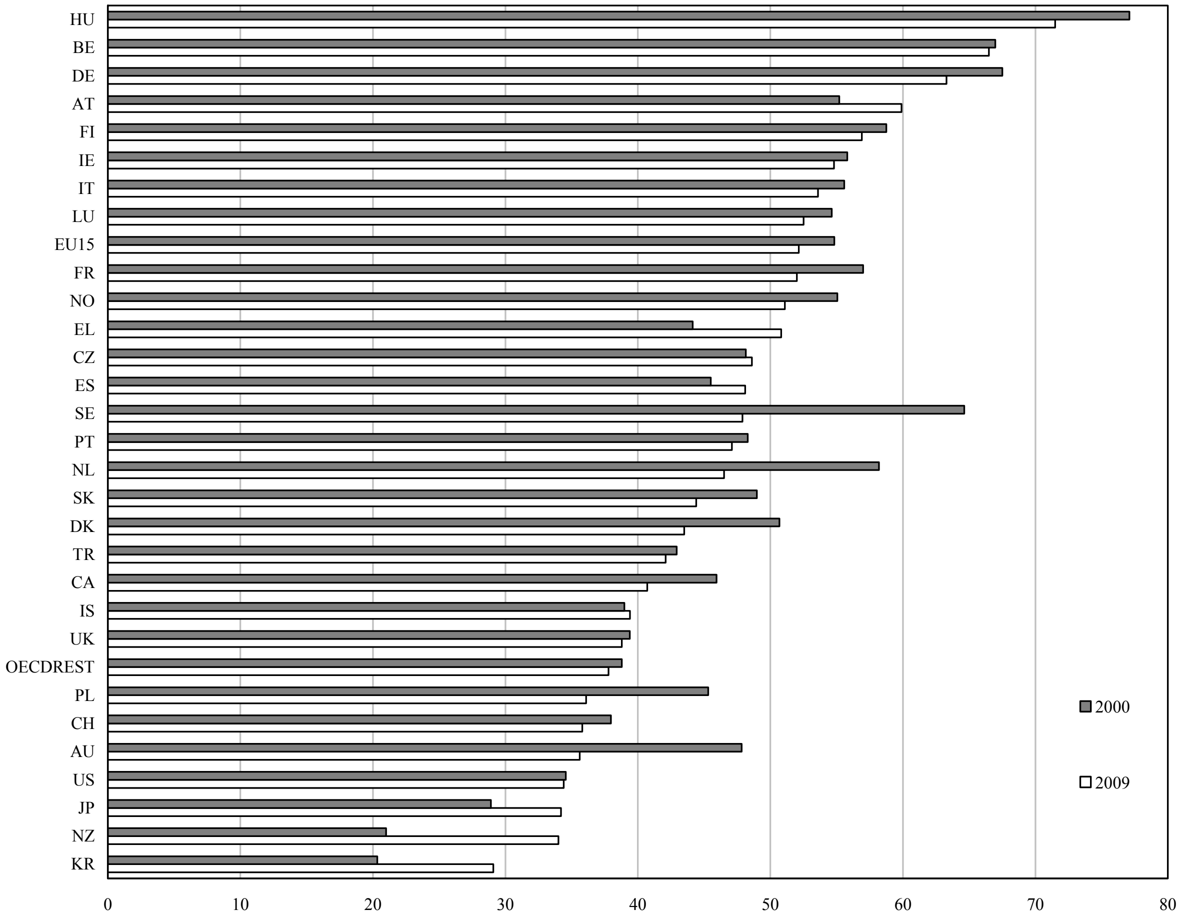
Source: OECD (2011).

respectively. In the EU15 countries, on the other hand, top income tax rates stagnated on average, amounting to 47.5 per cent in 2010. In the rest-OECD countries analyzed here the average top income tax rate increased from 38.9 to 40.1 per cent.

To assess the incentive effects of personal income taxation with regard to labor supply, a focus on top personal income tax rates is far too narrow, however. Firstly, tax sensitivity of labor supply of workers in the top income groups – as the results of the overwhelming majority of empirical studies reported above show – is rather limited; tax elasticity is much higher in lower income groups. Secondly, marginal tax rates are important for decisions about the numbers of hours worked; the participation decision, however, is influenced by average tax rates which also take into account the rules to determine the tax base. Thirdly, to identify the incentive effects of taxation for labor supply all relevant taxes need to be considered: As can be seen in the macroeconomic data above, the majority of countries do not only levy wage taxes, but also social security contributions on labor incomes. Thus, to derive a more complete picture of the possible incentive effects of labor taxation, effective marginal as well as average microeconomic tax rates for different income groups with different tax rate elasticities of labor supply must be determined, which include personal income taxes as well as social security contributions.

Figure 13

Marginal Tax Wedge, 100 per cent of Gross Labor Income, 2000-09



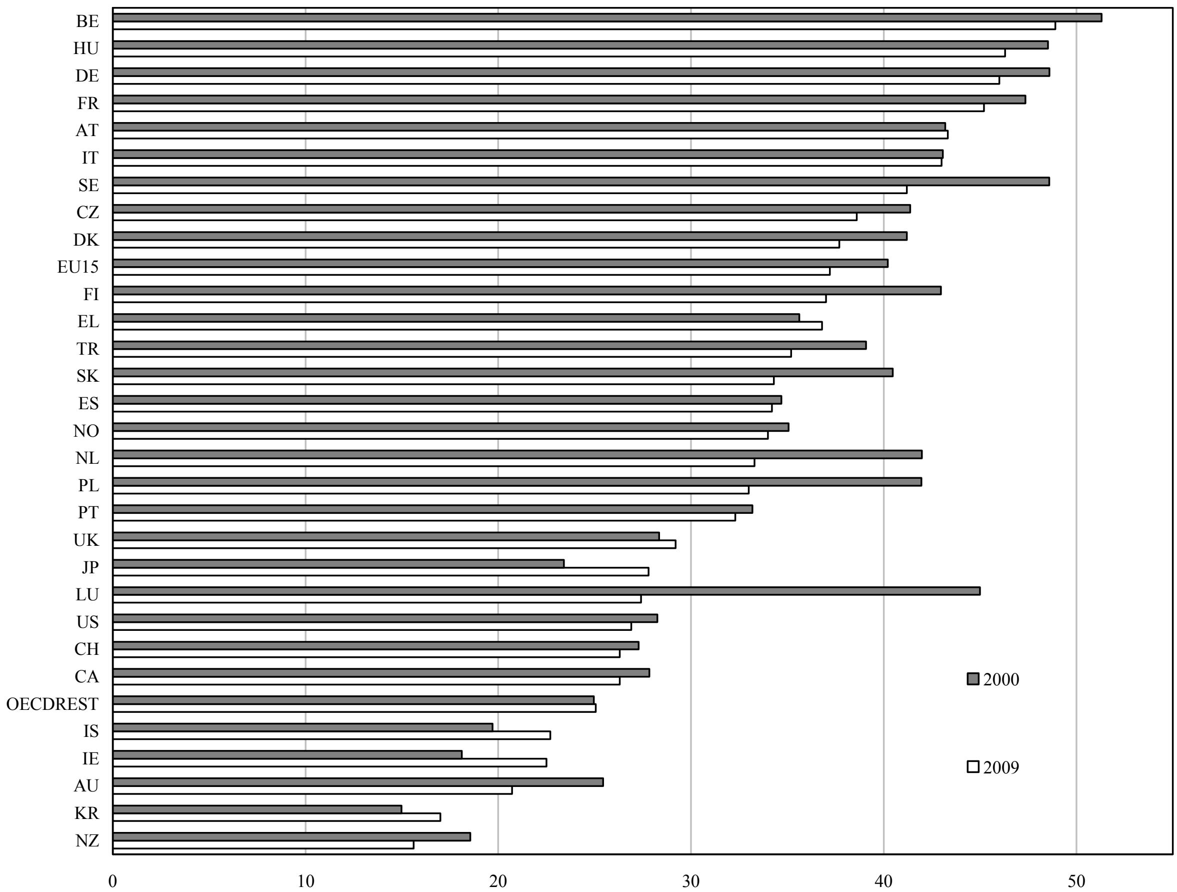
Source: OECD (2011).

Effective marginal and average tax wedges including personal income taxes and social security contributions are calculated regularly by the OECD. For sake of complexity reduction, we choose from the considerable selection of family constellations and income sizes the OECD offers two simple cases: a single earner with 67 per cent of an income (as representative for a rather low income group), and a single earner with an average income. In Figures 12 to 15, marginal and average tax wedges (resulting from wage tax and social security contributions minus cash benefits), respectively, are presented in comparison for the years 2000 and 2009.

For low income earners, in the EU15 the marginal tax wedge slightly rose on average between 2000 and 2009, to a rather high level of 50.1 per cent: Thus it approached the marginal tax rate for an average earner, who faced a marginal tax wedge of 52.1 per cent in 2009 (compared to 54.8 per cent in 2000). The marginal tax wedge for low incomes was lowest in South Korea (19.3 per cent) and highest in Belgium (71.3 per cent). Average incomes were burdened with the lowest marginal tax wedge in South Korea (29.1 per cent) and with the highest marginal tax wedge in Hungary (71.5 per cent). The average tax wedge for the EU15 went down by about 3 percentage points both for low incomes (to 37.2 per cent) and average incomes (to 41.6 per cent). The average tax wedge for low and for average incomes was lowest in New Zealand (15.6 and 18.4 per cent,

Figure 14

Average Tax Wedge, 67 per cent of Gross Labor Income, 2000-09



Source: OECD (2011).

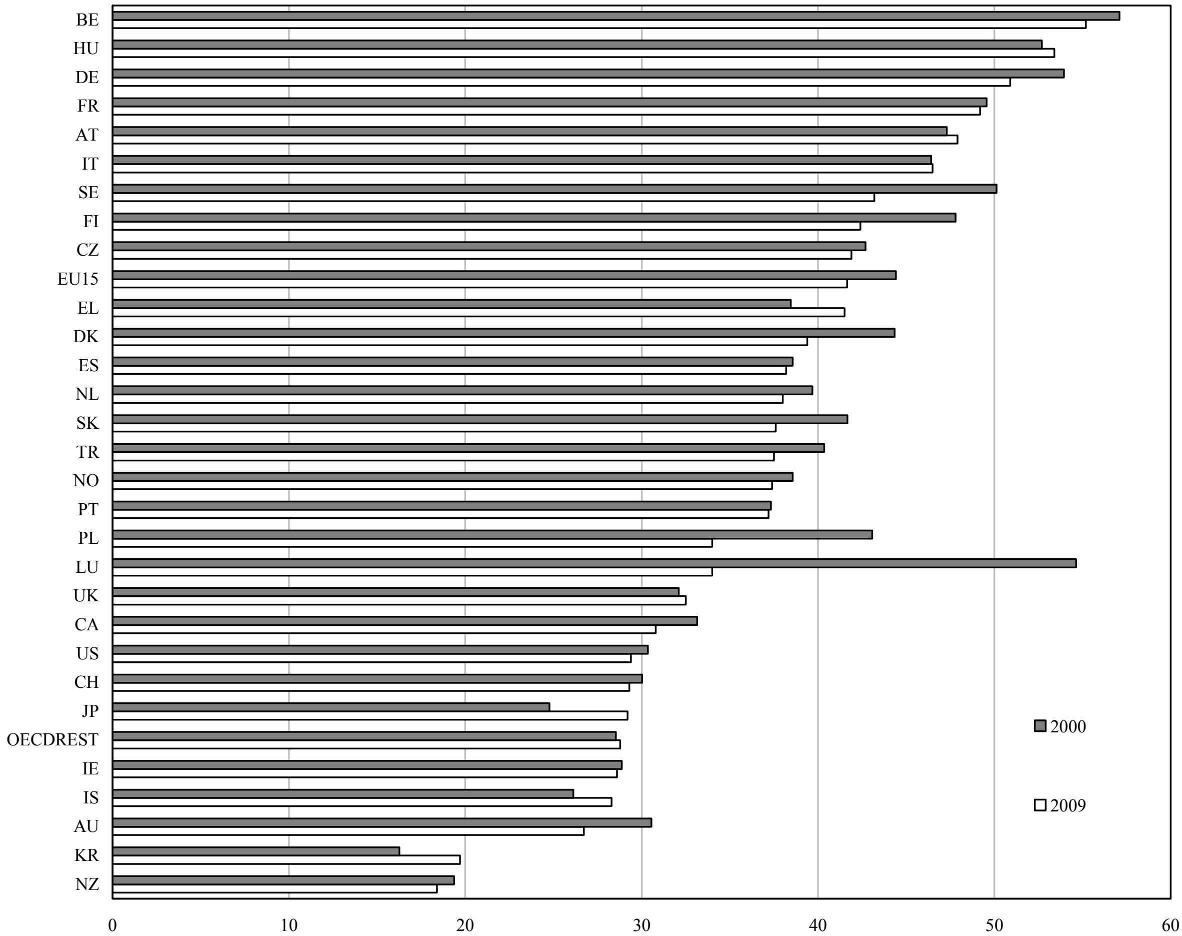
respectively). Low as well as average incomes faced the highest average tax wedge in Belgium (48.9 and 55.2 per cent, respectively). Interestingly, during the past decade the marginal tax wedge for low incomes went down in only about half the countries regarded, while the marginal tax wedge for average incomes as well as the average tax wedges for low and average incomes went down in a clear majority of countries.

3.3.2.2 Microeconomic corporate income tax rates

As mentioned above, a number of recent empirical studies corroborate the theoretical expectation that firm decisions – also in an international context – are influenced by corporate taxation. Hereby statutory corporate income tax rates as well as effective marginal (EMTR) and average (EATR) tax rates are relevant. Figure 16 shows that in our sample of 36 countries plus 10 peripheral European countries statutory corporate income tax rates fell markedly between 1995 and 2010. Only one country (Finland) slightly increased its corporate income tax rate, in 6 other countries (among them the 3 peripheral countries Montenegro, Armenia, and Belarus, but also Malta, Norway, and the United States) it remained constant. Again, the most marked reduction took place in the EU12 countries, where the average corporate income tax rate went down from 31.8 to

Figure 15

Average Tax Wedge, 100 per cent of Gross Labor Income, 2000-09



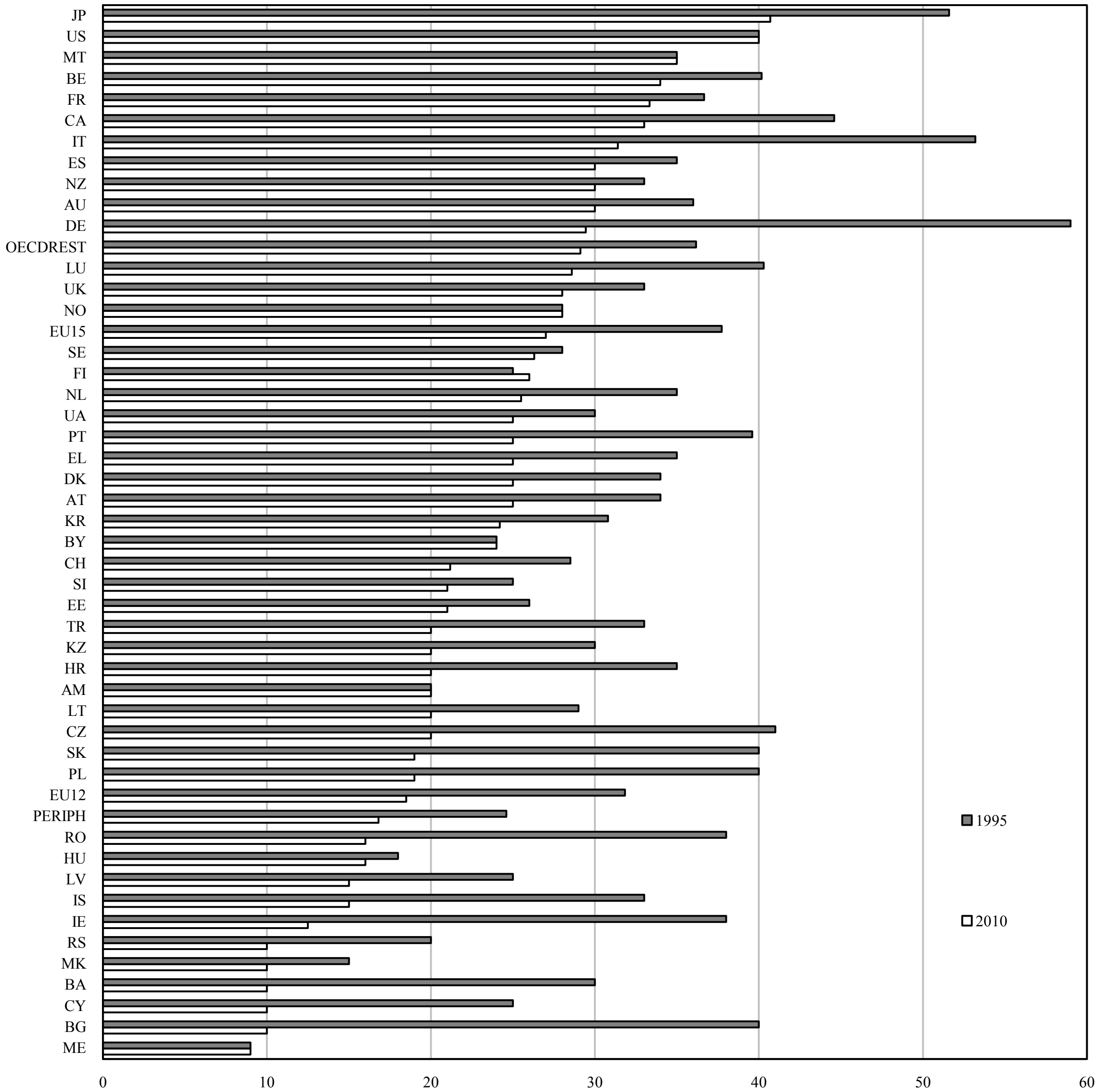
Source: OECD (2011).

18.5 per cent. But also the fall in the EU15 countries (from an average of 37.7 per cent in 1995 to 27 per cent in 2010) as well as in the European peripheral countries (from 24.6 to 16.8 per cent) is considerable. Less pronounced is the upward trend in the group of rest-OECD countries included in our sample; here the average statutory corporate income tax rate fell from 36.2 to 29.1 per cent. The distance between the high-tax and the low-tax countries narrowed down since the mid-Nineties, and while in 1995 3 countries in our sample of 46 countries had a corporate income tax rate of over 50 per cent, 2010 only 2 countries remained in which the corporate income tax rate reached about 40 per cent; it was below this threshold in all other countries.

Table 4 contains EMTR and EATR for all 27 EU countries plus 5 developed OECD countries as well as 3 European periphery countries for 2009 compared to 1998. On average EMTR and EATR were reduced in the rest-OECD countries, from 24.1 to 22 per cent and from 27.4 to 25.9 per cent, respectively. In the EU15, EMTR fell from 23.6 to 19 per cent, in the EU12 from 20.4 to 11.9 per cent. EATR went down from 30.7 to 25.1 per cent in the EU15 and from 27.4 to 17 per cent in the EU12. In this sample of 35 countries, EATR went up in 3 countries only and EMTR increased in 5 countries only; constant EATR and EMTR, respectively, can be observed in 2 identical countries.

Figure 16

Corporate Income Tax Rates, 1995-2010



Sources: KPMG (2010), and WIFO calculations. Earliest data 1995, except for Korea: 1997, Croatia, Kazakhstan, Macedonia: 1999, Serbia: 2002.

3.4 Conclusions

Table 5 gives an overview of the ranks of the countries regarded here (as far as available) with respect to the indicators presented above, whereby higher values of the tax burden indicators imply higher ranks. Of particular interest appears the relationship between the total tax burden on the one hand and the individual tax burden indicators on the other hand. However, a more detailed analysis of the relationships between the individual tax burden indicators goes beyond the scope of the study.

Table 4

Effective Average (EATR) and Marginal Corporate (EMTR) Tax Rates, 1998-2009

Country	EATR			EMTR		
	1998	2009	Δ 1998-2009	1998	2009	Δ 1998-2009
Austria	29.7	22.7	–7.0	20.2	17.4	–2.8
Belgium	34.5	24.7	–9.8	22.7	–5.1	–27.8
Bulgaria	32.0	8.8	–23.2	21.2	5.5	–15.7
Canada[1]	37.1	32.9	–4.2	38.6	32.8	–5.8
Cyprus	27.5	10.6	–16.9	24.4	9.5	–14.9
Czech Republic	26.4	17.5	–8.9	23.0	11.2	–11.8
Denmark	30.0	22.5	–7.5	21.5	16.7	–4.8
Estonia	22.4	16.5	–5.9	13.4	3.6	–9.8
Finland	25.9	23.6	–2.3	21.5	18.1	–3.4
France	39.8	34.6	–5.2	36.8	34.9	–1.9
Germany	41.2	28.0	–13.2	37.9	21.7	–16.2
Greece	30.4	21.8	–8.6	20.5	14.1	–6.4
Hungary	19.0	19.5	0.5	18.7	15.5	–3.2
Ireland	9.4	14.4	5.0	7.8	13.3	5.5
Italy	32.0	27.4	–4.6	9.7	20.8	11.1
Japan[1]	41.7	41.3	–0.4	42.8	41.9	–0.9
Latvia	22.7	13.8	–8.9	17.5	10.8	–6.7
Lithuania	23.0	16.8	–6.2	6.7	8.3	1.6
Luxembourg	32.6	25.0	–7.6	22.4	16.5	–5.9
Malta	32.2	32.2	0.0	26.9	26.9	0.0
Netherlands	32.3	23.7	–8.6	27.2	19.6	–7.6
Norway[1]	26.4	26.5	0.1	23.1	23.3	0.2
Poland	32.4	17.5	–14.9	25.3	13.7	–11.6
Portugal	33.4	23.7	–9.7	25.5	17.1	–8.4
Romania	34.0	14.8	–19.2	26.0	11.9	–14.1
Slovakia	36.7	16.8	–19.9	30.8	11.3	–19.5
Slovenia	20.9	19.1	–1.8	10.5	14.5	4.0
Spain	36.5	32.8	–3.7	35.4	33.4	–2.0
Sweden	23.8	23.2	–0.6	17.9	17.4	–0.5
Switzerland[1]	18.8	18.7	–0.1	12.5	12.4	–0.1
United Kingdom	29.7	28.3	–1.4	27.3	28.9	1.6
United States[1]	38.3	37.4	–0.9	35.9	35.1	–0.8
Croatia[1]	16.5	16.5	0.0	6.9	6.9	0.0
Macedonia[1]	13.3	7.9	–5.4	8.8	1.9	–6.9
Turkey[1]	26.8	17.9	–8.9	19.6	12.6	–7.0
EU 15	30.7	25.1	–5.7	23.6	19.0	–4.6
EU 12	27.4	17.0	–10.4	20.4	11.9	–8.5
OECD rest	27.4	25.9	–1.6	24.1	22.0	–2.0

(1) Earliest data: 2005.
Source: European Commission (2010b), and WIFO calculations.

Table 5

Country-specific Ranks with Respect to Tax Burden Indicators

Country	Total Tax Burden	Share of Growth-dampening Taxes	Top Personal Income Tax Rate [(1)]	Marginal Tax Wedge 100%	Average Tax Wedge 100%	Corporate Income Tax Rate	EMTR	EATR
Australia	28	13	13	24	26	8		
Austria	7	4	4	4	5	18	13	17
Belgium	3	7	5	2	1	4	32	12
Bulgaria	22	36	36	n.a.	n.a.	35	30	32
Canada	32	11	29	19	20	6	5	4
Cyprus	17	34	28	n.a.	n.a.	36	28	31
Czech Republic	15	9	34	12	9	26	26	23
Denmark	1	16	2	18	11	19	16	18
Estonia	25	25	31	n.a.	n.a.	24	31	27
Finland	5	10	8	5	8	16	12	15
France	6	14	18	9	4	5	3	3
Germany	10	8	14	3	3	11	9	8
Greece	24	22	15	11	10	20	20	19
Hungary	11	26	26	1	2	30	18	20
Iceland	9	33	11	20	25	32		
Ireland	26	31	10	6	24	34	22	29
Italy	8	15	16	7	6	7	10	9
Japan	34	1	6	26	23	1	1	1
Korea	36	35	22	28	27	22	n.a.	n.a.
Latvia	29	24	30	n.a.	n.a.	33	27	30
Lithuania	31	21	35	n.a.	n.a.	27	29	25
Luxembourg	16	19	21	8	17	12	17	11
Malta	21	32	23	n.a.	n.a.	3	7	6
Netherlands	12	17	3	16	13	17	11	13
New Zealand	19	20	25	27	28	9	na	na
Norway	4	5	9	10	15	13	8	10
Poland	20	29	27	22	18	28	21	24
Portugal	23	28	12	15	16	21	15	14
Romania	33	30	33	n.a.	n.a.	31	24	28
Slovakia	27	23	32	17	14	29	25	26
Slovenia	13	18	19	n.a.	n.a.	25	19	21
Spain	18	12	17	13	12	10	4	5
Sweden	2	3	1	14	7	15	14	16
Switzerland	30	6	20	23	22	23	23	22
United Kingdom	14	27	7	21	19	14	6	7
United States	35	2	24	25	21	2	2	2

[(1)] Out of a sample of 28 countries.
Source: WIFO.

4 Regulation

4.1 The regulatory framework and economic growth

A further dimension of government size is the intensity of regulation. Governments provide the framework for market transactions by setting the rules for voluntary exchange and market entry (and sometimes also: exit). Government regulations impose restrictions on individual market participants' actions and thereby limit the range of opportunities. On the one hand, a minimum set of regulations is a pre-condition for the functioning of markets and competition so that they can unfold their productivity enhancing power. A good regulatory framework reduces transaction costs on goods and factor markets and thus contributes to growth. Moreover, regulations may also improve the allocation of resources by channeling economic behavior of market participants in order to correct market failures from asymmetric information, externalities or natural monopoly markets. On the other hand, overly rigid regulatory systems can be an obstacle to economic growth if the set of implemented rules impedes welfare-enhancing voluntary transactions. Regulatory restraints can be so strict that they prevent an economy to respond quickly to technological change and to allocate scarce resources to their most productive uses.

While too little regulation is bad for growth because the necessary framework for competitive markets is not provided, too much regulation can be bad for growth if it restricts competition (by entry limitations) and voluntary exchange. A lack of competition in markets can thwart incentives for productivity improvements and therefore lead to reduced innovation dynamics through barriers to entrepreneurship (Aghion *et al.*, 2001, Cincera and Galgau, 2005). Severe regulations place an additional burden on economic activities and thus reduce the rate of return from investment in physical or human capital. As such, the burdens from regulation are similar to burdens of taxation. Structural policies and regulations which influence the working properties of markets can therefore contribute to cost differences in goods and factor markets. In case of excessive entry regulations, a liberalization or de-regulation can improve allocative efficiency by reducing monopoly rents and bringing prices in line with marginal costs. Also, enhanced competition will raise the productive efficiency of an economy by changing incentives for businesses. Moreover, a more open economy with reduced entry restrictions is also more attractive to foreign trade and investment (Nicodème and Sauner Leroy, 2007; Djankov, 2009). Finally, regulation also can serve as a means for state enforced re-distribution towards organized special interest groups. Achieving regulatory protection from competition is therefore a goal in socially unproductive rent seeking (Posner, 1975).

Seen from this view, the theoretical problems regarding the choice of an "optimal degree of regulation" are not too different from the questions with respect to the optimal fiscal size of government.[22]

Empirical evidence on the growth effects of the regulatory framework almost always points to the advantages of less heavily regulated markets. A number of empirical papers find that a more market-friendly regulatory environment is conducive to economic growth performance, and that too strict regulatory policies and lack of competition in markets are at the heart of a disappointing growth performance, specifically in some OECD nations (e.g., Dutz and Hayri, 1999; Griffith Harrison and Simpson, 2006; Nicodème and Sauner Leroy, 2007). Nicoletti and Scarpetta (2003) find that productivity growth is boosted by reforms that promote private corporate governance and competition, and claim that "… entry-limiting regulation may hinder the adoption of technologies, possibly by reducing competitive pressures, technology spillovers, or the entry of new high-tech

[22] Wright (2004) even develops a similar theoretically hump-shaped relation between regulation intensity and growth performance as in Figure 1 of this paper.

firms". Alesina *et al.* (2005) report that a more competitive environment is good for growth as it stimulates private business investment. Fernandes (2008) finds a positive impact of de-regulation on productivity in the services sector in transition economies. Djankov, McLiesh and Ramalho (2006) use data from the World Bank's Doing Business reports as objective measures of business regulations in 135 countries. They find that countries with less regulation grow faster. Dawson (2006) reports a significant negative relationship between a broad measure of economic regulation and growth. Similar results are found when measures of credit market and business regulations are used.

Although it is still an ongoing debate, the vast majority of theoretical models and empirical papers conclude that trade is good for growth (e.g., Grossman and Helpman, 1991; but see also Rodriguez and Rodrik, 2001). The international division of labor is generally supposed to be a major driver for world-wide development. Restrictions on international trade – tariffs, quotas, hidden administrative regulations etc. – are therefore suspected to be growth depressing. What is more controversial among economists is whether freedom of international capital movements is unequivocally good for growth (e.g., Klein, 2005; Edwards, 2007). Even before the recent Financial Crisis a number of economists advocated capital controls as a means to protect local producers and financial markets at a developmental stage (e.g., Stiglitz, 2002).

The most heavily disputed regulations are concerned with labor market issues. On the one hand, market imperfections like asymmetric information and distribution of market power between employers and employees require some protection for workers through labor market legislation (Beetsma and Debrun, 2003). On the other hand, restrictive regulation of labor markets can easily cause sclerotic labor markets that are an obstacle to efficient allocation and growth. Empirical evidence on the growth effects of restrictive labor market regulations is scarce. Most empirical studies are rather concerned with employment effects. Rigid labor market institutions are frequently seen as a fundamental cause for high and persistent unemployment in a number of European countries (e.g., Blanchard and Wolfers, 2000). Though empirical evidence is somewhat scarce, at least some empirical studies indicate that growth in industrial countries – especially in the European economies – could be enhanced by lower de facto labor market regulation (Calderon and Chong, 2005).

4.2 Regulatory policies

In this sub-section we provide an overview of the degree of regulation in OECD and EU27 economies, as well as in a number of countries in the European periphery. Yet, whereas fiscal size can in principle be measured – though only imperfectly and involved with a lot of problems – the quality of regulations governing markets is even more difficult to gauge, as it is not the mere number of laws that is decisive. Instead of introducing a vast number of different indicators and measurement systems for regulatory policies in this sub-section, we employ the most comprehensive composite Economic Freedom of the World-index from the Fraser Institute, which is based on data from various international sources. We take the data from the most recent edition of the Economic Freedom of the World-report (Gwartney and Lawson, 2010) which provides data for the degree of regulation of certain markets and businesses up to 2008. We concentrate on the following dimensions of the *efw*-index:

- the regulation of international trade and capital flows,
- the regulation of domestic credit markets,
- the regulation of business in general, and
- the regulation of labor markets.

Table 6 displays the results for 2008.

Table 6

Intensity of Market Regulations According to Economic Freedom of the World Sub-indices, 2008

Country	Code	International Trade and Capital	Domestic Credit	Domestic Business	Domestic Labor	Summary*
New Zealand	NZ	7.9	10.0	7.8	8.5	8.6
Denmark	DK	7.7	9.5	7.4	7.5	8.0
Canada	CA	7.1	9.5	7.1	8.3	8.0
Ireland	IE	8.2	9.0	6.9	7.6	7.9
Australia	AU	6.7	9.5	6.7	8.5	7.9
United Kingdom	UK	7.6	9.0	6.7	8.0	7.8
United States	US	7.6	7.7	6.7	9.2	7.8
Slovakia	SK	8.1	10.0	5.3	7.7	7.8
Netherlands	NL	8.3	9.5	6.4	6.7	7.7
Estonia	EE	8.0	10.0	7.3	5.6	7.7
Switzerland	CH	6.8	9.0	7.0	7.9	7.7
Belgium	BE	8.0	9.4	6.3	6.9	7.7
Czech Republic	CZ	7.8	9.3	5.6	7.7	7.6
Iceland	IS	5.7	9.3	7.7	7.7	7.6
Bulgaria	BG	7.6	9.5	5.4	7.7	7.6
Hungary	HU	8.1	8.8	6.0	7.1	7.5
Luxembourg	LU	8.1	9.5	7.0	5.3	7.5
Austria	AT	7.6	9.4	6.8	5.9	7.4
Latvia	LV	7.3	9.2	6.1	7.1	7.4
Sweden	SE	7.7	9.5	7.1	5.1	7.4
Japan	JP	6.1	8.9	6.1	8.2	7.3
Finland	FI	7.4	9.8	6.9	5.1	7.3
France	FR	7.3	9.2	6.2	5.6	7.1
Malta	MT	7.1	9.4	4.6	7.0	7.0
Cyprus	CY	7.1	9.5	6.1	5.3	7.0
Lithuania	LT	7.5	9.2	5.7	5.6	7.0
Slovenia	SI	7.3	9.0	6.0	5.4	6.9
Romania	RO	7.4	7.5	5.9	6.7	6.9
Norway	NO	6.5	9.3	6.6	4.9	6.8
Spain	ES	7.0	9.3	5.8	5.1	6.8
Poland	PL	7.1	8.7	4.9	6.5	6.8
Italy	IT	7.1	7.9	5.4	6.3	6.7
Korea	KR	7.1	9.3	6.1	4.0	6.6
Germany	DE	7.7	8.2	6.6	3.9	6.6
Portugal	PT	7.2	7.6	5.9	5.2	6.5
Greece	EL	6.4	7.6	5.7	4.4	6.0
sample mean		7.4	9.1	6.3	6.5	7.3
Georgia	GE	7.7	8.7	7.5	7.3	7.8
Montenegro	ME	7.2	9.6	5.3	7.9	7.5
Kyrgyzstan	KG	7.4	9.2	6.4	6.2	7.3
Croatia	HR	6.5	9.4	5.1	6.3	6.8
Armenia	AM	6.6	9.0	5.3	6.1	6.8
Bosnia and Herzegovina	BA	6.2	8.9	5.2	6.7	6.8
Albania	AL	6.3	8.1	6.1	5.8	6.6
Serbia	RS	6.7	8.7	4.8	5.7	6.5
Turkey	TR	6.4	7.5	6.3	4.4	6.2
Ukraine	UA	6.5	8.1	3.7	6.3	6.2
sample mean		7.2	8.6	6.1	5.7	6.9

* Simple average of the four regulation sub-indices, WIFO calculations.
Source: Gwartney and Lawson (2010).

International trade and capital flows

Also as a consequence of integration of international goods and capital markets through various international treaties, the countries in the sample observe a high level of trade and capital markets liberalization in 2008. On a 0-to-10-point-scale, average regulation index level is 7.4, lying in a range between 8.3 (Netherlands) and 5.7 (Iceland) (see Table 6). Trade and international capital movements are also reasonably liberalized in the 10 countries of the European periphery for which data are available. On average, the liberalization level is 7.2 points, with Georgia (7.7) having a regulatory regime that provides liberties comparable to Sweden or the USA.

Credit market regulations

This sub-index measures the extent to which the banking industry is dominated by private firms and whether foreign banks are permitted to compete in the market. It also indicates the extent to which credit is supplied to the private sector and whether controls on interest rates interfere with the market in credit. The average liberalization level of domestic credit markets in 2008 was 9.1, only a few countries (Portugal, Greece, Romania, Italy, and the USA) observed a liberalization level that is slightly less than 8 points on the scale.

Business regulations

The index of private business regulation identifies the extent to which regulatory policies and bureaucratic procedures restrain entry and reduce competition. In order to score high in this sub-index, governments must allow predominantly markets to determine prices and refrain from regulatory activities that retard entry into business and increase the cost of production. On average, the countries in the OECD/EU27 sample arrive at a liberalization level of 6.3, which is far lower than the international trade regulations level. While New Zealand and Iceland observe the highest level of de-regulation of product markets, especially Malta and Poland appear to have still a high potential to liberalize and, thus, enhance competition on domestic markets. According to the results of most empirical studies, this would boost growth in these countries. OECD (2005b), hence, expected a substantial increase of GDP per capita growth in the EU15 if competition-restraining regulations were abandoned.

Labor market regulations

The least regulated labor markets according to the *efw*-index can be found in the Anglo-Saxon Welfare States (USA, Australia, New Zealand, Canada, UK) as well as in Japan. Continental Europe, especially Germany in 2008, is lagging behind.[23] Greece, Spain, and Portugal also faced more rigid labor market regulations.

Summary index

Taking the simple mean of these four regulation-indices, New Zealand is the least regulated country in the sample, while Greece is the most heavily regulated. The countries in the European Periphery observe somewhat more economic regulation than the ones of the developed countries sample. Yet, the differences in 2008 are not very pronounced.

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23 In the meantime Germany put in place a number of labor market reforms which will probably improve its score of the labor market regulation index.

Figure 17 shows a positive relationship between the level of GDP per capita and the state of market liberalization in 2008, taking also into account countries from the European Periphery sample. A simple bi-variate cross-country regression indicates that the interrelation between both variables is statistically significant at a 1 per cent level of confidence.

Figure 18 illustrates development of the summary regulation index over time in four country groups. While markets are already highly liberalized in EU15 and further OECD countries, the EU12 and the European Periphery observed a liberalization of regulatory policies over time. Until 2008 the differences between the country groups have been substantially reduced.

5 Interplay between expenditures, taxation and regulation

5.1 The role of policy complementarities

Having analyzed separately the spending, taxation and regulation patterns of the countries in our sample, the focus of this section will be placed on the interplay of the respective policies. Although often neglected in theoretical as well as empirical investigations, complementarities between policies can play an important in role for the growth friendliness of entire policy packages. As reforms are mutually interdependent, a country's economic policy package needs coherence, or, "economic complementarities", "… in a sense that the effectiveness of one policy depends on the implementation of other policies" (Orszag and Snower, 1998). Neglecting such interdependencies between policies can result in a wrong assessment of the economic effects of single policy measures (Aziz and Wescott, 1997).

The role of the interaction between certain economic policies in promoting growth has only recently received significant attention in the empirical growth literature. Aziz and Wescott (1997) consider measures for international openness, macro stability and size of government in a sample of 76 developing countries, and report that – analyzed separately – virtually none of these policies is significant in boosting growth over a 10 year period from 1985-95. Introducing a concept of complementarities between these different policies, they find that countries which have high quality of policies in all three measures (or at least only one "medium quality policy") have a significantly higher probability to observe higher growth.

Chang, Kaltani and Loayza (2009) find that the growth-promoting effect of trade openness depends on complementary reforms which help a country take advantage of international competition. Their estimates show that trade openness can reduce or increase growth, depending on the status of the complementary reforms in the areas educational investment, financial depth, inflation stabilization, public infrastructure quality, governance, labor-market flexibility, ease of firm entry, and ease of firm exit. This clearly indicates that the growth effects of an increase in international trade openness depend positively on the progress made in other policy areas. Bokaky and Freund (2004) also find that increased trade does not stimulate growth in economies with substantial regulatory interventions, it may even reduce growth in countries with excessive government regulation. In a similar vein, Gwartney, Holcombe and Lawson (2006) find countries with a higher overall institutional quality to experience a higher productivity of investment. More specifically, private investment is much more responsive to cross-country differences in economic freedom than are rates of government investment.

Figure 17

Intensity of Market Regulations and GDP per capita, 2008

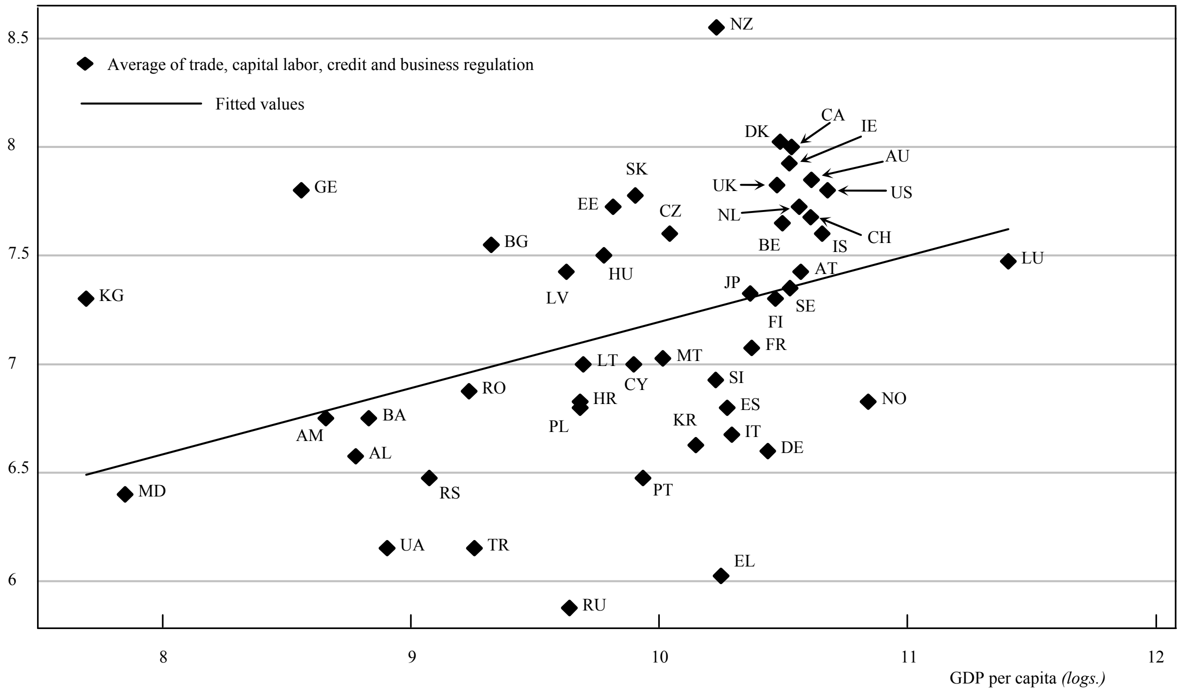
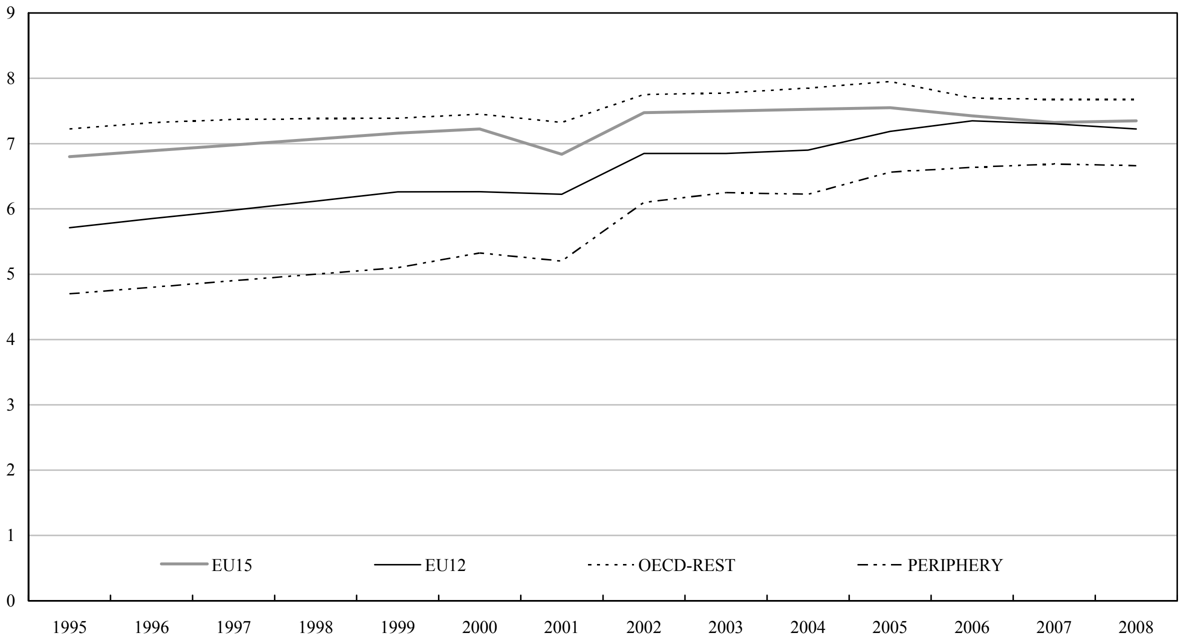


Figure 18

Median Economic Liberalization Levels in Groups of EU15, EU12 and Further OECD Countries, 1995-2008

(according to summary regulation index)



Source: WIFO calculations,based on Gwartney and Lawson (2010). Median values for the years 1996-99 derived from interpolated data.

Most recently, Braga de Macedo, Oliveira Martins and Rocha (2010) assess the possible impact of complementarities over six broad policy areas cross-country estimates in a sample of 130 countries over a time span of 13 years (1994-2006). The policy areas included are: i) trade openness, ii) business regulations, iii) freedom of capital movement, iv) openness of the domestic banking and financial system, v) property rights protection and vi) infrastructure quality. These major areas therefore resemble to some extent the policies that are considered to be growth enhancing in the present paper. Policy complementarities are captured by the standard deviation of the six aforementioned individual policy indicators, which have been standardized on a 0-100scale.[24] The authors find evidence that the variables having the strongest explanatory power are the average change of policies towards more economic liberalization and the time-averaged standard deviation of individual policy indicators, even after the inclusion of several controls. They conclude that "[t]his implies that countries where policy complementarities can unfold to a greater extent grow faster. Achieving a higher level of policy complementarity has therefore a permanent effect on growth rates". Turning to panel techniques, the introduction of (country) fixed-effects destroys the significance of the complementarities measure, indicating that the effect is driven mainly by the cross-section variance. In a simple random-effects framework, the positive impact of more coherent policies remains. Braga de Macedo, Oliveira Martins and Rocha (2010) therefore confirm the findings of a previous paper on transition economies, where the authors used different measures for complementarities (Braga de Macedo and Oliveira Martins, 2008).

In contrast to these economic complementarities between policy areas, political policy complementarities arise when the ability to gain political consent for one policy depends on the implementation of others (Orszag and Snower, 1998). This somehow parallels the famous argument of Rodrik (1998) who claims that many countries have increased social security spending and social regulation in order to compensate for higher risks due to globalization and market deregulation. On the other hand, Bergh and Karlson (2010) report evidence that high-tax countries might use a liberalization of trade as a substitute for excessive overall government size. Their results support the idea that countries with big government can use economic openness to mitigate the negative growth effects of high taxes and expenditures.

5.2 *Some empirical facts*

In this sub-section we will aim to investigate the existence (or absence) of complementarities between public expenditures, taxation and regulation in our sample. Note, first, that there is no single measure for complementarities, and, second, that we do not have an exact notion of the "optimal" level of productive spending or regulations. We therefore calculate a simple standardized index of the relative growth friendliness of a country's policy package as well as for the coherence/dispersion of the respective policy package, taking into account the real world range and distribution of the data in our sample. The construction of the indices assumes linearity, *i.e.*, possible non-linear relations between policy variables and economic outcomes are not reflected in the indices.

The first index is an index of the average growth friendliness of a country's policy mix, consisting of indicators for spending, taxation and regulation policies. It is constructed by measuring the growth friendliness of 13 policy indicators (see box) in relation to other countries in the sample. The resulting index is standardized on a 0-100 scale, where higher values reflect higher (average) growth friendliness.

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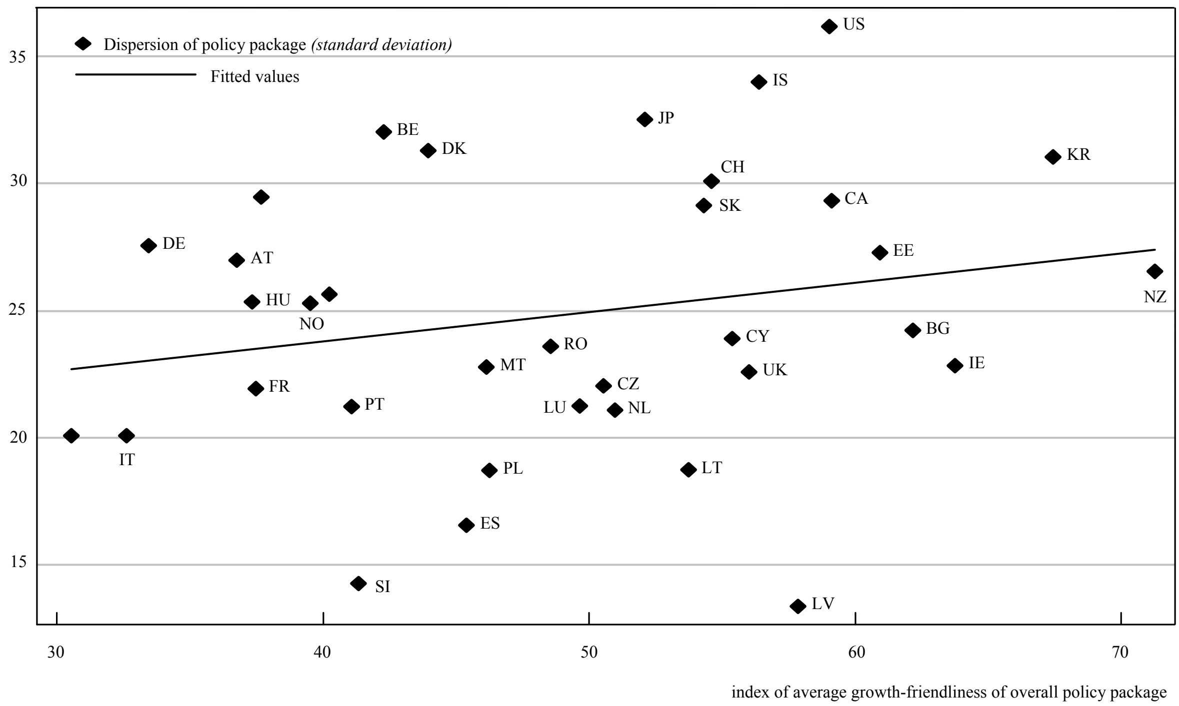
[24] Instead of employing the Fraser Institutes measures the authors use instead the Economic Freedom index of Wall Street Journal and Heritage Foundation.

Figure 19

Policy Dispersion and Average Growth Friendliness, 2008



The second index is simply calculated as the standard deviation of the growth-friendliness index of these 13 policies. Higher values indicate more dispersion and a less coherent overall policy package. Table 7 indicates the respective values for 2008.

The average index is led by New Zealand, followed by Korea, Ireland and Bulgaria. At the bottom of the 2008 ranking we find Austria, Germany, Italy and Greece. With respect to the policy dispersion measure, the most coherent policy mix can be found in Latvia, Slovenia and Spain, while the USA, Iceland, and Japan observe the highest standard deviation of our set of 13 policy indicators. Both measures are not strongly correlated, though. Figure 19 shows that average growth friendliness and policy dispersion are not strongly connected. If anything, there is a slightly positive relation between the two variables. Simple correlation tests also reveal no significant between both indicators.

6 Summary and outlook

Are fiscal and regulation policies in Europe in line with the recommendations from the new growth literature? The present study provides an overview of the growth friendliness of fiscal and regulatory structures in a sample of developed OECD countries and EU members (EU15 and EU12). Peripheral European (transition) countries are also included, whenever respective data are available.

Based on several measures capturing the expenditure and the tax side of the budgets, as well as regulatory policies, the size and the structure of public sectors differ markedly across countries. Our analysis of regulatory regimes is based on indicators for the liberalization of international trade and capital movements, as well as domestic credit markets, labor markets and business regulations.

Table 7

Growth-friendliness Index and Policy Dispersion Index, 2008

S-code	Country	Growth Friendliness	Dispersion
NZ	New Zealand	71.3	26.6
KR	Korea	67.4	31.0
IE	Ireland	63.8	22.8
BG	Bulgaria	62.2	24.2
EE	Estonia	60.9	27.3
CA	Canada	59.1	29.3
US	United States	59.0	36.2
LV	Latvia	57.9	13.4
IS	Iceland	56.4	34.0
UK	United Kingdom	56.0	22.6
CY	Cyprus	55.4	23.9
CH	Switzerland	54.6	30.1
SK	Slovakia	54.3	29.1
LT	Lithuania	53.7	18.7
JP	Japan	52.1	32.5
NL	Netherlands	51.0	21.1
CZ	Czech Republic	50.5	22.0
LU	Luxembourg	49.6	21.2
RO	Romania	48.5	23.6
PL	Poland	46.3	18.7
MT	Malta	46.1	22.8
ES	Spain	45.4	16.5
DK	Denmark	44.0	31.3
BE	Belgium	42.3	32.0
SI	Slovenia	41.3	14.3
PT	Portugal	41.1	21.2
FI	Finland	40.2	25.7
NO	Norway	39.5	25.3
SE	Sweden	37.7	29.5
FR	France	37.5	21.9
HU	Hungary	37.3	25.3
AT	Austria	36.8	27.0
DE	Germany	33.5	27.5
IT	Italy	32.6	20.1
EL	Greece	30.5	20.1

Source: WIFO calculations.

On average, New Zealand is the least regulated country in the sample, while Greece is the most heavily regulated. Countries of the European periphery observe a bit more strict economic regulation than those of the developed countries sample. Yet, the differences have become smaller over time and in 2008 they are not very pronounced any more.

Using a standardized index of the relative growth friendliness of a country's policy package as well as for the coherence/dispersion of the respective policy mix of spending, tax and regulation policies, in 2008 the most coherent policy mix can be found in Latvia, Slovenia and Spain. The USA, Iceland, and Japan observe the least coherent policy package, as measured by the standard deviation of our set of 13 policy indicators. Average growth friendliness of public policy and the level of policy dispersion are not strongly related.

Future work will have to take a closer look at the economic and political determinants of these substantial differences in size and composition of government spending, structure and volume of taxation and the regulatory regimes. Are productive and growth-friendly spending, tax and regulation structures driven by demographic change or by income development? Empirical analyses suggest that population aging is linked to higher social expenditures (e.g., Sanz and Velazquez, 2007), but what about the economic determinants of productive spending (e.g., Shelton, 2007; Pitlik, 2009)?

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SERVICE REGULATION AND GROWTH: EVIDENCE FROM OECD COUNTRIES

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*We study the effects of anti-competitive service regulation by examining whether OECD countries with less anti-competitive regulation see better economic performance in manufacturing industries that use less-regulated services more intensively. Our results indicate that lower service regulation increases value added, productivity, and export growth in downstream service intensive industries. The regulation of professional services and energy provision has particularly strong negative growth effects. Our estimates are robust to accounting for alternative forms of regulation (*i.e.*, product and labour market regulation), alternative measures of financial development and a range of other specification checks.*

Do countries with less anti-competitive service regulation perform better economically? Policy makers appear to think so as regulatory barriers have fallen in many countries. And their position is generally supported by a large empirical literature looking at the effects of entry barriers, red-tape costs or legal requirements on economic performance. Much of this literature examines the effects of regulation on the performance of the regulated sector. Less is known about the impacts on downstream manufacturing activities, which is surprising as regulation affects many key service inputs.

In this paper, we study how regulation in the supply of a variety of services affects the economic performance of downstream manufacturing industries. We do so by examining whether countries with less service regulation see faster value added, productivity, and export growth in manufacturing industries using services more intensively (this methodology was pioneered for financial services by Rajan and Zingales, 1998). We measure service dependence across manufacturing industries using input-output account matrices. Our measures of service regulation are OECD indicators designed to capture anti-competitive regulatory settings for the energy sector (electricity and gas), the telecommunication and the transportation sectors and for professional services. These account for barriers to entry, for the integration between a priori competitive activities and natural monopolies (in the case of energy), and for the existence of restrictions on prices and fees, advertising or the form of business (in professional services).

Our empirical findings indicate that lower service regulation has non-negligible positive effects on the value added, productivity and export growth rates of service intensive users. To get a sense for the size of the regulation effect, consider the annual value added growth differential between an industry at the 75^{th} percentile (Pulp, paper and printing) relative to one at the 25^{th} percentile (Fabricated metal products) of the distribution of service dependence. Our estimates imply that this differential is 0.7-1 per cent higher in a country with average regulation at the 25^{th} percentile (as Canada) than in a country at the 75^{th} percentile (as France) of the distribution of service regulation. We find this effect is mainly driven by regulation in energy and in professional

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services. Also, the average effect is driven by larger economies in the sample. The results are not sensitive to how we account for other forms of regulation (*i.e.*, product and labour market regulation) and prove robust to a number of specification checks.

Our findings have important implications for the ongoing debate surrounding service deregulation. In particular, our estimates imply that the strongest gains from deregulation would come from specific policies such as the removal of conduct regulation (*i.e.*, of restrictions to price and tariff setting) by professions, or the complete separation of ownership between energy generation and other segments of the industry (the so-called "unbundling"). Both measures are among those ranking highest in the current EU competition policy agenda and in policy recommendations by international organizations.[1]

Research on the economic effects of regulation has grown in recent years, in part because of the increased availability of comparable cross-country data. Empirical work has focused mainly on the *direct* effects of regulation on the regulated sector or stage of business development. Economy-wide restrictions such as barriers to entry have been shown to hamper economy-wide entrepreneurship by stifling growth in the number of firms (Klapper *et al*., 2006), by increasing industry concentration (Fisman and Sarria-Allende, 2004), and by reducing responsiveness to global demand and technology shifts (Ciccone and Papaioannou, 2007). Sector-specific restrictions, such as those prevailing in utilities and services, have been shown to decrease investment (Alesina *et al*., 2005) and employment (Bertrand and Kramartz, 2002), and to increase prices (Martin *et al*., 2005) in the regulated sectors. Yet, regulation may also have relevant *indirect* effects on the allocation of resources among downstream industries, in particular when affecting the production of key non-tradable inputs.

In theoretical models of industry interdependence, the under-development of markets for non-tradable inputs has been shown to constrain (or even prevent) the diffusion of input-intensive technologies, thus affecting the patterns of resource allocation and international specialization (Okuno-Fujiwara, 1988; Rodriguez-Clare, 1996). Empirical research into the relationship between upstream markets development and the allocation of resources across downstream industries has, however, been largely confined to the case of finance.

Rajan and Zingales' (1998) test of the finance-growth nexus using country-industry data represents a major contribution to this literature. The authors exploit industry heterogeneity in financial dependence (*i.e.*, the need for external funds) to show that in countries with better developed financial markets, financially dependent industries experience faster value added growth than less dependent industries. Their findings, confirmed by many subsequent studies, point to financial development as one relevant determinant of the patterns of international specialization. One contribution of our work is to show that the growth effects of service regulation can be just as large. As in the case of finance studies, our main explanatory variable is obtained as the interaction of an industry characteristic (service dependence) with a country characteristic (service regulation). The coefficient for this variable measures whether countries with lower service regulation grow relatively more in industries that depend more intensively on regulated services. Following Rajan and Zingales, we use country and industry fixed-effects to deal with various concerns arising in standard growth analysis (e.g., reverse causation and omitted variables).

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[1] The reduction and harmonization of legal and administrative barriers is the main goal of the recent EU Services Directive, implemented at the end of 2009 and motivated by the concern for the knock-on effects that barriers in services may trigger "given the integration of services into manufacturing". The Third Legislative Package on Energy Markets is a controversial recent set of Directives by the Commission promoting the unbundling of network operation from supply and generation in energy. Similarly, the OECD recently recommended revising the energy regulatory framework in most member countries, and indicated the liberalization of professional services as a priority policy area for six European countries (including France, Germany and Italy), and Canada (OECD, 2009, *Going for Growth*).

By highlighting the relevance of service regulation for both value added and export growth our work closely relates to a growing literature on the relevance of institutions and policies for resource allocation and comparative advantages. Recent works focused on the ability to enforce written contracts. Nunn (2007) showed that countries with better contract enforcement specialize in contract intensive industries, those for which relationship-specific investment is more important. Levchenko (2007) found these countries also tend to export goods that, by requiring a large variety or range of inputs, are more institutionally dependent. In an earlier contribution, Claessens and Laeven (2003) explored the nexus between property rights protection and growth in industries that are more intensive in intangible assets, whose returns are more exposed to the actions of competitors. Looking at labour market institutions, Caballero *et al*. (2006) found that, in countries with strong rule of law, higher job security is associated with slower adjustment to shocks and lower productivity growth. Cuñat and Melitz (2007) found that countries with light regulation of employment relationships specialize in high-volatility industries. Against this background, our results emphasize the role of regulatory settings that are on top of competition policy agendas.

Two recent papers combined indexes of service regulation with input-output coefficients to estimate the impact of regulation and productivity growth (Conway *et al*., 2006; Arnold *et al*., 2008). Differently from us, they focus on the relevance of regulation for the transfer of technology to firms behind the productivity frontier, estimated exploiting the time series relationship between productivity in frontier and non-frontier countries. Their results indicate that regulation significantly slows technology transfers, and suggest that this happens, in particular, because it increases the costs of absorbing new technologies (as ICTs). Our interest on the patterns of specialization and trade requires that we focus on different specifications and outcomes. In line with the literature of reference, we also employ a different measure of regulatory impact (both papers use the recently issued OECD Regulation Impact Indicators, see Conway and Nicoletti, 2006). As we will see, such change turns out to have relevant empirical implications.[2]

Our results indicate that service efficiency matters for growth even in a restricted sample of high-income countries, for which the relationship between financial development and growth has previously been shown to be weak (Manning, 2003). We argue that this difference can be traced to our use of value added data at constant rather than current prices. To illustrate the point we use a simple theoretical framework in which countries produce differentiated goods and lower regulation raises output in service-intensive industries by reducing the service component of production costs. In this case there are two countervailing effects of lower regulation on nominal value added of service-intensive industries: a positive effect due to higher output and a negative effect due to lower prices. Estimates of the combined effect will therefore understate the impact of service regulation on production. We find empirical support for this hypothesis: lower regulation and higher financial development reduce the growth rate of (implicit) prices relatively more in service-intensive manufacturing industries. Accordingly, we do not find any significant effects of regulation or financial development on nominal value added growth.

1 Background

In this section we introduce a simple framework relating service regulation to the costs of production in downstream industries, and illustrate why regulation might affect industry specialization using insights from the recent trade literature. We start by considering an economy

[2] Three other papers used input-output linkages to study the consequences of upstream markets inefficiencies, but focused on specific countries. Allegra *et al*. (2004) looked at competition problems (as measured by the number of antitrust cases) and exports in Italian manufactures. Faini *et al*. (2006) focused on the link between regulation of network industries and productivity growth in Germany, Italy and the UK. Arnold *et al*. (2007) showed that barriers to FDI in services slowed TFP growth by Czech manufacturing firms.

with access to two production technologies j = 1, 2 combining labour (L) and an intermediate input Z, $y_j = Z_j^{\gamma_j} L_j^{1-\gamma_j}$. We assume that industry 1 is relatively more intensive in input Z: ($\Delta\gamma = \gamma_1 - \gamma_2 > 0$). The intermediate input is a composite of different production services $x(i)$, $Z_j = \left[\int_0^1 x(i)^\sigma di\right]^{\frac{1}{\sigma}}$, where $\sigma \in (0,1)$ determines the elasticity of substitution $\chi = 1/(1-\sigma)$ between varieties. Each variety is produced using one unit of labour, priced w. The price index of the composite service can be obtained from maximization conditions as $p_z = \left[\int_0^1 p(i)^{-\frac{\sigma}{1-\sigma}} di\right]^{-\frac{1-\sigma}{\sigma}}$, where $p(i)$ is the price of the i^{th} service.

Service regulation is introduced assuming that only a fraction $\varphi \in (0,1)$ of varieties can be bought at competitive prices, while the share $(1 - \varphi)$ is available in regulated markets, where inputs are sold at monopolistic prices. This assumption implies that $p(i)=w$ if $i \in (0, \varphi)$, and $p(i)=w/\sigma$ when $i \in (\varphi, 1)$ and regulation grants monopoly profits to producers of service varieties.

The equilibrium price of the composite service becomes:

$$p_z = w\left[\varphi + (1-\varphi)\sigma^{\frac{\sigma}{1-\sigma}}\right]^{-\frac{1-\sigma}{\sigma}} = w\mathrm{C}(\varphi)$$

where $\mathrm{C}'(\varphi) < 0$, $C(\varphi)=1/\sigma > 1$ if $\varphi=0$ (fully regulated services) and $C(\varphi)=1$ if $\varphi=1$ (fully competitive services). The expression above implies that, given the unit cost function $c_j = p_z^{\gamma_j} w^{1-\gamma_j}$, the relative cost in the service intensive industry can be written as a decreasing function of the fraction of deregulated markets φ:

$$c_1/c_2 = p_z^{\Delta\gamma} w^{-\Delta\gamma} = C(\varphi)^{\Delta\gamma}.$$

To see how regulation can affect the equilibrium allocation of production and trade consider first the case of a small open economy taking world relative prices of final goods $p = p_1/p_2$ as given. In this case, the condition for diversification:

$$C(\varphi)^{\Delta\gamma} = p$$

identifies a threshold level of regulation $\varphi^*(p)$ such that any country would in general be fully specialized in production. If $\varphi^* \in (0,1)$, regulatory reforms raising the share of liberalized input markets above the threshold φ^* would imply a dramatic shift in the country production structure, from full specialization in labour intensive industries to full specialization in service intensive industries.

Less extreme predictions can be obtained following the modern trade literature to think of firms within each industry as supplying varieties of imperfectly substitutable goods (see Helpman and Krugman, 1985). For simplicity, varieties will be differentiated by country of origin (as in Armington, 1969). In this case, producers of country c in industry j will face a downward sloping world-demand curve $q_{j,c} = p_{j,c}^{-\varepsilon}\Omega_{j,c}$, where $p_{j,c}$ is the domestic price, and $\varepsilon>1$ is the constant elasticity of substitution across varieties. The scale variable $\Omega_{j,c}$ includes the amount of domestic and foreign expenditures allocated to industry j, which can be considered exogenous to the producer. Prices are set applying a constant mark up over marginal costs ($p_j = \mu p_z^{\gamma_j} w^{1-\gamma_j}$), so that the equilibrium relative production of the service intensive variety will be an increasing function of the share of liberalized service markets φ:

$$q_{1,c} / q_{2,c} = \Theta C(\phi)^{-\varepsilon * \Delta\gamma}$$

(recall that $C'(\varphi) < 0$). The elasticity of relative production to regulation is $\varepsilon_q = -\Lambda\varepsilon$ where ε is the price elasticity of demand and $\Lambda = \Delta\gamma * [1/(1-\chi)]$ measures the impact of a change in regulation on relative prices. In this framework, service deregulation would therefore imply an increase in the service intensive industry share of total production, driven by shifts in both domestic and foreign demand. From profit maximization one can derive that relative labour productivity in the service intensive industry is also increasing in the extent of deregulation.

Notice that if the value of production is measured at current prices (*i.e.*, $r_{j,c} = p_{j,c} q_{j,c}$) the above relation becomes $r_{1,c} / r_{2,c} = \widetilde{\Theta} C(\phi)^{(1-\varepsilon)*\Delta\gamma}$. Because of the counteracting effects on prices, the elasticity of relative production to regulation $\varepsilon_r = \Lambda(1-\varepsilon)$ is therefore lower when production is measured at current rather than constant prices (and tends to zero as the substitutability across varieties ε decreases). Hence, an empirically interesting implication of this framework is that detecting the effects of regulation on the structure of industrial production would be easier using real as opposed to nominal measures of value added, as they allow insulating the industry accounts from the offsetting effects of deregulation on industry prices.

The framework above suggests that the process of service liberalization many developed countries started in the early 1990s should have implied a shift in the long run composition of production towards service intensive industries.[3] In the empirical part we will check whether such reallocation reflected in industry growth differentials by testing whether service intensive industries grew more in low regulation countries relative to less intensive service users. One reason for looking at growth rates is that production reallocation across industries is likely to be a lengthy process. A second reason is that such specification eases comparison of the results with those in the financial development literature, an important benchmark when studying the consequences of service underdevelopment.

2 Data and sample

All the data needed to perform our exercise are available from the OECD.[4] Information on value added, export and employment at the country-industry-year level is obtained from the STructural ANalysis (STAN) dataset. STAN has been assembled by the OECD complementing member countries' Annual National Accounts with information from other sources, such as national business surveys and censuses. The data are classified according to the International Standard Industrial Classification (ISIC) Rev. 3 industry list; they cover 17 countries and 15 manufacturing industries.

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3 An alternative way to model the role of services would be thinking of regulation as limiting the number of available input varieties in a model featuring increasing returns from specialization. Rodriguez-Clare (1996), Ciccone and Matsuyama (1996) and Rodrik (1996) are examples of papers showing that, with heterogeneous industry-intensity in non-traded intermediate inputs, the long run industry composition of a small open economy will significantly vary with the amount of locally produced inputs. As in the framework presented here, this occurs because the relative cost of service-intensive industries will decrease as the intermediate sector develops.

4 See the Data Appendix and Table 1 for detailed variable definition and sources.

2.1 Measuring service regulation

Exposure of manufacturing industries to service regulation is measured combining country-level information on service regulation and industry-level data on service dependence. Specifically, our main indicator is the weighted average

$$SERVREG_{j,c} = \sum_{s} \left(w_{j,s} X_{c,s} \right)$$

where $X_{c,s}$ is an index of service regulation in sector s and country c, and $w_{j,s}$ captures industry j dependence on regulated services.

Cross-country measures of service regulation $(X_{c,s})$ are obtained from the OECD Product Market Regulation (PMR) database. We focused on four upstream service activities: energy (electricity and gas), communication (telecommunication and postal services), transportation (air, road, rail transportation services) and professional services (including accountants, architects, engineers and legal services). For each sector, the OECD codes a large amount of basic information on regulatory settings into quantitative scores increasing in the amount of restrictions to competition (see Conway and Nicoletti, 2006). Following Alesina *et al*. (2005), we only considered those scores designed to measure ex-ante anti-competitive restrictions: barriers to entry, vertical integration and market conduct.[5] While the OECD-PMR database covers regulation in energy, communication and transports since 1975, only two observations (in 1996 and 2003) are available for professions.

Two measures of industry j dependence on service s $(w_{j,s})$ were recovered from input-output account matrices. The first measure, capturing direct dependence, is obtained as the ratio between the cost of service inputs and the value of industry output (the so-called "technical coefficients"). The second is recovered from the inverse Leontief matrix, whose coefficients account for both direct and indirect contributions of service s to the value of production in industry j.[6] In our baseline specification, service dependence will be computed based on the US input-output tables (*i.e.*, $w_{j,s} = w^{US}_{j,s}$). As in the rest of the literature following Rajan and Zingales (1998), we therefore start assuming that US input-output coefficients reflect technological differences rather than country-specific determinants, as the level of regulation itself.[7] Accordingly, the US is excluded from the sample. In the robustness section, however, we will exploit the availability of country-specific weights taken from the OECD input-output database to construct an alternative measure of service dependence not reflecting input intensities that are specific to a country or a level of regulation (Ciccone and Papaioannou, 2006). As we will see, the two approaches produce very similar results.

2.2 Alternative measures

The OECD has recently made available a measure of the relevance of service regulation (the

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[5] Entry barriers include measures distorting the structure of markets relative to a competitive outcome, as the conditions for third party access to electricity and gas transmission grids, the existence of legal limitations on the number of competitors in communications or to the number services each profession has an exclusive right to provide. Vertical integration measures whether a priori competitive activities (as electricity generation or the final supply of energy) are separated from natural monopolies such as the national grid. Finally, conduct regulation includes restrictions on prices and fees, advertising, the form of business etc. in professional services.

[6] These weights thus account for potential effects of anti-competitive service regulation working through industry j linkages with other, possibly non-regulated, industries in the economy. See the Data Appendix for more information on how the direct and indirect weights are obtained from the available input-output accounts.

[7] In our data, the US is the country featuring the lowest average level of service regulation for the longest time period (see the figure in the Supplementary Appendix).

Regulation Impact Indicator, *RII*) constructed in a way similar to *SERVREG*. Specifically, the *RII* is obtained as $RII_{j,c} = \sum_s w^c_{j,s} X^{RII}_{c,s}$, where $w^c_{j,s}$ are country-specific input-output coefficients and $X^{RII}_{c,s}$ are measures of service regulation from the PMR database. Service sectors *s* include energy, communication, transportation and professional services (as in our measure) and retail trade. Recent papers used the *RII* to study the relation between regulation and technology transfer (see Conway *et al*., 2006; Arnold *et al*., 2008). Despite the obvious similarities, there are several reasons to expect the *RII* would be less appropriate than *SERVREG* to study the relevance of service regulation in our framework. First, as already discussed, the Rajan and Zingales approach requires that input-output coefficients should be a measure of technological determinants of service dependence. Such condition would be hardly met using country-specific input-output coefficients as they might reflect unobserved determinants of service dependence at the country level, introducing potentially relevant sources of bias. If, in particular, country-specific weights are a combination of technological service dependence and country-specific shocks that are independent of other model determinants, then they would tend to distort the estimated coefficients towards zero (attenuation bias).[8] Second, given the focus on the relevance of services as input providers, unlike the *RII* our indicator excludes retail trade from the list of regulated services. Because it does not cover wholesale activities, the OECD measure of retail regulation is in fact based on information that is unlikely to matter for downstream performance.[9] Finally, while the index $X^{RII}_{c,s}$ accounts for all regulatory areas covered by the OECD regulation database, including for example the extent of public ownership, we focused on measures capturing ex-ante anti-competitive practices (as barriers to entry). As we will see, comparing the results obtained using the two measures confirms our concerns regarding the appropriateness of using the *RII* in our framework.

Assembling the data imposes constraints on the number of available observations: in particular, we are forced to restrict the analysis to a relatively limited growth period, starting in 1996. The reason is twofold: first indicators of regulation in professional services are available at earlier dates; second, the number of missing entries in value added data significantly increases shifting to earlier dates, due to both the reduction in the number of available countries and to changes in industry classification within each country.[10]

The main variables used in the empirical part are summarized and described in Tables 1 to 3.

3 Results

3.1 Regulation and output growth

Table 4 reports the results obtained from our baseline value added growth regression:

$$\hat{VA}_{j,c} = \alpha + \beta\ SERVREG_{j,c} + \phi\ SHARE_{j,c} + \mu_c + \mu_j + \varepsilon_{j,c}$$

where $\hat{VA}_{j,c}$ is the average (1996-2002) real value added growth in industry j a nd country c

8 On the other hand if country-specific weights respond to country-level regulation, the error in measurement could be non-classical and the direction of the bias undetermined a priori (see Ciccone and Papaioannou, 2006).

9 The retail trade indicator covers restrictions as the existence of barriers to entry in food distribution, limits to shops opening hours and price controls on products as food, pharmaceutical, tobacco and gasoline. Such retail activities have a very low relevance as input to manufactures: according to the 1997 US "use" matrix their purchase represented 0.1 per cent of manufacturing production (against 5.7 per cent of wholesale trade). Notice also that the OECD input-output matrices we use throughout the paper do not separate retail from wholesale trade, and would thus have provided an inappropriate weight for trade regulation.

10 For example, as early as in 1990 the number of observations falls by nearly 25 per cent with respect to 1996.

Table 1

Variables Definition and Sources

Variable	Definitions and Sources
Industry Level	
$w_{j,s}$	Industry dependence on service s, computed on 1997 US Input-Output accounts. It includes energy ($w_{j,ENERGY}$), telecommunications and post ($w_{j,TLCPOST}$), transports ($w_{j,TRANSP}$) and and professional services ($w_{j,PROSERV}$). Source: our calculations. See also the Data Appendix.
ED_j	Industry dependence on external finance, defined as capital expenditure minus internal funds. Source: de Serres *et al*. (2006) on Thomson Financial Worldscope database.
$LABINT_j$	Industry labor intensity measured as the ratio between employees and total assets in the US in 1996. Source: OECD STAN database (total assets are computed from investment data using the perpetual inventory method with a 15% depreciation rate).
$GROP_j$	Annual compounded growth rate of production in real terms in industry *j* in USA over the 1996-2002 period. Source: OECD STAN database.
$\hat{w}_{j,s}$	Industry dependence on service *s* net of regulation- and country-specific determinants of inputs demand. For each of the four service sectors $\hat{w}_{j,s}$ have been estimated according to the following two-steps procedure (see also Ciccone and Papaioannou, 2006): (*a*) Regress country-specific input-output coefficients $w_{j,s,c}$ on country dummies, industry dummies and industry dummies interacted with country-level regulation in sector *s*; the most deregulated country $\bar{c}$ is excluded from the regression and the estimation follows Papke and Wooldridge (1996) to account for the fact that the dependent variable is fractional. (*b*) Obtain $\hat{w}_{j,s}$ as the fitted values of $w_{j,s,c}$ when regulation is set at country $\bar{c}$ levels and country fixed effects are set to zero. Country $\bar{c}$ is set to either the USA sectors (Table 7, column 5) or Great Britain (for energy and transport), USA (*TLCPOST*) and Finland (*PROSERV*) for *ENERGY* and *TRANSP*, *TLCPOST* and *PROSERV*, respectively (Table 7, column 6).
$GLOPP_{j,s}$	Estimated world-average industry growth opportunities. For each of the four service sectors global opportunities ($GLOPP_j$) are the estimated industry value added growth over the period 1996-2002 obtained according to the following two-steps procedure (see also Ciccone and Papaioannou, 2006): (*a*) Regress $GROWTH_{j,c}$ on country dummies, industry dummies and industry dummies interacted with country-level regulation in sector *s*; the USA are excluded from the regression. (*b*) Obtain $GLOPP_j$ as the predicted values of $GROWTH_{j,c}$ for the USA.
Country Level	
$X_{c,s}$	Regulation indexes on a 0-6 scale (from least to most restrictive conditions) in 1996 in four non-manufacturing industries. $X_{c,s}$ includes $X_{c,\ ENERGY}$, $X_{c,\ TLCPOST}$, $X_{c,TRANSP}$, $X_{c,PROSERV}$ referring to energy (electricity and gas), communications (posts and telecommunications), transports (air, rail and road), professional services (legal, accounting, engineering and architects). Source: OECD Product market Regulation database. $X_{c,\ ENERGY}$ takes into account entry barriers and the degree of vertical integration in electricity and gas supply; $X_{c,\ TLCPOST}$ accounts for entry barriers in postal and telecommunications services; $X_{c,TRANSP}$ accounts for entry barriers in air, rail and road services and on vertical integration in rail; $X_{c,PROSERV}$ accounts for entry barriers and the regulation of market conduct in legal services, accounting services, engineers and architects. See also Data Appendix.
FD_c	Financial development in country *c* measured as Private Credit by Deposit Money Banks over GDP in 1996. Source: World Bank's financial development and structure database (based on IMF's Financial Statistics).
$ACCSTAN_c$	Indicator of financial disclosure in 1983. Source: Rajan and Zingales (1998).
LMR_c	Indicator of employment protection in 1988-1995. Source: Fonseca and Utrero (2005).
$COST_c$	Direct start-up costs of obtaining legal status to operate a firm as a share of per capita GDP in 1999. Source: Djankov *et al.* (2002).

Table 1 (continued)

Variables Definition and Sources

Variable	Definitions and Sources
Industry – Country Level	
$GROWTH_{j,c}$	Annual compounded growth rate of real value added in industry j in country c over the 1996-2002 period. Source: OECD STAN database.
$NGROWTH_{j,c}$	Annual compounded growth rate of nominal value added in industry j in country c over the 1996-2002 period. Source: OECD STAN database.
$DEFGROWTH_{j,c}$	Annual compounded growth rate of the value added implicit deflator in industry j in country c over the 1996-2002 period. Source: OECD STAN database.
$LPGROWTH_{j,c}$	Annual compounded growth rate of labor productivity (value added at constant prices per employee) in industry j in country c over the 1996-2002 period. Source: OECD STAN database.
$EXGROWTH_{j,c}$	Annual compounded growth rate of exports at constant prices (current exports are deflated with the value added deflator) in industry j in country c over the 1996-2002 period. Source: OECD STAN database.
$SHARE_{j,c}$	Share of industry j in total value added in manufacturing in country c in 1996. Source: OECD STAN database.
$EXSHARE_{j,c}$	Share of industry j in exports in manufacturing in country c in 1996. Source: OECD STAN database.
$LLP_{j,c}$	Natural logarithm of labor productivity (value added at constant prices per employee) in industry j in country c in 1996. Source: OECD STAN database.
$SERVREG_{j,c}$	Index of exposure of manufacturing industry j to regulation in four service sectors (energy, communications, transport and professional services). It is computed as $\sum_s w_{j,s} X_{c,s}$ where s = *ENERGY*, *TLCPOST*, *TRASP*, *PROSERV*. Source: OECD Product market Regulation database and USA 1997 Input-Output accounts.
$DSERVREG_{j,c}$	Difference between $SERVREG_{j,c}$ in 1996 and in 2002. Source: OECD Product market Regulation database and USA 1997 Input-Output accounts.
$POWN_{j,c}$	Index of exposure of manufacturing industry j to the degree of public ownership in three service sectors (energy, communications, transport). It is computed as $\sum_s w_{j,s} POWN_{c,s}$ where $POWN_{c,s}$ is an index measuring on a 0-6 scale (increasing with the role of public sector) the degree of public ownership in 1996 and s = *ENERGY*, *TLCPOST* and *TRASP*. Source: OECD Product market Regulation database and USA 1997 Input-Output accounts.
$FDIREG_{j,c}$	Index of exposure of manufacturing industry j to restriction to foreign investment in four service sectors. It is computed as $\sum_s w_{j,s} Z_{c,s}$ where $Z_{c,s}$ are FDI restriction indicators in electricity, telecommunications, transport and professional services. Source: Koyama and Golub (2006) and USA 1997 Input-Output accounts.

Table 2

Summary Statistics

Variable	Obs	Mean	St. Dev.	Min	Max
Industry Level					
Dependence on energy [$w_{j,ENERGY}$]	15	0.018	0.010	0.007	0.039
Dependence on communications [$w_{j,TLCPOST}$]	15	0.004	0.001	0.002	0.007
Dependence on transports [$w_{j,TRANSP}$]	15	0.030	0.014	0.011	0.063
Dependence on professional services [$w_{j,PROSERV}$]	15	0.027	0.011	0.013	0.055
External dependence [ED_j]	15	0.697	1.595	–0.450	6.200
Labor intensity [$LABINT_j$]	15	0.028	0.013	0.004	0.052
Growth opportunities [$GROP_j$]	15	0.010	0.029	–0.028	0.093
Country Level					
Regulation in energy in 1996 [$X_{c,ENERGY}$]	16	4.475	1.338	1.808	6.000
Regulation in communications in 1996 [$X_{c,TLCPOST}$]	16	2.868	1.614	0.000	5.680
Regulation in transports in 1996 [$X_{c,TRASP}$]	16	2.949	1.062	1.530	5.133
Reg. in professional services in 1996 [$X_{c,PROSERV}$]	16	2.464	1.160	0.830	4.178
Financial development [FD_c]	16	0.718	0.272	0.304	1.141
Labor market regulation [LMR_c]	16	1.359	0.491	0.300	1.933
Red tape costs [$COST_c$]	16	0.146	0.141	0.012	0.586
Financial disclosure [$ACCSTAN_c$]	16	0.647	0.122	0.420	0.810
Industry – Country Level					
Value added growth 1996-2002 (real terms) [$GROWTH_{j,c}$]	220	0.018	0.034	–0.081	0.204
Val. added gr. 1996-2002 (nominal terms) [$NGROWTH_{j,c}$]	220	0.032	0.038	–0.123	0.221
Implicit deflator growth 1996-2002 [$DEFGROWTH_{j,c}$]	220	0.014	0.030	–0.095	0.189
Labor productivity growth 1996-2002 [$LPGROWTH_{j,c}$]	220	0.025	0.026	–0.051	0.162
Export growth 1996-2002 [$EXGROWTH_{j,c}$]	205	0.050	0.050	–0.094	0.194
Value added share in 1996 [$SHARE_{j,c}$]	220	0.069	0.047	0.001	0.234
Log labor productivity in 1996 [$LLP_{j,c}$]	220	3.864	0.481	2.821	6.932
Export share in 1996 [$EXSHARE_{j,c}$]	220	0.068	0.068	0.000	0.364
Service regulation [$SERVREG_{j,c}$]	220	0.246	0.109	0.070	0.628
Change in service deregulation [$DSERVREG_{j,c}$]	220	0.080	0.054	0.001	0.291

Table 3

Correlation Between Regulation Indicators in Four Service Sectors in 1996

	Energy [$X_{c,ENERGY}$]	**Communications** [$X_{c,TLCPOST}$]	**Transports** [$X_{c,TRASP}$]	**Prof. Serv.** [$X_{c,PROSERV}$]
Energy [$X_{c,ENERGY}$]	1.000			
Communications [$X_{c,TLCPOST}$]	0.549	1.000		
Transports [$X_{c,TRASP}$]	0.801	0.541	1.000	
Professional services [$X_{c,PROSERV}$]	0.497	0.519	0.645	1.000

Table 4

Service Regulation and Growth

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline, Direct Weights	**Baseline, Indirect Weights**	**Financial Development 1**	**Financial Development 2**	**Average 1996-02 Regulation**	**Deregulation (1996-2002)**
Service regulation	–0.172*	–0.170*	–0.176**	–0.158*	–0.198**	–0.287**
[$SERVREG_{j,c}$]	*(0.069)*	*(0.072)*	*(0.068)*	*(0.071)*	*(0.075)*	*(0.080)*
Financial dev. × external dep.			0.010*		0.011*	0.009*
[$FD_c \times ED_j$]			*(0.004)*		*(0.004)*	*(0.004)*
Accounting stand. × ext. dep.				0.013+		
[$ACCSTAN_c \times ED_j$]				*(0.007)*		
Change in service regulation						0.320**
[$DSERVREG_{j,c}$]						*(0.116)*
Initial industry share	0.189**	0.198**	0.169*	0.187**	0.174**	0.163**
[$SHARE_{j,c}$]	*(0.071)*	*(0.069)*	*(0.067)*	*(0.072)*	*(0.066)*	*(0.062)*
Constant	0.037	0.048+	0.006	–0.001	0.005	0.014
	(0.023)	*(0.025)*	*(0.019)*	*(0.020)*	*(0.019)*	*(0.019)*
Observations	220	220	220	220	220	220
R^2	0.66	0.66	0.67	0.67	0.68	0.69

+ significant at 10 per cent; * significant at 5 per cent; ** significant at 1 per cent.

Notes:
The dependent variable is the annual compounded growth rate of real value added at the country-industry level for the period 1996-2002 ($GROWTH_{j,c}$).
$SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s w_{j,s} * X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases.
Service regulation ($X_{c,s}$) is measured in 1996 except in column 5, where it is the 1996-2002 average value.
Interaction weights $w_{j,s}$ are ("direct") technical coefficients of dependence between service sector s and manufacturing industry j computed on the 1997 USA Input-Output matrix, except for column 2, where they are measured to account for both direct and indirect dependence (see the Data Appendix for computational details).
Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (FD_c, column 3) and as accounting standards in 1983 ($ACCSTAN_c$, column 4). It is interacted with External dependence (ED_j), an industry-level measure of reliance on external finance obtained from US firm-level data. Both interactions follow Rajan and Zingales (1998). $DSERVREG_{j,c}$ measures exposure to service deregulation obtained as $\Sigma_s w_{j,s} * \Delta X_{c,s}$, where $\Delta X = X_{1996} - X_{2002}$ is the 1996-2002 change in regulation of service s in country c.
$SHARE_{j,c}$ indicates the industry share in total value added in manufacturing in 1996.
All regressions include country- and industry-fixed effects and use (employment) weighted least squares as estimation method.
Robust standard errors are reported in parentheses.

$SHARE_{j,c}$ is the beginning-of-period value-added industry share, and μ_c and μ_j a re country- and industry-specific fixed-effects. As explained above, $SERVREG_{j,c}$ captures differences in the relevance of service regulation in country c for each manufacturing industry j. Regulation indicators are measured in 1996. There is a negative link between regulation and growth if $\beta < 0$.

The coefficient reported in column 1 of Table 4 indicates that lowering beginning-of-period anti-competitive regulation in the provision of services has a significant and positive effect on growth. One way to get a sense for the size of this effect is thinking of the annual value added growth differential between an industry with overall service-dependence $\left(D_j = \sum_s w_{j,s}\right)$ at the 75th percentile (Pulp, paper and printing) and an industry at the 25th percentile (Fabricated metal products). The coefficient estimated in column 1 implies this differential would rise by approximately 0.75 per cent if regulation were to be uniformly lowered in the four services by an amount corresponding to the difference in average regulation between the 75th (France) to the 25th (Canada) most regulated countries. For comparison, the median value added growth rate in our sample is 1.8 per cent. This finding is confirmed irrespective of which of the two available measures of industry dependence on regulated services $(w_{j,s})$ we use. This can be seen in column 2, where we replicate the previous regression using the so-called Leontief transformation of the technical coefficients, thus accounting for both direct and indirect inter-sectoral relationships. While the point estimate is unchanged, the implied effect of service deregulation would be slightly larger (about 1 per cent) in this case.[11]

A first important robustness check for the above findings consists in accounting for the well-documented empirical nexus between finance and industry growth. This is obtained augmenting the baseline specification with two alternative measures of financial development, both proposed by Rajan and Zingales (1998). Column 3 focuses on the ratio of bank credit to GDP, while column 4 considers accounting standards. In both cases, the interaction term is US industry external finance dependence. Neither of the two variables affects the relevance of service regulation. On the other hand, financial development confirms as a significant growth determinant. The coefficient estimated in column 3, for example, implies the growth differential between an industry at the 75th percentile and one at the 25th percentile of external finance dependence (Plastic products and Pulp and paper, respectively) would increase of approximately 0.2 per cent moving from a country with private credit at the 25th percentile to a country close to the 75th percentile of financial development (Norway and the Netherlands, respectively).

The last two columns in Table 4 test the robustness of our estimate to changes in the regression specification. In column 5 we focus on the relationship between industry growth and average (as opposed to initial) service regulation in 1996-2002 using initial regulation as instrument, an approach recently followed in the financial development literature. Results are slightly stronger than in previous specification. Finally, in column 6 we account for the possibility that our estimates are at least in part capturing the effects of changes in regulation occurred between 1996 and 2002. This would be the case if countries with high initial regulation implemented relatively stronger subsequent deregulation processes, and regulation has level-effects on value added. We checked for this possibility augmenting the regression with a measure ($DSERVREG = SERVREG_{96} - SERVREG_{02}$) that is increasing in the extent of deregulation. The positive and significant coefficient attracted by *DSERVREG* does in fact indicate that, holding

11 The positive coefficient we estimate on initial shares, indicating that countries tend to experience relatively faster growth in those industries they are more specialized in, is in contrast with results obtained by most of the comparable literature. While apparently puzzling, this finding can be explained by the large weight Western European countries have in our sample. The recent intense process of economic and monetary integration seems in fact to have resulted in increased industrial specialization in these countries (see Midelfart *et al*., 2003).

beginning-of-period regulation constant, value added growth in service intensive industries benefits from higher deregulation.[12] But our baseline estimate is, if anything, larger than in previous specifications.

3.2 Output and price effects

Several works adopting the Rajan-Zingales approach noticed that the empirical relevance of the finance-growth nexus is subject to strong variability depending on the countries included in the sample (Favara, 2003), and loses statistical significance as developing countries are omitted (Carlin and Mayer, 2003; Manning, 2003).[13] Building on time-series results as those in Rousseau and Wachtel (1998), one proposed explanation for this finding is that alternative financial instruments (as equity, debt, and derivative markets) may substitute for credit availability in advanced economies. But the significant coefficients we estimated in Table 4, obtained examining a sample of OECD countries, suggest we should look for a different explanation.

In a world where high-income countries tend to produce differentiated goods, one way to reconcile our findings with the literature is thinking of a possible counteracting role of prices. While we look at the growth of output (as measured by value added at constant prices), most of the existing cross-country cross-industry papers use nominal value added data. As shown at the end of Section 2, if lower regulation raises output in service-intensive industries by lowering the service component of the cost of production, then there are two countervailing effects on nominal value added: a positive effect due to higher output and a negative effect due to lower prices. Their combination will tend to weaken the relation between service underdevelopment and industry output when this is measured in nominal terms.

We explore this issue in greater detail in Table 5, estimating the effects of regulation on industry prices. We do in fact find that, among OECD countries, lower regulation and higher financial development translate into lower prices in service-intensive manufacturing industries (Table 5, columns 1 to 3). As a result, when we replicate the real value added analysis of Table 4 using nominal value added the effect becomes, as in above mentioned works, largely insignificant (Table 5, columns 4 to 6). Even so, the issue remains of why using nominal output does allow estimating significant effects when the sample includes a large share of less developed countries. According to the above argument, one possibility is that less developed countries produce more homogeneous commodities relative to advanced countries, facing a higher elasticity of demand. In this case, the counteracting effect of prices would become less and less relevant, on average, as the share of developing countries in the sample increases allowing to recover significant estimates even with nominal data.

3.3 Regulation, productivity and exports

Does lower regulation improve productive efficiency or are the estimated value added growth differentials absorbed by offsetting shifts in industry employment? Despite its relevance, the interaction between service regulation and labour productivity has so far received relatively

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12 To get a sense for the size of this effect, consider the comparison between a country with deregulation at the 75th percentile (e.g., Germany) and a country at the 25th percentile (e.g., Japan). Our estimates imply an annual growth gap between the industry at the 75th and the industry at the 25th percentile of service-intensity of nearly 1 per cent.

13 Using the same dataset (UNIDO Industrial Statistics) and regression specification of Rajan and Zingales (1998) we found, for example, that their baseline estimate (0.118, with a standard deviation of 0.037, see Table 4, column 2 of Rajan and Zingales, 1998) falls to –0.004 (0.019) when the analysis is restricted to OECD countries, and to –0.021 (0.017) when further focusing on the sub-sample of developed countries we use here.

Table 5

Financial Development, Prices and Nominal Growth

	Prices			Nominal Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
	Service Regulation	**Financial Development**	**Regulation and Fin. Dev.**	**Service Regulation**	**Financial Development**	**Regulation and Fin. Dev.**
Service regulation	0.210^{**}		0.211^{**}	–0.004		–0.006
[$SERVREG_{j,c}$]	*(0.072)*		*(0.070)*	*(0.078)*		*(0.078)*
Financial dev. × external dep.		-0.009^{*}	-0.009^{*}		0.005	0.005
[$FD_c \times ED_j$]		*(0.005)*	*(0.004)*		*(0.005)*	*(0.004)*
Initial industry share				0.027	0.017	0.017
[$SHARE_{j,c}$]				*(0.049)*	*(0.048)*	*(0.050)*
Constant	0.015	0.056^{**}	0.019	0.037^{*}	0.036^{**}	0.037^{*}
	(0.014)	*(0.006)*	*(0.013)*	*(0.016)*	*(0.012)*	*(0.016)*
Observations	220	220	220	220	220	220
R^2	0.62	0.60	0.63	0.64	0.64	0.64

$^{+}$ significant at 10 per cent; * significant at 5 per cent; ** significant at 1 per cent.

Notes:
In columns 1-3 the dependent variable is the annual compounded growth rate of value added implicit deflator at the industry-country level for the period 1996-2002 ($DEFGROWTH_{j,c}$); in columns 4-6 the dependent variable is the annual compounded growth rate of nominal value added at the industry-country level for the period 1996-2002 ($NGROWTH_{j,c}$). $SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s w_{j,s} * X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation ($X_{c,s}$) is measured in 1996. Interaction weights $w_{j,s}$ are ("direct") technical coefficients of dependence between service sector *s* and manufacturing industry *j* computed on the 1997 USA Input-Output matrix. Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (FD_c) and is interacted with External dependence (ED_j), an industry-level measure of reliance on external finance obtained from US firm-level data. $SHARE_{j,c}$ indicates the industry share in total value added in manufacturing in 1996. All regressions include country- and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

little empirical attention. Our cross-country and industry results indicate that service regulation has a significant impact on the growth rate of value added per worker in service intensive industries (see Table 6, panel A). This finding is robust to accounting for financial development or by changing the regression specification, as in Table 4. To get a sense for the economic relevance of the estimated coefficients, consider the annual productivity growth differential between Pulp and paper and Fabricated metal products (the two industries at the 75^{th} and 25^{th} percentile of the distribution of service-dependence, respectively). The coefficient in column 1 implies this growth differential is approximately 0.9 per cent larger in a low than in a high regulation country (respectively Canada and France). For comparison, the median productivity growth rate in our sample is 2.2 per cent.

Table 6

Service Regulation, Productivity and Exports

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline, Direct Weights	**Baseline, Indirect Weights**	**Financial Development 1**	**Financial Development 2**	**Average 1996-02 Regulation**	**Deregulation (1996-2002)**
Panel A: Productivity Growth						
Service regulation	–0.201*	–0.218*	–0.202*	–0.194*	–0.228*	–0.280**
[$SERVREG_{j,c}$]	*(0.081)*	*(0.100)*	*(0.080)*	*(0.085)*	*(0.090)*	*(0.106)*
Financial dev. × external dep.			0.009		0.010	0.008
[$FD_c \times ED_j$]			*(0.006)*		*(0.006)*	*(0.005)*
Accounting stand. × ext. dep.				0.006		
[$ACCSTAN_c \times ED_j$]				*(0.006)*		
Change in service regulation						0.228
[$DSERVREG_{j,c}$]						*(0.158)*
Initial labor productivity	0.031**	0.032*	0.028*	0.031**	0.030**	0.030**
[$LLP_{j,c}$]	*(0.012)*	*(0.012)*	*(0.012)*	*(0.012)*	*(0.011)*	*(0.011)*
Constant	–0.079+	–0.062	–0.069	–0.082+	–0.073	–0.066
	(0.047)	*(0.048)*	*(0.047)*	*(0.047)*	*(0.046)*	*(0.045)*
Observations	220	220	220	220	220	220
R^2	0.58	0.58	0.59	0.58	0.60	0.60
Panel B: Export Growth						
Service regulation	–0.213+	–0.249*	–0.215*	–0.202+	–0.242*	–0.297*
[$SERVREG_{j,c}$]	*(0.108)*	*(0.111)*	*(0.106)*	*(0.108)*	*(0.119)*	*(0.121)*
Financial dev. × external dep.			0.005		0.006	0.005
[$FD_c \times ED_j$]			*(0.007)*		*(0.007)*	*(0.006)*
Accounting stand. × ext. dep.				0.010		
[$ACCSTAN_c \times ED_j$]				*(0.013)*		
Change in service regulation						0.229
[$DSERVREG_{j,c}$]						*(0.179)*
Initial industry export share	–0.013	–0.007	–0.017	–0.015	–0.016	–0.024
[$EXSHARE_{j,c}$]	*(0.054)*	*(0.053)*	*(0.052)*	*(0.055)*	*(0.052)*	*(0.050)*
Constant	0.060**	0.081**	0.059**	0.055**	0.007	0.070**
	(0.018)	*(0.025)*	*(0.018)*	*(0.019)*	*(0.023)*	*(0.019)*
Observations	205	205	205	205	205	205
R^2	0.72	0.72	0.72	0.72	0.72	0.72

+ significant at 10 per cent; * significant at 5 per cent; ** significant at 1 per cent.

Notes to Table 6:
In Panel A, the dependent variable is the annual compounded growth rate of labor productivity (value added per employed worker) at the industry-country level for the period 1996-2002 ($LPGROWTH_{j,c}$).
In Panel B, the dependent variable is the annual compounded growth rate of exports at the industry-country level for the period 1996-2002 ($EXPGROWTH_{j,c}$).
$SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s\, w_{j,s}*X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases.
Service regulation ($X_{c,s}$) is measured in 1996 except in column 5, where it is the 1996-2002 average value. Interaction weights $w_{j,s}$ are ("direct") technical coefficients of dependence between service sector s and manufacturing industry j computed on the 1997 USA Input-Output matrix, except for column 2, where they are measured to account for both direct and indirect dependence (see the Data Appendix for computational details).
Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (*FDc*, column 3) and as accounting standards in 1983 ($ACCSTAN_c$, column 4). It is interacted with External dependence (*EDj*), an industry-level measure of reliance on external finance obtained from US firm-level data. Both interactions follow Rajan and Zingales (1998).
$DSERVREG_{j,c}$ measures exposure to service deregulation obtained as $\Sigma_s\, w_{j,s}*\Delta X_{c,s}$, where $\Delta X = X_{1996} - X_{2002}$ is the 1996-2002 change in regulation of service s in country c.
$LLP_{j,c}$ indicates the log of labor productivity in 1996. $EXSHARE_{j,c}$ indicates the industry share in total exports in manufacturing in 1996.
All regressions include country- and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

Finally, we exploited the availability of industry data on exports to explore whether the sectoral reallocation patterns implied by our value added results correspond to changes in international specialization. Results reported in panel B of Table 6 indicate that service regulation is an important determinant of comparative advantages. Throughout all the empirical specifications adopted in the previous tables we find that exports by service intensive industries tend to grow disproportionately more in countries with low levels of service regulation. The usual thought experiment yields an increase of about 1 per cent in the 25th-75th industry growth differential following a reduction in regulation.

All in all, our empirical findings point to the existence of non-negligible indirect effects of lack of competition in upstream markets for the patterns of international specialization and comparative advantages.

4 Robustness

Having established our baseline findings, we proceeded to a number of robustness checks considering the potential confounding role of regulation in other markets, the appropriateness of US weights as a measure of service dependence, the role of influential observations and the suitability of our measure of regulation impact compared to other possible measures.

4.1 The role of product and labour market regulation

We first considered the possibility that our estimates are driven by omitted country-industry shocks not captured by either country or industry fixed-effects and correlated with service regulation. If regulation is a countrywide phenomenon, our findings might in particular be capturing anti-competitive measures targeting other markets, as the labour or the product market.

We checked for this possibility augmenting the baseline specification with regulation-related variables, which have been shown to significantly affect industry growth. In columns 1 and 2 of Table 7 we accounted for country-level measures of employment protection and administrative (red-tape) barriers to entrepreneurships (Djankov *et al.*, 2002; Nicoletti and Scarpetta, 2003;

Table 7

Robustness Check

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Other Regulation Measures					**Weights**		**Influential Obs.**	
	Employee Protection	**Red Tape**	**FDI Regulation**	**Public Ownership**	**All**	**IV - US**	**IV-lowest Country**	**Most/least Dependent Industries**	**Most/least Regulated Countries**
Service regulation	–0.191**	–0.203**	–0.182**	–0.232**	–0.272**	–0.193*	–0.218*	–0.274**	–0.180*
[$SERVREG_{j,c}$]	*(0.071)*	*(0.067)*	*(0.068)*	*(0.074)*	*(0.073)*	*(0.087)*	*(0.105)*	*(0.088)*	*(0.072)*
Fin. dev. × external dep.	0.011**	0.010*	0.011**	0.010**	0.012**	0.010*	0.010*	0.008*	0.013**
[$FD_c \times ED_j$]	*(0.004)*	*(0.004)*	*(0.004)*	*(0.004)*	*(0.004)*	*(0.004)*	*(0.004)*	*(0.004)*	*(0.004)*
Lab. market reg. × lab. int.	–0.400				–0.578+				
[$LMR_c \times LABINT_j$]	*(0.323)*				*(0.304)*				
Red tape costs × gr. opp.		–1.449+			–1.599+				
[$COST_c \times GROP_j$]		*(0.871)*			*(0.871)*				
FDI restrictions			0.879		0.807				
[$FDIREG_{j,c}$]			*(0.794)*		*(0.806)*				
Public ownership				0.084+	0.059				
[$POWN_{j,c}$]				*(0.047)*	*(0.047)*				
Initial industry share	0.182**	0.135+	0.167*	0.152*	0.135*	0.167*	0.165*	0.155*	0.184*
[$SHARE_{j,c}$]	*(0.067)*	*(0.069)*	*(0.067)*	*(0.063)*	*(0.066)*	*(0.068)*	*(0.068)*	*(0.071)*	*(0.073)*
Constant	0.019	0.015	–0.009	0.003	0.020	0.039	0.014	0.055*	0.035
	(0.024)	*(0.019)*	*(0.022)*	*(0.019)*	*(0.025)*	*(0.025)*	*(0.026)*	*(0.027)*	*(0.024)*
Observations	220	220	220	220	220	220	220	188	193
R^2	*0.68*	*0.68*	*0.68*	*0.68*	*0.70*	*0.67*	*0.67*	*0.67*	*0.69*

+ significant at 10 per cent; * significant at 5 per cent; ** significant at 1 per cent.

Notes to Table 7:
The dependent variable is the annual compounded growth rate of real value added at the industry-country level for the period 1996-2002 ($GROWTH_{j,c}$). $SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s w_{j,s}*X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation ($X_{c,s}$) is measured in 1996. Interaction weights $w_{j,s}$ are ("direct") technical coefficients of dependence between service sector *s* and manufacturing industry *j* computed on the 1997 USA Input-Output matrix.
Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (FD_c) and is interacted with External dependence (ED_j), an industry-level measure of reliance on external finance obtained from US firm-level data.
Labor market regulation (LMR_c) is an indicator of employment protection in 1988-95 and is interacted with labor intensity ($LABINT_j$) computed as the ratio between employees and total assets in the USA in 1996. Red tape costs ($COST_c$) are direct start-up costs of obtaining legal status to operate a firm as a share of per capita GDP in 1999; this variable is interacted with growth opportunities ($GROP_j$) measured as the growth rate of real value added growth in industry *j* in USA over the 1996-2002 period.
FDI restrictions in services ($FDIREG_{j,c}$) is an index of exposure of each manufacturing industry *j* to the degree of FDI regulation in four service sectors (electricity, telecommunications, transport and professional services). It is computed as $\sum_s w_{j,s} Z_{c,s}$ where *s* = *ELECTRICITY*, *TLCPOST*, *TRASP*, *PROSERV* where $Z_{c,s}$ are FDI restriction indicators on a 0-1 scale (increasing with the degree of restrictiveness). Weights $w_{j,s}$ are the technical coefficients computed on the USA 1997 Input-Output matrix (see also Data Appendix). Public ownership ($POWN_{j,c}$) is an index of exposure of industry *j* to the degree of public ownership in services. It is computed as $\sum_s w_{j,s} POWN_{c,s}$ where $POWN_{c,s}$ is an index measuring on a 0-6 scale (increasing with the role of public sector) the degree of public ownership in 1996 and *s* = *ENERGY*, *TLCPOST* and *TRASP*.
Columns 6 and 7 report IV estimates obtained using $\sum_s \hat{w}_{j,s} X_{c,s}$ as instrument for $SERVREG_{j,c}$. $\hat{w}_{j,s}$ is the estimated industry *j*'s dependence on service *s* net of regulation- and country-specific determinants of factor demand.
See Table 1 and Section 5 in the main text for more information on the IV approach.
Results in columns 8 and 9 are obtained removing from the sample the most and least intensive industrial users of regulated services ("Other non-metallic mineral products" and "Machinery and equipment N.E.C.") and the most and least service-regulated countries (Greece and Sweden), respectively.
$SHARE_{j,c}$ is the industry share in total value added in manufacturing in 1996.
All regressions include country- and industry-fixed effects and use (employment) weighted least squares as estimation method.
Robust standard errors are reported in parentheses.

Bassanini *et al.* 2009). Both variables are negatively related to industry growth, although the relationship is statistically significant only in the case of labour market regulation. On the other hand, the estimated impact of services regulation is unaffected. The next two columns show that our results are robust to accounting for alternative forms of regulation in services, as restrictions to foreign direct investment (column 3), or the extent of public ownerships in energy, transportation and communication services (column 4). Finally, column 5 shows robustness to accounting for all regulation variables simultaneously. The Supplementary Appendix reports further robustness checks to alternative channels highlighted by the literature on the determinants of international specialization and comparative advantages.[14]

4.2 The appropriateness of US weights

We next dealt with the possibility that using input-output weights from a benchmark country does not allow to correctly measure technological dependence on service inputs because country-specific weights differ from "true" weights by a idiosyncratic component. Such component could be unrelated to other determinants of industry growth, a case in which our estimates would be subject to standard attenuation bias, or depend on the level of regulation itself, so that using a

[14] In particular, we show our estimates are unaffected when accounting for the role of human and physical capital (as in Ciccone and Papaioannou, 2007) and property rights (Claessens and Laeaven, 2003) in value added growth regressions; and for the role of institutional quality and contract enforcement in export regressions (we used the same specifications as in Levchenko, 2007 and Nunn, 2007, respectively).

benchmark country would induce a priori ambiguous biases in the estimated coefficients (Ciccone and Papaioannou, 2006). These considerations suggest that neither choosing a different benchmark country nor using an average of input-output weights recovered from multiple sources would solve the measurement problems. An alternative procedure consists in recovering a measure of average service-dependence not reflecting input intensities specific to a country or to a level of regulation, and use it as an instrument for the benchmark-country index of service-dependence. Following Ciccone and Papaioannou (2006), one such measure was estimated for each service sector *s* in two steps. First, we regressed country-industry weights $w_{j,c}$ on country dummies, industry dummies and industry dummies interacted with country-level regulation in sector *s*, to estimate the marginal effect of regulation on industry dependence: $w_{j,c} = \mu_j + \mu_c + \delta_j X_c + \varepsilon_{j,c}$.[15] In this regression, the most deregulated country $\bar{c}$ is excluded from the sample. Second, we estimated $\hat{w}_{j,\bar{c}}$ as the fitted values of $w_{j,c}$ when regulation is set at the minimum observed value $(X_{\bar{c}})$ and country-specific averages are set to zero: $\hat{w}_j = \hat{\mu}_j + \hat{\delta}_j X_{\bar{c}}$. The fitted weights $\hat{w}_{j,\bar{c}}$ will therefore not reflect input intensities that are regulation or country-specific, and can be used as instruments for US weights in the empirical specification.

The results obtained following this procedure are reported in columns 6 and 7 of Table 7 and confirm the negative role of anti-competitive service regulation for growth. The only difference between the two columns consists in the choice of the country excluded from the service-specific first stage regressions. In column 6, we excluded the US, the country with the lowest levels of regulation from an historical perspective. In column 7, we excluded the least regulated country in each service sector in 1996 (the US for communications, the UK for energy and transportation, Finland for professional services).

4.3 *The role of influential observations*

The last two columns of Table 8 report results obtained removing from the sample the most and the least service intensive industries (Other non metallic mineral products and Machinery and equipment, respectively; column 8), and the most and the least regulated countries (Greece and Sweden, respectively; column 9). The estimated coefficient on the growth effect of service regulation is robust to both exercises.

4.4 *Alternative definitions of regulation impact*

Two recent papers used the OECD Regulation Impact Indicator (*RII*) described in Section 3 to estimate the effect of regulation on productivity growth in a time-series framework (Conway *et al.*, 2006; Arnold *et al.*, 2008). In their analyses, productivity growth in an industry is expressed as a function of regulation and of the industry "technological distance" from the frontier (*i.e.*, from the country with the highest productivity level).[16] The latter variable, a measure of the potential for technology transfer, allows estimating the speed of convergence to the productivity leader. In this context, regulation is allowed for both direct and indirect (*i.e.*, through the speed of convergence) effects on growth. Both papers find that higher regulation hinders productivity growth by slowing the speed of convergence to the technological frontier. In the sub-sample of ICT

[15] The regressions account for the fact that the dependent variable is fractional (Papke and Wooldridge, 1996).

[16] The empirical analysis moves from a first-order autoregressive distributed lag model [ADL(1,1)] where own productivity is cointegrated with frontier productivity. In the long run, this has an Error Correction Model (ECM) representation, which is the relationship estimated in the two papers.

intensive (mainly service) industries they also find evidence of direct effects of regulation on growth.

Despite the two works differ from ours in many dimensions, it is important to empirically assess the relevance and robustness of our findings against the OECD Regulation Impact Indicator. In the Supplementary Appendix we report results obtained when (*a*) the *RII* replaces *SERVREG* in our baseline specifications, and (*b*) the *RII* is added to our baseline specifications. The results suggest that the OECD indicator tends to understate the relevance of service regulation for industry growth, thus confirming our concerns regarding its appropriateness in our framework (see Section 3). On one hand, using the *RII* as main explanatory variable yields to estimate non-significant effects of regulation on two out of three of the outcomes we focus on (productivity and exports). When significant, the coefficient estimated using the *RII* implies much lower gains from deregulation with respect to what we obtained using *SERVREG*. In particular, the implied effect of a one standard deviation reduction in regulation on value added industry growth would be nearly 50 per cent lower. Finally, all estimates obtained using *SERVREG* are robust to contemporaneously adding the *RII*, whose impact on growth is not statistically significant (or even positive).[17]

5 Extensions

To further qualify the role of service regulation in the next sections we focus on two potential dimensions of heterogeneity in the estimated average coefficient: by size of the regulated market and by regulated service.

5.1 Service regulation and country size

The benefits from lower regulation might vary with the extent of the regulated market. Recent cross-country evidence by Hoekman *et al*. (2004) showed, for example, that the positive relation between entry barriers and average mark-ups in manufacturing is substantially higher in large than in small countries. In a world with imperfect competition and fixed costs of production this would happen if the level of existing regulatory barriers (e.g., licenses) is such that there is greater scope for profitable entry in larger than in smaller economies. In our setting, the positive effects of lower service regulation could therefore be stronger in countries characterized by a larger extent of demand by downstream industries.

We checked for this possibility splitting the sample in two groups of large and small OECD countries. Large countries account for nearly 90 per cent of total manufacturing employment in our data.[18] Table 8 reports the results obtained estimating alternative specifications of the value added growth regression in the two sub-samples and compares it to the average coefficient. In all cases, our evidence indicates that previous results are determined by the positive growth effects of lower

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17 The Supplementary Appendix also reports results obtained considering a third measure of regulation impact, computed to highlight the relevance of using benchmark-country (or "global") indicators of service dependence. Such measure is obtained interacting the ex-ante anti-competitive regulation index we use throughout the paper ($X_{c,s}$) with country-specific input-output weights ($w^c_{j,s}$), as in the *RII*. Using this "mixed" regulation index yields statistically significant effects on value added and productivity, but not on export growth. The implied effects of a one-standard deviation reduction in regulation is slightly higher than in the case of *RII*, but still nearly a half of what would be obtained using *SERVREG*. Finally, the estimates obtained using *SERVREG* are robust to adding the "mixed" regulation indicator, which in turn has very little statistically significance in all specifications.

18 The sample of large countries include Canada, France, Germany, Italy, Japan, the Netherlands, Spain and the UK; small countries are Austria, Belgium, Denmark, Finland, Greece, Norway, Portugal and Sweden. The cross-country variability of our measure of service regulation is very similar in the two sub-samples (and close to the value for the whole sample).

Table 8

Service Regulation, Growth and Country Size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Baseline			**Including Financial Development**			**Including All Controls**		
	All Countries	**Large Countries**	**Small Countries**	**All Countries**	**Large Countries**	**Small Countries**	**All Countries**	**Large Countries**	**Small Countries**
Service regulation	–0.172*	–0.191*	0.019	–0.176**	–0.182*	0.096	–0.272**	–0.313**	0.107
[$SERVREG_{j,c}$]	*(0.069)*	*(0.080)*	*(0.131)*	*(0.068)*	*(0.078)*	*(0.141)*	*(0.073)*	*(0.086)*	*(0.174)*
Initial industry share	0.189**	0.262**	0.072	0.169*	0.226*	0.090	0.135*	0.200*	0.048
[$SHARE_{j,c}$]	*(0.071)*	*(0.098)*	*(0.055)*	*(0.067)*	*(0.092)*	*(0.055)*	*(0.066)*	*(0.092)*	*(0.047)*
Constant	0.037	0.051*	0.026	0.006	0.049*	0.021	0.020	0.036	0.033
	(0.023)	*(0.023)*	*(0.018)*	*(0.019)*	*(0.022)*	*(0.016)*	*(0.025)*	*(0.038)*	*(0.030)*
Observations	220	113	107	220	113	107	220	113	107
R^2	0.66	0.70	0.52	0.67	0.72	0.55	0.70	0.75	0.59

+ significant at 10 per cent; * significant at 5 per cent; ** significant at 1 per cent.

Notes:
The dependent variable is the annual compounded growth rate of real value added at the country-industry level for the period 1996-2002 ($GROWTH_{j,c}$).
SERVREGj,c measures exposure to service regulation at the country-industry level as a weighted average (Σs *wj,s*Xc,s*) of country-level anti-competitive regulation indexes from the OECD-PMR databases.
Service regulation (*Xc,s*) is measured in 1996. Interaction weights *wj,s* are ("direct") technical coefficients of dependence between service sector *s* and manufacturing industry *j* computed on the 1997 USA Input-Output matrix.
Specifications in columns 4-9 include (unreported) controls for financial development [*FDc* × *EDj*]. In columns 7-9 further account for (unreported) Labour market regulation [*LMRc* × *LABINTj*], Red tape costs [*COSTc* × *GROPj*], FDI restrictions [*FDIREGj,c*] and Public ownership [*POWNj,c*] (see Table 1 for the definition of these variables).
Large countries are Canada, France, Germany, Italy, Japan, the Netherlands, Spain and the UK; small countries include Austria, Belgium, Denmark, Finland, Greece, Norway, Portugal and Sweden.
All regressions include country- and industry-fixed effects and use (employment) weighted least squares as estimation method.
Robust standard errors are reported in parentheses.

regulation in the sub-set of larger countries, suggesting these economies should expect substantial payoffs from competition policies. For example, the coefficient estimated in column 8 implies that the annual growth differential between Pulp and paper and Fabricated metal products (the two industries at the 75th and 25th percentile of the distribution of service-dependence, respectively) would rise by nearly 1.4 per cent if regulation in a large and highly regulated country as France was lowered to the level of Canada. On the other hand, the estimates are largely insignificant in the case of smaller economies.[19]

5.2 Sector-specific effects

We allow for sector-specific effects focusing on the unrestricted specification:

$$\hat{V}A_{j,c} = \alpha + \sum_{s} \beta_s \left(w_{j,s} X_{c,s}\right) + \phi SHARE_{j,c} + \mu_c + \mu_j + \varepsilon_{j,c}$$

The coefficients β_s are easier interpreted recalling they represent a second derivative $\beta = \partial \hat{V}A / \partial w \partial X$. Hence, $\beta_s<0$ indicates that, other things equal, intensive users of service s fare better in those countries where the provision of such service is relatively less regulated.

Our results, reported in Table 9, point to the existence of significant sectoral heterogeneity underlying the aggregate estimates presented in previous tables. This can be seen in columns 1 to 4, where we separately considered the role of energy, professional services, communication and transportation services, respectively. All estimated coefficients are negative, but only the first two are statistically significant, a result confirmed when all regressors are jointly considered (column 5). In both cases, the implied effect of regulation is non-negligible. Consider, for example, the annual value added growth differential between an industry with an intensity in professional services at the 75th percentile (Textile and textile products) and an industry at the 25th percentile (Transport equipment). The estimated coefficient in column 5 implies this growth differential is approximately 0.8 per cent higher in a country with regulation of professions at the 25th percentile (as the UK) than in a country close to the 75th percentile (as Spain). This effect is large relative to the median industry value-added growth rates in our sample (1.8 per cent) and represents more than one-third of the observed 25th-75th difference in industry growth rates. In the case of energy, moving from a heavily regulated (e.g., Italy) to a deregulated (e.g., Finland) country would imply an even larger effect on the industry growth differential (1.4 per cent).[20]

All specifications already account for the possibility of contemporaneous effects from labour and product market regulation. In column 6, we further checked for the potential confounding role of short run shocks. This amounts to distinguishing whether low regulation induces faster growth by service intensive industries or rather facilitates downstream firms exploiting industry-level worldwide short run shocks. While still of interest, evidence in favour of the second mechanism would imply that absent these shocks, deregulation would have no effects on growth. Fisman and Sarria-Allende, (2004) raised this point in the case of finance, suggesting a test for robustness to short run shocks obtained interacting the country-level variable of interest with a direct measure of worldwide industry-specific shocks (see the Table note for a detailed description of how we

19 In the Supplementary Appendix we show these findings extend to productivity and, although to a lesser extent, exports.

20 Unlike the case of professional services, the OECD measure of energy regulation is available before 1996, allowing in principle to focus on a longer growth period. Unfortunately, as we go back in time the number of missing observations on the dependent variables rapidly increases, complicating the comparison of estimates. As an example, the Supplementary Appendix shows the results obtained when the specification in column 1, Table 8 is considered, and growth rates are computed starting in various years from 1980 to 1996. We always estimate negative coefficients which become statistically insignificant starting in the mid-1980s, when the number of observations becomes nearly a half with respect to those available in 1996.

Table 9

Sector-specific Effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Energy Services	**Professional Services**	**Community Services**	**Transportation Services**	**All Services**	**Robs. to GLOPP**
Energy Regulation × Energy dependence	–0.482**				–0.540*	–0.530*
[$X_{c,ENERGY} \times w_{j,\,ENERGY}$]	*(0.147)*				*(0.232)*	*(0.232)*
Prof. Serv. Regulation × Prof. Serv. dependence		–0.286*			–0.254*	–0.259*
[$X_{c,PROSERV} \times w_{j,\,PROSERV}$]		*(0.124)*			*(0.118)*	*(0.114)*
Communications Regulation × Comm. dep.			–0.417		0.115	0.206
[$X_{c,TLCPOST} \times w_{j,TLCPOST}$]			*(1.193)*		*(1.147)*	*(1.100)*
Transports Regulation × Transports dependence				–0.231	0.101	0.112
[$X_{c,TRANSP} \times w_{j,\,TRANSP}$]				*(0.160)*	*(0.247)*	*(0.246)*
Energy Regulation × Global opportunities (energy)						0.038
[$X_{c,ENERGY} \times GLOPP_{j,\,ENERGY}$]						*(0.072)*
Prof. Serv. Regulation × Global opp. (prof. serv.)						–0.343**
[$X_{c,PROSERV} \times GLOPP_{j,\,PROSERV}$]						*(0.131)*
Financial dev. × external dep.	0.010*	0.011**	0.010*	0.011*	0.011**	0.011**
[$FD_c \times ED_j$]	*(0.004)*	*(0.004)*	*(0.005)*	*(0.005)*	*(0.004)*	*(0.004)*
Initial industry share	0.171*	0.156*	0.169*	0.167*	0.159*	0.182**
[$SHARE_{j,c}$]	*(0.067)*	*(0.073)*	*(0.069)*	*(0.069)*	*(0.069)*	*(0.062)*
Constant	0.004	0.014	–0.007	0.004	0.021	0.039
	(0.017)	*(0.020)*	*(0.022)*	*(0.020)*	*(0.030)*	*(0.031)*
Observations	220	220	220	220	220	220
R^2	0.69	0.68	0.67	0.67	0.70	0.71

+ significant at 10 per cent; * significant at 5 per cent; ** significant at 1 per cent.

Notes to Table 9:
The dependent variable is the annual compounded growth rate of real value added at the industry-country level for the period 1996-2002 ($GROWTH_{j,c}$).
Variables $X_{c,s} * w_{j,s}$ are interaction terms between country-level measures of regulation in energy, professional services, communications, transports in 1996 ($X_{c,s}$) and the corresponding industry-level indicators of dependence ($w_{j,s}$).
Interaction weights $w_{j,s}$ are ("direct") technical coefficients of dependence between service sector *s* and manufacturing industry *j* computed on the 1997 USA Input-Output matrix.
Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (FD_c) and is interacted with External dependence (ED_j) an industry-level measure of reliance on external finance obtained from US firm-level data.
$GLOPP_{j,\ ENERGY}$ and $GLOPP_{j,\ PROSERV}$ are the estimated industry value added growth in the USA. For each of the service sector *ENERGY* and *PROSERV*, global opportunities ($GLOPP_{j,s}$) are obtained according to the following two-steps procedure: (*a*) regress $GROWTH_{j,c}$ on country dummies, industry dummies and industry dummies interacted with country-level regulation in sector *s*; USA are excluded from the regression; (*b*) obtain $GLOPP_j$ as the predicted values of $GROWTH_{j,c}$ for the USA.
$SHARE_{j,c}$ indicates the industry share in total value added in manufacturing in 1996.
All regression include (unreported) controls for labor market regulation and red tape costs (see Table 1 for the definition of these variables).
All regressions also include country- and industry-fixed effects and use (employment) weighted least squares as estimation method.
Robust standard errors are reported in parentheses.

obtained such measure). The underlying idea is simple: if estimates in column 5 were to reflect short run shocks, they should be dominated by direct measures of the opportunities of expansion faced by different industries. Interestingly, our results indicate that lower regulation of professional services (but not of energy) does help accommodating short run shocks. On the other hand, however, our previous findings are unaffected and still statistically significant.[21]

Data limitations (e.g., the lack of comparable data on prices, the quality or efficiency of each of the four services, etc.) prevent a thorough analysis of the reasons why regulation is more relevant in some services than others. Interestingly, however, our results highlight the relevance of two sectors (energy and professional services) that have recently attracted increasing attention by policymakers in many developed economies.[22] Our findings can therefore be used to infer the potential growth effects of competition policies that are high in the current policy agenda: those addressing barriers to entry in energy and conduct regulation in professional services. Our estimates imply that the complete removal of the two main determinants of conduct regulation, that is *(a)* bans to comparative or price advertising and *(b)* the regulation of price and tariffs, would imply the Textiles-Transport equipment growth differential to rise by 0.3 and 0.5 percentage points, respectively.[23] As to the energy market, our findings imply the industry growth differential associated to *(a)* creating a liberalized wholesale market for electricity, *(b)* allowing third party access to the electricity and gas transmission grid, or *(c)* imposing the separation of ownership between energy production (or import) and its distribution would increase by 0.3, 0.7 and 0.9 percentage points per year, respectively.

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21 In the Supplementary Appendix, we show that our previous results on the aggregate effect of regulation (see Tab. 4) are also robust to accounting for a measure of global opportunities.

22 See the European Commission "Third Legislative Package on Energy Markets" (July 2009), promoting among other things the unbundling of network operation from supply and generation in energy, and the Commission report on "Competition in Professional Services" (February 2004), urging "the reform of unjustified restrictions in the professional services sector". See also the chapter on Structural Policy Priorities in "Going for Growth" (OECD, 2009).

23 Fore each service sector, the OECD regulation index $X_{c,s}$ is obtained as the weighted average of several sub-indexes measuring the extent of regulation in different areas (see the Data Appendix). The thought exercises reported in the text are obtained considering the change in the $X_{c,s}$ implied by the maximum possible variation of each of the sub-indexes. In the case of regulation of prices and fees in professions, for example, this would correspond to moving from having "minimum prices in all services" (as in the case of legal service in Italy) to "no regulation" (as in the case of accounting service in Canada).

6. Conclusions

Growing concerns that high levels of regulation might not reflect public interest have motivated a number of academic and policy-oriented researches aimed at evaluating the impact of regulatory barriers on the performance of regulated firms. We contribute to this debate highlighting the non-negligible indirect effects of anti-competitive regulation on downstream industries, focusing on the case of service inputs. Our results indicate that service regulation has a significant negative impact on the growth rate of value added, productivity and exports of service dependent industries. Interestingly, the impact of regulation appears to be particularly relevant in the case of those service activities (energy supply and professional services) the recent competition policy debate has been focusing on most intensively, both in Europe and in other developed countries. Also, our findings suggest the payoffs from lower service regulation would be more significant the larger the extent of the domestic market.

Our results leave several interesting questions open to future research. On one hand, the increased availability of detailed firm-level data should allow disentangling whether the aggregate growth effects we estimated here are mainly due to entry and exit of firms, to the performance of existing firms or both. On the other, it would be important to look deeper into the mechanisms underlying our findings, focusing on how regulation affects the industrial organization of services (for example, in terms of number and size of firms, of turnover rates etc), on how this shapes service market outcomes and, eventually, the patterns of international specialization and comparative advantages.

DATA APPENDIX

Country sample:

Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States.

Industry sample:

"Food products, beverages and tobacco" (Isic Rev. 3 = "15-16"), "Textiles and textile products" (Isic Rev. 3 = "17-18"), "Leather, leather products and footwear" (Isic Rev. 3 = "19") , "Wood and products of wood and cork" (Isic Rev. 3 = "20") , "Pulp, paper, paper products, printing and publishing" (Isic Rev. 3 = "21-22"), "Coke, refined petroleum products and nuclear fuel" (Isic Rev. 3 = "23"), "Chemicals and chemical products" (Isic Rev. 3 = "24"), "Rubber and plastics products" (Isic Rev. 3 = "25"), "Other non-metallic mineral products" (Isic Rev. 3 = "26"), "Basic metals" (Isic Rev. 3 = "27"), "Fabricated metal products, except machinery and equipment" (Isic Rev. 3 = "28"), "Machinery and equipment, N.E.C." (Isic Rev. 3 = "29"), "Electrical and optical equipment" (Isic Rev. 3 = "30-33"), "Transport equipment" (Isic Rev. 3 = "34-35"), "Manufacturing N.E.C., recycling" (Isic Rev. 3 = "36-37").

Dependence of manufacturing industries on service inputs

Throughout most of the paper we use weights $w_{j,s}$ computed as the technical coefficients derived from the 1997 US Input-Output matrix. They are given by the elements of the matrix $T = M\, diag\, (y)^{-1}$, where M is the industry-by-industry (44 × 44) input-output matrix, y is the (44 × 1) vector of industry output. In Table 4, column 2, weights are instead computed as the product of the elements of the inverse Leontief matrix by a vector of the industry value added-to-output ratios. More specifically, let v be the (44 × 1) vector of industry value added. The inverse Leontief matrix is $F = (I - T)^{-1}$ and satisfies $\iota' = q'F$, where $q = diag\,(y)^{-1}v$ is the vector of industry value added-to-output ratios. According to the last relation the value of production in each sector (normalized to one) is decomposed in the contribution of value added produced in all the sectors (q) weighted with the (direct and indirect) measure of intersectoral dependence (F). For each industry, the relation can be written as $1_j = \sum_{k=1}^{44} q_k f_{k,j}$ with $k = 1, ..., 44$. The indirect weights used in Table 4, column 2 are given by the elements $q_k f_{k,j}$.

Data on regulation in selected non-manufacturing sectors

All the regulatory indicators range on a common (0-6) scale from least to most restrictive conditions for competition. Data are available for seven non-manufacturing sectors: electricity and gas supply, road freight, air passenger transport, rail transport, post and telecommunications and professional services (accounting, architects, engineers and legal services). For each sector, a set of sub-indexes is available covering different forms of regulation: barriers to entry, vertical integration, market structure, price regulation, conduct regulation and public ownership. See Table 1 and the main text for a description of the sub-indexes we focused on in the analysis. See Nicoletti *et al*. (1999) and Conway and Nicoletti (2006) for a complete description of the OECD-PMR database.

SUPPLEMENTARY APPENDIX

Table 10

Alternative Determinants of International Specialization and Comparative Advantages

	(1)	(2)	(3)	(4)	(5)	(6)
	Value Added Growth				**Exports**	
	Human Capital	**Physical Capital**	**Both**	**Property Rights**	**Contract Enforcement (a)**	**(b)**
Service regulation [$SERVREG_{j,c}$]	-0.154^{*} *(0.066)*	-0.174^{*} *(0.068)*	-0.154^{*} *(0.067)*	-0.176^{*} *(0.068)*	-6.786^{*} *(3.011)*	-3.688^{+} *(2.032)*
Financial dev. × external dep. [$FD_c \times ED_j$]	0.007^{+} *(0.004)*	0.010^{*} *(0.004)*	0.007^{+} *(0.004)*	0.010^{*} *(0.004)*	0.405^{**} *(0.144)*	0.298^{+} *(0.158)*
Human capital × skill intensity	0.101^{*} *(0.048)*		0.101^{*} *(0.048)*			
Physical capital × physical capital intensity		–0.468 *(2.885)*	0.082 *(2.790)*			
Property rights × intangible intensity				–0.001 *(0.003)*		
Quality of contract enforcement × contract intensity					0.144^{**} *(0.048)*	
Quality of contract enforcement × institutional dependence						0.003^{*} *(0.001)*
Initial industry share [$SHARE_{j,c}$]	0.141^{*} *(0.064)*	0.169^{*} *(0.067)*	0.141^{*} *(0.064)*	0.171^{*} *(0.067)*		
Constant	-0.789^{*} *(0.382)*	0.023 *(0.106)*	-0.793^{*} *(0.366)*	0.009 *(0.022)*	2.595 *(1.736)*	6.634^{**} *(2.207)*
Observations	220	220	220	220	220	220
R^2	0.69	0.67	0.69	0.67	0.79	0.37

$^{+}$ significant at 10%; * significant at 5%; ** significant at 1%.

Notes:

In cols. 1-4 the dependent variable is the annual compounded growth rate of real value added at the country-industry level for the period 1996-2002 (GROWTHj,c); in col. 5 the dependent variable is the natural logarithm of total exports in industry j from country c in 1996; in col. 6 the dependent variable is an index of export specialization given by $\left(EXPORTS_{j,c} \big/ \sum_c EXPORTS_{j,c}\right) \Big/ \left(\sum_j EXPORTS_{j,c} \big/ \sum_{j,c} EXPORTS_{j,c}\right)$, where j and c represent industries and countries, respectively. SERVREGj,c measures exposure to service regulation at the country-industry level as a weighted average (Σs wj,s*Xc,s) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation (Xc,s) is measured in 1996. Interaction weights wj,s are ("direct") technical coefficients of dependence between service sector s and manufacturing industry j computed on the 1997 USA Input-Output matrix. Financial development is measured as Private Credit by Deposit Money Banks over GDP in 1996 (FDc) and is interacted with External dependence (EDj) an industry-level measure of reliance on external finance obtained from USA firm-level data (see Table 1). In cols. 1 and 3, Human capital is an index of labor force quality on a (0-100) scale taken from Bosworth and Collins (2003). It is interacted with average years of schooling at the industry level in 1980 (as obtained from the US 1990 Integrated PUMS). In cols. 2 and 3, Physical capital is the physical capital-to-GDP ratio in 1980. The capital stock is calculated using the perpetual inventory method as implemented by Klenow and Rodriguez-Clare (2005). Source: Penn World Table 5.6. It is interacted with US capital-value added ratio at industry level in 1995 taken from the EUKLEMS database (http://www.euklems.net/). In col. 4, "Property rights" is an index of the protection of the private property across countries. It is interacted with an industry-level measure of intangible intensity in US industries. Both are taken from Claessens and Laeven (2003). In cols. 5 and 6, "Quality of contract enforcement" measures the extent to which agents have confidence in and abide by the rules of society (Kaufmann, Kraay and Mastruzzi, 2003). In col. 5, contract enforcement is interacted with Nunn (2007) measure of contract intensity (i.e., of the importance of relationship-specific investments). In col. 6 it is interacted with a measure of institutional dependence. Following Levchenko (2007), this is computed as the (opposite of) an Herfindahl index of intermediate input use from the U.S. Input-Output Use Table for 1997. SHAREj,c indicates the industry share in total value added in manufacturing in 1996. All regressions include country- and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

Table 11

Alternative Measures of Regulation Impact

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Value Added Growth			**Productivity Growth**			**Export Growth**		
	ALTERN.	**SERVREG**	**BOTH**	**ALTERN.**	**SERVREG**	**BOTH**	**ALTERN.**	**SERVREG**	**BOTH**
Panel A : OECD Regulation Impact Indicator (*RII*)									
Reg. Imp. Ind.	-0.246^{*}		–0.158	–0.164		–0.043	0.199		0.352^{*}
[$rii_{j,c}$]	*(0.120)*		*(0.111)*	*(0.144)*		*(0.120)*	*(0.150)*		*(0.162)*
Service reg.		-0.176^{**}	-0.145^{*}		-0.202^{*}	-0.193^{*}		-0.215^{*}	-0.279^{**}
[$servreg_{j,c}$]		*(0.068)*	*(0.064)*		*(0.080)*	*(0.075)*		*(0.106)*	*(0.102)*
Implied effects	–0.009	–0.019	–	–0.006	–0.022	–	0.007	–0.023	–
Observations	220	220	220	220	220	220	205	205	205
R^2	0.67	0.67	0.67	0.57	0.59	0.59	0.71	0.72	0.76
Panel B : "Mixed" indicator of Service Regulation									
Serv. Reg. Mixed	-0.076^{*}		–0.052	-0.086^{*}		-0.058^{+}	–0.016		0.028
[$mixed_{j,c}$]	*(0.036)*		*(0.037)*	*(0.038)*		*(0.035)*	*(0.039)*		*(0.043)*
Service reg.		-0.176^{**}	-0.123^{+}		-0.202^{*}	-0.140^{*}		-0.215^{*}	-0.242^{*}
[$servreg_{j,c}$]		*(0.068)*	*(0.070)*		*(0.080)*	*(0.071)*		*(0.106)*	*(0.116)*
Implied effects	–0.011	–0.019	–	–0.012	–0.022	–	–0.002	–0.023	–
Observations	220	220	220	220	220	220	205	205	205
R^2	0.67	0.67	0.68	0.59	0.59	0.60	0.71	0.72	0.72

$^{+}$ significant at 10%; * significant at 5%; ** significant at 1%.

Notes:

In cols. 1-3 the dependent variable is the annual compounded growth rate of real value added at the country-industry level for the period 1996-2002 ($GROWTH_{j,c}$). In cols. 4-6 the dependent variable is the annual compounded growth rate of labor productivity (value added per employed worker) at the industry-country level for the period 1996-2002 ($LPGROWTH_{j,c}$). In cols. 7-9 the dependent variable is the annual compounded growth rate of exports at the industry-country level for the period 1996-2002 ($EXPGROWTH_{j,c}$). $SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s\, w_{j,s}{}^{*}X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation ($X_{c,s}$) is measured in 1996. Interaction weights $w_{j,s}$ are ("direct") technical coefficients of dependence between service sector s and manufacturing industry j computed on the 1997 USA Input-Output matrix. In Panel A the Regulation Impact Indicator (RII) is the OECD measure of the relevance of service regulation for manufacturing industries (taken from Conway and Nicoletti, 2006). In Panel B, the "Mixed" indicator of Service regulation is computed as a weighted average ($\Sigma_s\, w^{c}_{j,s}{}^{*}X_{c,s}$). Country-specific weights $w^{c}_{j,s}$ are ("direct") technical coefficients of dependence between service sector s and manufacturing industry j computed on the OECD Input-Output matrices. All regressions include (unreported) controls for financial development and for initial conditions: $SHARE_{j,c}$ in cols. 1-3, $LLP_{j,c}$ in cols. 4-6 and $EXSHARE_{j,c}$ in cols. 7-9 (see Table 1 for the definition of these variables). All regressions also include country- and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

Table 12

Global Opportunities and Average Regulation

	(1)	(2)
	Without Other Controls	**With Other Controls**
Service regulation	-0.185^{**}	-0.234^{**}
[$SERVREG_{j,c}$]	*(0.068)*	*(0.070)*
Average service regulation ×	–0.101	–0.035
global opportunities	*(0.099)*	*(0.123)*
Fin. dev. × external dep.	0.009^{*}	0.011^{**}
[$FD_c \times ED_j$]	*(0.004)*	*(0.004)*
Initial industry share	0.160^{*}	0.148^{*}
[$SHARE_{j,c}$]	*(0.067)*	*(0.068)*
Constant	0.016	0.042^{+}
	(0.020)	*(0.025)*
Observations	220	220
R^2	0.68	0.69

$^{+}$ significant at 10%; * significant at 5%; ** significant at 1%.

Notes:

The dependent variable is the annual compounded growth rate of real value added at the industry-country level for the period 1996-2002 ($GROWTH_{j,c}$). $SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s w_{j,s}{}^{*}X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation ($X_{c,s}$) is measured in 1996. Interaction weights $w_{j,s}$ are ("direct") technical coefficients of dependence between service sector *s* and manufacturing industry *j* computed on the 1997 USA Input-Output matrix. Average service regulation is the simple average of sectoral regulation given by ($X_{c,ENERGY} + X_{c,PROSERV} + X_{c,TLCPOST} + X_{c,TRANSP}$) / 4. It is interacted with an industry-level measure of global opportunities obtained according to the following two-steps procedure: (*a*) Regress $GROWTH_{j,c}$ on country dummies, industry dummies and industry dummies interacted with country-level simple average of sectoral regulation; USA are excluded from the regression. (*b*) Obtain global opportunities as the predicted values of $GROWTH_{j,c}$ for the USA. All regression include (unreported) controls for financial development, labor market regulation and red tape costs (see Tables 1, 2 and 7 for the definition of these variables). $SHARE_{j,c}$ is the industry share in total value added in manufacturing in 1996. All regressions include country- and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

Table 13

Service Regulation and Country Size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Value Added Growth			**Productivity Growth**			**Export Growth**		
	All Countries	**Large Countries**	**Small Countries**	**All Countries**	**Large Countries**	**Small Countries**	**All Countries**	**Large Countries**	**Small Countries**
Service reg.	–0.272**	–0.313**	0.107	–0.282**	–0.340**	0.012	–0.241*	–0.270+	–0.233
[$SERVREG_{j,c}$]	*(0.073)*	*(0.086)*	*(0.174)*	*(0.101)*	*(0.124)*	*(0.127)*	*(0.104)*	*(0.145)*	*(0.180)*
Constant	0.020	0.036	0.033	–0.070	–0.083	0.017	0.028	0.006	–0.006
	(0.025)	*(0.038)*	*(0.030)*	*(0.048)*	*(0.065)*	*(0.054)*	*(0.030)*	*(0.047)*	*(0.043)*
Observations	220	113	107	220	114	106	205	98	107
R^2	0.70	0.75	0.59	0.61	0.65	0.52	0.75	0.80	0.75

+ significant at 10%; * significant at 5%; ** significant at 1%.

Notes:

In cols. 1-3 the dependent variable is the annual compounded growth rate of real value added at the country-industry level for the period 1996-2002 ($GROWTH_{j,c}$). These columns replicate results of table 8, cols. 7-9 in the main text. In cols. 4-6 the dependent variable is the annual compounded growth rate of labor productivity (value added per employed worker) at the industry-country level for the period 1996-2002 ($LPGROWTH_{j,c}$). In cols. 7-9 the dependent variable is the annual compounded growth rate of exports at the industry-country level for the period 1996-2002 ($EXPGROWTH_{j,c}$). $SERVREG_{j,c}$ measures exposure to service regulation at the country-industry level as a weighted average ($\Sigma_s\, w_{j,s} {}^* X_{c,s}$) of country-level anti-competitive regulation indexes from the OECD-PMR databases. Service regulation ($X_{c,s}$) is measured in 1996. Interaction weights $w_{j,s}$ are ("direct") technical coefficients of dependence between service sector *s* and manufacturing industry *j* computed on the 1997 USA Input-Output matrix. All regressions include (unreported) controls for financial development [$FD_c \times ED_j$], Labour market regulation [$LMR_c \times LABINT_j$], Red tape costs [$COST_c \times GROP_j$], FDI restrictions [$FDIREG_{j,c}$], Public ownership [$POWN_{j,c}$] and the corresponding initial conditions [$SHARE_{j,c}$, $LLP_{j,c}$ and $EXSHARE_{j,c}$]. See Table 1 for the definition of these variables. The sample of large countries include Canada, France, Germany, Italy, Japan, the Netherlands, Spain and the UK while the sample of small ones include Austria, Belgium, Denmark, Finland, Greece, Norway, Portugal and Sweden. All regressions also include country- and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

Table 14

Sector-Specific Effects Over Longer Horizons: Energy

	(1)	(2)	(3)	(4)	(5)
	Initial Year: 1980	**Initial Year: 1984**	**Initial Year: 1988**	**Initial Year: 1992**	**Initial Year: 1996**
Energy Regulation × Energy dependence	–0.206	–0.210	–0.434*	–0.469**	–0.482**
[$X_{c,ENERGY} \times w_{j,\,ENERGY}$]	*(0.207)*	*(0.175)*	*(0.182)*	*(0.178)*	*(0.147)*
Observations	139	139	154	220	220
R^2	0.74	0.74	0.75	0.66	0.69

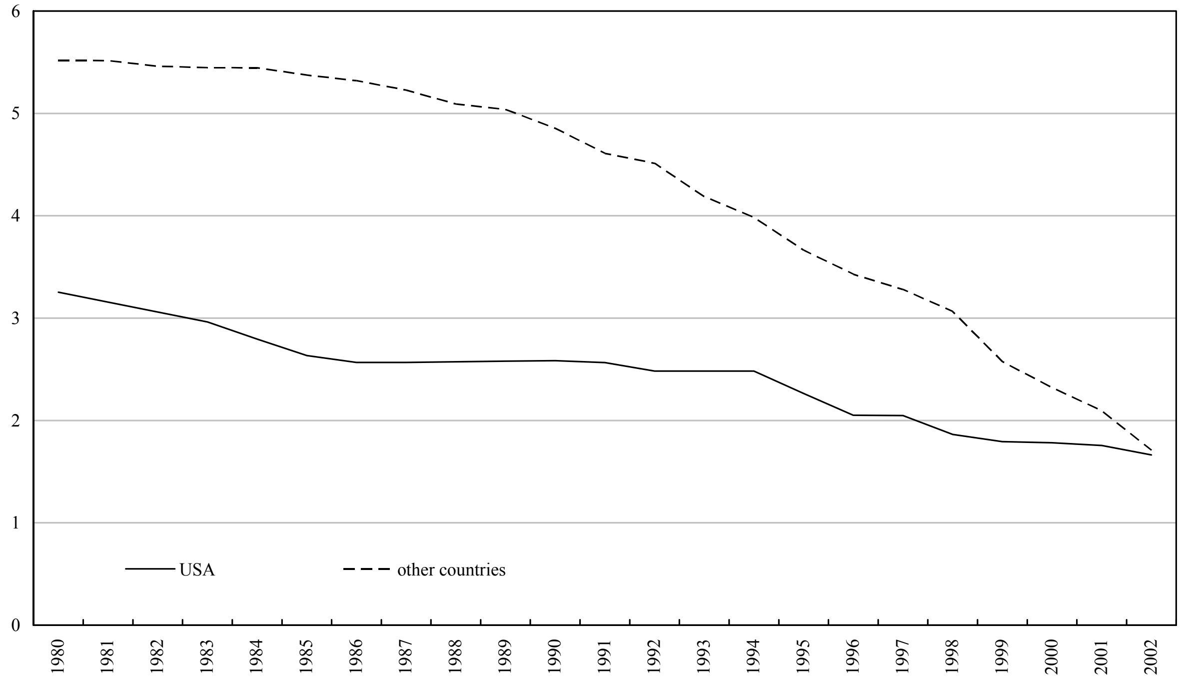
+ significant at 10%; * significant at 5%; ** significant at 1%.

Notes:

The dependent variable is the annual compounded growth rate of real value added at the industry-country level for the period 1996-2002 (GROWTHj,c). Xc,ENERGY * wj,ENERGY is an interaction term between country-level measures of regulation in energy in 1996 (Xc,ENERGY) and the corresponding industry-level indicators of dependence (wj,ENERGY). The interaction weight wj,ENERGY is the ("direct") technical coefficients of dependence between energy and manufacturing industry j computed on the 1997 USA Input-Output matrix. All regression include (unreported) controls for financial development, labor market regulation and red tape costs (see Tables 1, 2 and 7 for the definition of these variables), and the industry share in total value added in manufacturing in 1996. All regressions also include country- and industry-fixed effects and use (employment) weighted least squares as estimation method. Robust standard errors are reported in parentheses.

Figure 1

Service Regulation in USA and Other OECD Countries



Notes:

Service regulation is the simple average of the OECD measures of regulation (Xc,s) in energy, communications and transports. Other countries are: Austria, Belgium, Canada, Germany, Denmark, Finland, France, Great Britain, Greece, Italy, Japan, the Netherlands, Norway, Portugal, Spain and Sweden.

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THE MARGINAL COST OF PUBLIC FUNDS IN THE EU: THE CASE OF LABOUR VERSUS GREEN TAXES

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One key objective of tax-based fiscal consolidations which is too often disregarded in public debate is to minimise economic distortions. This paper uses a computable general equilibrium model to gauge these potential distortions by calculating the marginal cost of public funds (MCF) for EU member states. We consider two specific tax categories which prove especially relevant in such a context: labour and green taxes. First the economic distortion provoked by labour taxes is significantly larger than for green taxes. This result suggests that a green-taxes oriented fiscal consolidation would be preferred to a labour-tax oriented one (assuming that both tax increases would yield the same tax revenues). This holds for all EU member states modelled and despite the fact that potential welfare enhancement through pollution abatement are cancelled-out. Nevertheless, this result is slightly less strong when one considers the spillover effects between countries, which are more pronounced (in relative terms) for energy taxes. This suggests that the use of energy taxes for fiscal consolidation would be more effective were there to be close coordination across EU countries. In addition the efficiency losses associated with labour taxes are also likely to be greater when labour markets are less flexible (from an efficiency-wage perspective), a result also found to a small extent for green taxes. This raises the possibility that undertaking structural reforms (especially in the labour market) would help to minimize the efficiency losses entailed by tax-driven fiscal consolidations.

Introduction

The need to restore sound fiscal balance represents a key objective of EU economic policy making in the aftermath of the financial crisis. Whenever tax increases are contemplated, the challenge for policy makers is to strike a balance between short-term recovery and long-term growth, the latter requiring supply and economic efficiency-enhancing policy measures. The need to lower the efficiency loss of tax increases is also aimed at optimising the level of extra-tax revenues obtained from it given that inappropriate tax hikes could lead to lower than expected tax revenue and would eventually require successive tax increases in order to meet fiscal policy objectives. To date, much of the policy debate has been informed by (neo) Keynesian types of models assessing the size of fiscal multipliers and potential effects of fiscal consolidation in a context of zero-bound monetary policy and impaired financial sector, see in particular Corsetti *et al.* (2010), IMF (2012) and Coenen *et al.* (2012) for recent, model-based discussions. Some additional guidance on these important issues, albeit too often disregarded in the policy debate, could be drawn from the optimal tax policy literature analysis of the potential distortionary effect of tax increases, see in particular Feldstein (1997). Accordingly, the objective for policy makers should be to minimise the distortionary effect of taxation and related adverse effects on the economic recovery since existing evidence suggests that the least distortionary a tax system is, the less detrimental its impact on growth, see in particular Arnold *et al.* (2011). The efficiency loss associated with tax increases crucially depends on the behavioural responses of economic agents

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which affect the tax bases and the supply side of the economy. An appropriate metric to gauge the losses related to (and potential growth-detrimental effect of) tax increases should compare the relationship between the deadweight loss and the extra-revenue associated with a given tax increase.

In this paper we calculate more specifically the marginal cost of public funds (MCF) which proves especially useful for this purpose. This indicator is widely used in the public economics literature for the evaluation of tax reforms and public spending program requiring the transfer of resources from the private to the public sector, see in particular Dahlby (2008). Based on this measure, existing evidence suggests that the efficiency loss of tax increases vary widely across tax categories and countries and increases with the level of taxation burden in the economy, see in particular Devarajan and Robinson (2002) and Dahlby and Ferede (2011). The MCF metric is used here to gauge the cost of tax increases in the EU. To do so we make use of the computable general equilibrium model GEM-E3. One important feature of this model version is that it is calibrated using social accounting matrices derived from national account data of EuroStat. The resulting tax rates used in the simulations therefore reflect actual effective tax rates. Our analysis is carried out for all of the 24 EU member states that are specified in the model (all except for Croatia, Cyprus, Malta and Luxembourg).

We consider two specific tax categories: labour and energy taxes. Our choice of tax categories is motivated by a number of questions of special relevance in the EU context. First, we chose labour taxation because of its relatively high level in most EU countries and because it is well known to have wide-ranging effects spilling well beyond fiscal outcomes. More than any other tax category, labour taxation are directly embedded into country-specific economic and social institutions thus reflecting underlying economic structures, see Blundell *et al.* (1999). Second, green taxation links this analysis with the "double dividend" literature as it is often advocated for as potential instrument for shifting the tax systems in the current EU context in order to make taxation both more employment- and environment-friendly, see Saveyn *et al.* (2011). Because green taxes enter the indirect tax category and is in most EU countries relatively low, resorting to it is also likely to have lower detrimental effects on economic efficiency although it may have non-negligible effects onto the low-income categories of the population.[1] Green taxation may also have direct effect on energy efficiency and thus help minimize the corresponding efficiency losses to be expected from an increase in tax rates. Third we also chose these two tax categories because they could prove instrumental to implement EU-wide coordinated tax reforms despite the fact that they are generally not invoked as candidates for coordination across EU counties according to the optimal tax theory literature. In particular the so-called destination/residence principles, whereby the coordination of direct tax measure should concern primarily (cross-country) mobile production factors while indirect taxation should be collected at the country of destination (see Andersen and Sorensen, 2012, for a review). In practice in the EU however, the high degree of openness and economic integration, the high starting level of public expenditure and tax burden suggest that individual country tax policies might have non-negligible impact on EU partners, potentially influencing the outcome of fiscal consolidation strategies.

Our results show that the efficiency losses related to tax increases (as measured by the MCF) are significantly larger for the labour tax than for green taxes, the latter being represented by households´ consumption taxes on energy products. However the degree of cross-EU countries spillovers is also higher for green taxation calling for coordinated tax strategies despite the low starting level of this type of taxation. Furthermore, we show that these economic costs are also likely to be reduced with a higher degree of flexibility of the labour market, especially so in the case of labour taxes but also, although to a lower extent, for energy taxes. More generally, our

1 See Speck (1999) for a discussion. In this paper we do not deal with inequality issues.

results tend to suggest that high burden tax categories such as labour tend to be more distortionary than low-burden tax categories lending support to the Laffer type hypothesis. As a result, EU countries might find it appropriate to shift taxation system away from high burden/highly distortionary tax categories in order to favour the growth recovery without which consolidation strategies might prove difficult to sustain in the long-run. Our results prove robust to a number of robustness checks using alternative hypotheses regarding the nature of the extra-tax revenue recycling derived from a given tax hike, the degree of cross-country interdependence in import vs. domestic production substitution and the size of labour supply elasticities.

The rest of the paper is organised as follows. In Section 1 we briefly review the existing literature on the marginal cost of public funds and present our modelling strategy. Our main results are presented in Section 2, while Section 3 provides robustness tests to check the sensitivity of our results to the main hypotheses of the model. Section 4 concludes.

1 Measuring the marginal cost of tax increases

1.1 Literature review

The existing literature provides a wide range of estimated MCF values, differentiated according to the methodology used, the tax categories and the country or region considered. A direct comparison of results across studies is rather complicated since definitions, the underlying theoretical framework and measurements are usually very different from one study to the other. Nevertheless, in order to give an impression of the magnitudes of previous MCF estimates we provide a succinct overview of possible estimates obtained using alternative methodologies.

The MCF metric is relatively straightforward: it simply indicates how many euros (or dollar) are lost in the economy to collect one extra euro (or dollar) tax revenues. As a result MCF usually value greater than one, e.g. $MCF=1+\alpha$, with α measuring the efficiency loss. On the methodological side, there are various ways of measuring the MCF. In this discussion we focus on the three main approaches to estimate the MCF econometric estimations, CGE modelling or through microsimulation.[2] Each of these methodological approaches has pros and cons. The main advantage of CGE models is to consider all potential interactions in the economy (including interactions between industrial sectors, consumers, government and the rest of the world) that determine the final welfare and tax revenue impacts of a given tax change. The drawback of this approach is that it relies on assumptions regarding the functional forms and/or elasticities of the different tax bases to the tax rate changes, however, although one must note that this limitation is not specific to the analysis of tax policy changes, however. The estimates provided by Ballard *et al.* (1985) suggested that the MCF for all taxes ranged between 1.17 and 1.56 depending on the saving and labour supply elasticity used.[3] Hansson and Stuart (1985) found a MCF between 0.67 and 4.51 for the Swedish economy although suggested that varying assumptions regarding labour supply elasticity could have substantial implication in these estimates. In a more recent paper Dixon *et al.* (2012) estimate the MCF for recent tax increases measures taken by the Finnish government in the aftermath of the global financial crisis and estimate this cost to rise up to 1.5 in the long-run. In a recent paper Auriol and Warlters (2012) compute the MCF for African countries using a CGE models with taxes on five tax bases: domestic output, exports, imports, capital and labour in the

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2 Another strand of models concern partial equilibrium/stylised models which are also best suited to tackle specific issues in analysing the marginal cost of public funds, see Devarajan and Robinson (2002) for a review.

3 Although formally Ballard *et al.* (1985) focused on the Marginal Excess Burden, the MCF can be proxied from these calculations by simply adding 1 to the estimated MEB, see Devarajan and Robinson (2002). One should note however that with such simplification it is assumed that the income elasticity for the taxed product is zero, see Dahlby (2008, chapter 2).

formal sector. These authors show that taxes on domestic output generally have the lowest MCF (around 1.1) and taxes on capital in the formal sector had the highest MCFs (around 1.60).

Econometric estimations allow considering a wide range of countries and/or tax categories as the only limitation is on the data side. An important restriction however comes from the availability of reliable data on the effective tax bases to calculate their potential variation following a tax rate hike. A wide range of studies exist where estimates of the MCF can be derived from the tax base elasticities to tax rate changes thereby capturing the behavioural response of the tax base. For instance in a recent paper Dahlby and Ferede (2012) calculate the MCF for Canadian provinces using information derived from official data used for the tax base equalisation system in place in this country. Their estimates of the MCF of Canadian provinces concerned three tax categories: the corporate income tax, the personal income tax and the sales tax. These authors find a wide range of estimates for the MCF across provinces and potentially important interactions across tax categories ranging from a maximum of 30.6 in the case of corporate taxes to the a minimum of 1 for sales taxes. Dahlby and Ferede also find that the MCF is greatly reduced at the federal level and by considering the impact of the vertical equalisation grants between the federation and the provinces, a result in line with previous findings by Smart (2007).

Microsimulation models in turn have also been used to quantify the marginal cost of public funds to tackle the potential effects of tax reforms by strand of the population, allowing thereby a finer analysis of behavioural effect of tax changes. In particular Kleven and Kreiner (2006) showed that the estimated effects of tax hikes differed sensibly once the labour participation effects is isolated from the number of hours worked (where the extensive and intensive margin of labour supply are distinguished). This approach aims to reflect the fact that labour participation can display very large elasticities while hours-of-work elasticities can be close to zero. Kleven and Kreiner found indeed that once the participation effect was considered into the analysis (and thus once the heterogeneity in labour supply response across different categories of workers was allowed for), then the estimated marginal cost of public funds tended to rise sharply. Applying their analysis for five EU countries namely Denmark, France, Germany, Italy and the UK, Kleven and Kreiner (2006) found that the MCF in certain cases can be more than three times higher due to higher initial distortions of the tax system and higher sensitivity of the MCF to the inclusion of the extensive margin effect of labour participation.

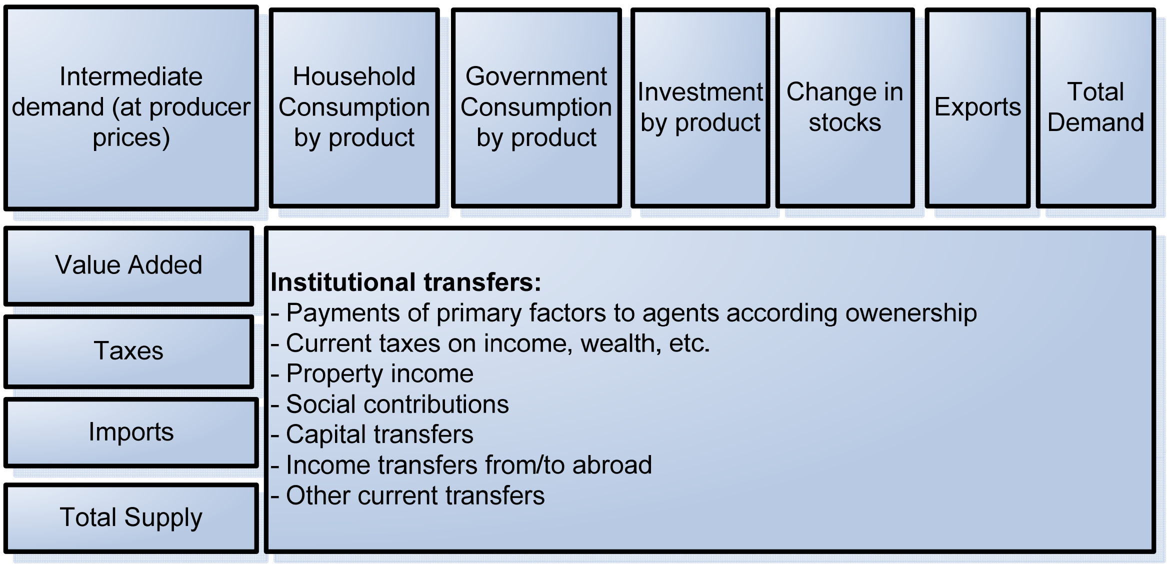
1.2 Modelling approach

In this paper we use a CGE model to quantify the welfare losses related to tax increases in the EU. As noted earlier, such an approach offers the advantage of considering altogether the different interactions in the economy, including the interactions between countries, which is particularly relevant in the EU context given the high level of integration of the EU Member States. The EU-version of the GEM-E3 model (General Equilibrium Model for Energy-Economy-Environment interactions) is a computable general equilibrium (CGE) model, which explicitly models 24 EU member states and the rest of the world. The GEM-E3 models the interactions between the economy, the energy system and the environment at country and EU level. It covers all production sectors (aggregated to 18) and institutional agents of the economy. The model computes the equilibrium prices of goods, services, labour and capital that simultaneously clear all markets under the Walras law. It formulates separately the supply or demand behaviour of the economic agents which are considered to optimise individually their objective while market derived prices guarantee global equilibrium. Further details of the model are given in the GEM-E3 Manual (European Commission, 2012).[4]

[4] For more information see also www.GEM-E3.net.

Figure 1

Social Accounting Matrix Representation as Used in GEM-E3



Source: European Commission (2012).

As discussed earlier, the use of a CGE model to calculate the MCF represents only one possible way of quantifying the welfare effect of tax increase. Such a CGE approach allows us to provide rather comprehensive approach across countries and tax categories with potentially important policy implications. Three main features of our model are especially illustrative in this respect. First, the calibration of the GEM-E3 model is based on social accounting matrices (SAMs) for 2005. As a result, the tax rates are calibrated as an effective rate, *i.e.*, the ratio between the tax revenues and the corresponding tax base for each tax category as reported in the SAMs, which provides a fairly reliable picture of the economy and the tax. The SAMs are calibrated to a base year data (2005) for each EU country built by combining input-output tables (as published by EUROSTAT) with national accounts data. Bilateral trade flows are also calibrated for each sector, taking into account trade margins and transport costs. Total demand (final and intermediate) in each country is optimally allocated between domestic and imported goods, which are assumed to be imperfect substitutes (the "Armington" assumption). Production is modelled through CES KLEM (capital, labour, energy and materials) production. Second, the GEM-E3 model offers a great level of detail regarding tax systems as it distinguishes between nine categories of government receipts, namely indirect taxes, environmental taxes, direct taxes, value added taxes, production subsidies, social security contributions, import duties, foreign transfers and government firms. These receipts are coming from product sales (*i.e.*, from branches) and from sectors (*i.e.*, agents) as described in the SAM. Unemployment benefits are part of the transfer from the government to the household sector which is a single aggregate in the SAM. We thus use observed unemployment benefit transfers to the household sector for the year 2005 which also include all other transfers related to the unemployment status (e.g., child benefit) as reported by the OECD in 2005. The latter is particular relevant to take into account the potential income loss from becoming unemployed. Third, the GEM-E3 model comprises all sectors of the economy broken down into 18 sectors while private consumption is divided among 13 durable and non-durable goods. Such level of detail allows for a consistent evaluation of the effects of tax policy changes for the different sectors of activity and economic agents. Figure 1 sketches out the main elements of these country-specific SAMs.

Though this particular CGE model does have considerable detail of taxation, one should note that the ability to fully represent the complexities of tax systems is limited. For instance, labour taxation is modelled to the representative unit of labour, which cannot incorporate the details of the (progressive) labour tax policies found in member states. Furthermore we do not aim to capture potential dynamic effects of tax changes. It is important to note also that the version of the GEM-E3 model used here includes labour market imperfections including involuntary unemployment. Due to these imperfections, employees enjoy a wage premium on the top of the wage rate that would result from non-distorted labour markets. We follow the approach of Shapiro and Stiglitz (1987) suggesting a positive correlation between wages and labour productivity (see also Blanchflower and Oswald, 1994, for empirical evidence).

The introduction of labour market imperfections has two important implications when it comes to estimating the MCF and comparing the results of labour taxes versus other tax categories. First the degree of labour market "imperfection", *i.e.*, the gap between the efficiency wage and the wage that would result from a perfect labour market where potential supply matches labour demand is likely to influence the MCF. A large wage premium should result in a greater distortive effect of labour taxation in particular. Labour market imperfections could also magnify trade-related tax spillovers effects to the extent that wages are set in some countries by partly taking into account evolutions in the main trading-partner countries (e.g., in as Belgium).

1.3 Measuring the marginal cost of public funds with GEM-E3

The measurement of welfare is central to the analysis of MCF. The welfare measure used in GEM-E3 is derived from the utility maximisation behaviour of the representative household. Here we only provide the specification of the utility function and the budget constraint, further details on the model can be found in European Commission (2012). The households receive income from their ownership of production factors (such as working time and capital), from other institutions and transfers from the rest of the world. Household expenditure is allocated between consumption, tax payment and savings. The representative household firstly decides on the allocation of its income between present and future consumption of goods and leisure. At a second stage, the household allocates its total consumption expenditure between the different consumption categories available. The consumption categories are split in non-durable consumption categories (food, culture etc.) and services from durable goods (cars, heating systems and electric appliances).

The general specification of the first stage problem, with a time separable Stone-Geary utility function, can be written as follows:

$$U_{i,t} = \sum_t \left(1 + stp_{i,t}\right)^{-t} . \left(bh_{i,t} . \ln\left(HCDTOTV_{i,t} - ch_{i,t}\right) + bl_{i,t} . \ln(LJV_{i,t} - cl_{i,t})\right) \quad (1)$$

where $HCDTOTV_{i,t}$ represents the consumption of goods (in volume), $LJV_{i,t}$: the consumption of leisure, $stp_{i,t}$: the subjective discount rate of the households, or social time preference,
$ch_{i,t}$ is the subsistence quantity of consumption, $cl_{i,t}$ the subsistence quantity of leisure,
$bh_{i,t}$, $bl_{i,t}$ are the respective shares of consumption and leisure in the disposable income of the households. The maximisation is subject to the following inter-temporal budget constraint, which states that all available disposable income will be spent either now or sometime in the future:

$$\mathring{a}_t \ (1 + r_{i,t})^{-t} \cdot (HCDTOT_{i,t} - PCI_{i,t} \cdot ch_{i,t} + PLJ_{i,t} \cdot LJV_{i,t} - PL_{i,t} \cdot cl_{i,t}) \quad (2)$$

where $r_{i,t}$ is the discount rate, $HCDTOT_{i,t}$ is the total private consumption, $PCI_{i,t}$ is the consumer price index, $PLJ_{i,t}$ is the price of leisure, $LTOT_{i,t}$ is the total available time to households. The non-wage income is income such as interest payments from assets, share in firms' profits, social benefits, and remittances. Based on myopic assumptions about the future, the household decides the amount of leisure that wishes to forsake in order to acquire the desired amount of income (thus also defining labour supply behaviour).

$$Welfare_i = \frac{1}{\exp(MUI)_i} \exp\left(bh_i * \ln(HCDTOT_i - ch_i) + bl_i * \ln(LJV_i - cl_i)\right)$$

where *MUI* is the marginal utility of income. Note that for the purposes of this version of the model, the leisure component is fixed, and therefore the changes in welfare occur only through the changes in consumption. The estimation of the MCF can be undertaken using a general equilibrium approach encompassing all the potential market effects of a given tax increase as well as the interactions between economic agents and resulting changes in the tax bases. The MCF can be calculated using the following formula:

$$MCF_{i,k} = \frac{\Delta W_{i,k}}{\Delta TR_i} \tag{3}$$

where $\Delta W_{i,k}$ is the welfare loss due to the increase of tax k in country i and is calculated as the change in consumer utility based on the indirect utility function in order to give it a monetary value. It could be conceptualised as the reduction in consumption relative to a benchmark case of no-policy change, where prices and incomes are fixed at their "no-policy-change" benchmark level. This technically corresponds to the "equivalent" variation. Alternatively, using the "compensating" variation would imply using the prices and income corresponding to "policy change" scenario. See Dahlby (2008) and Schöb (1994) for a discussion. The term ΔTR_i in equation (3) represents the corresponding change in tax collection in country i (including all tax revenues).

The MCF provides a metric for the loss in welfare (the efficiency loss) per unit of tax revenue gain. If the MCF equals one, then the tax is equivalent to a lump-sum transfer from the households to the government with no distortion. Typically, however, the MCF is greater than one such that MCF $=1+\alpha$, with α representing the cost of the distortion. This means that for every euro that goes into the government's purse, the economy pays an efficiency cost of α euros. The higher the MCF, the larger is the cost of distortion compared with the tax revenue gains.

As mentioned above, the externality modelled in GEM-E3 stems from bilateral trade relationships. A given tax policy change will affect bilateral trade flows and, thus, economic activity (*i.e.*, production and consumption). It will also impact on tax revenues via two channels: tax changes will affect both (i) relative prices of domestically produced versus foreign goods and services and (ii) disposable income through changes in price levels and purchasing power. Tax changes will also spill through the production chain: for instance countries importing intermediates from a country implementing a tax increase will face higher production costs if substitution possibilities (*i.e.*, import from alternative suppliers) are limited. Tax changes also affect demand for intermediates produced abroad. A country implementing a tax increase will thus face a competitiveness loss as well as lower purchasing power. Furthermore, partner countries may benefit on the one hand from a price-competitiveness gain if their exports are close substitutes of the goods and services produced by the tax-increasing country. On the other hand, partner countries may eventually lose if their exports are complementary to those of the tax-increasing country or if the lower economic activity in the tax-increasing country reduces its imports from the partner country.[5]

Alternatively, one can also derive a measure of the MCF where tax-related spillovers are taken into account by considering unilateral tax increases as indicated in equation (4) below:

$$MCF_{i,k} = \frac{\Delta W_j}{\Delta R_j + \sum_{j,j\neq i} \Delta R_j} + \frac{\sum_{j,j\neq i} \Delta W_j}{\Delta R_j + \sum_{j,j\neq i} \Delta R_j} \tag{4}$$

where i is the country implementing a given tax change while j are the other countries (not implementing any tax change). The second term of equation (4) represents the spillover effect which can be compared to the first term of equation (3) which represents the impact of a tax change for the country implementing it only. The average MCF for unilateral tax increases calculated as in (3) can then compared to the average value of the MCF for unilateral tax increases including the impact of unilateral tax increases on other countries welfare and tax revenues as calculated in (4).

The results presented here provide estimations of the MCF for a very small tax increase of 0.05 percentage points of the effective tax rate in 2005. The tax increase in the case of labour tax concerns total social total security contribution. In doing so, we aim at focusing on the labour "price" effect of taxation specifically. The green taxes considered here concerns an energy tax for households per petajoule of energy (which is the measure commonly used to express energy consumption by large customers groups such as countries). It is important to note that the effects of an energy tax increase on the utility level as a result of a better environmental quality due to lower CO2-emissions and other kinds of air pollution, is not taken into account here such that the resulting utility variation stems essentially from the traditional price and income effects of a price change of each product consumed by the representative consumer.

The small tax increment is intended to capture the marginal nature of the tax change. In practice the proceeds of a given tax increase are used to finance policy objectives such as an increase in public expenditure, a subsidy, or to repay public debt. As the impact of the allocation of tax proceeds is beyond the scope of this paper, the estimate of the MCF of a given tax increase is isolated by allocating the (small amount of) additional tax revenues to the rest of the world (*i.e.*, outside the EU). It is important to note also that when changing the level of taxes we fix the level of leisure to a given level. This is done in particular in order to isolate specifically the effect of labour taxes on time spent in employment and in unemployment. Given the labour market setting used, this means also that unemployment is never voluntary and thus neutralises the substitution effect of hours worked with time spent in leisure.

Table 1 provides descriptive statistics on the share of total labour taxes and energy taxes by country for the year 2005 which is used for the calibration of the model. The main source for the data is EuroStat. As one would expect, the labour taxes are substantially larger in EU countries (the simple average for labour taxes is 20.7 per cent of GDP vs. 1.4 per cent for energy taxes) although the relative dispersion of energy taxes is greater across countries (the coefficient of variation in 32.7 per cent for energy taxes vs. 25.9 per cent for labour taxes). Overall these figures also reflect the relatively large share of labour taxes in the richer EU countries.

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5 Andersen and Sørensen (2012) suggested recently that tax increases could also have positive side-effects on the production side since firms needed to counter-act the extra-tax burden through productivity improvement.

Table 1

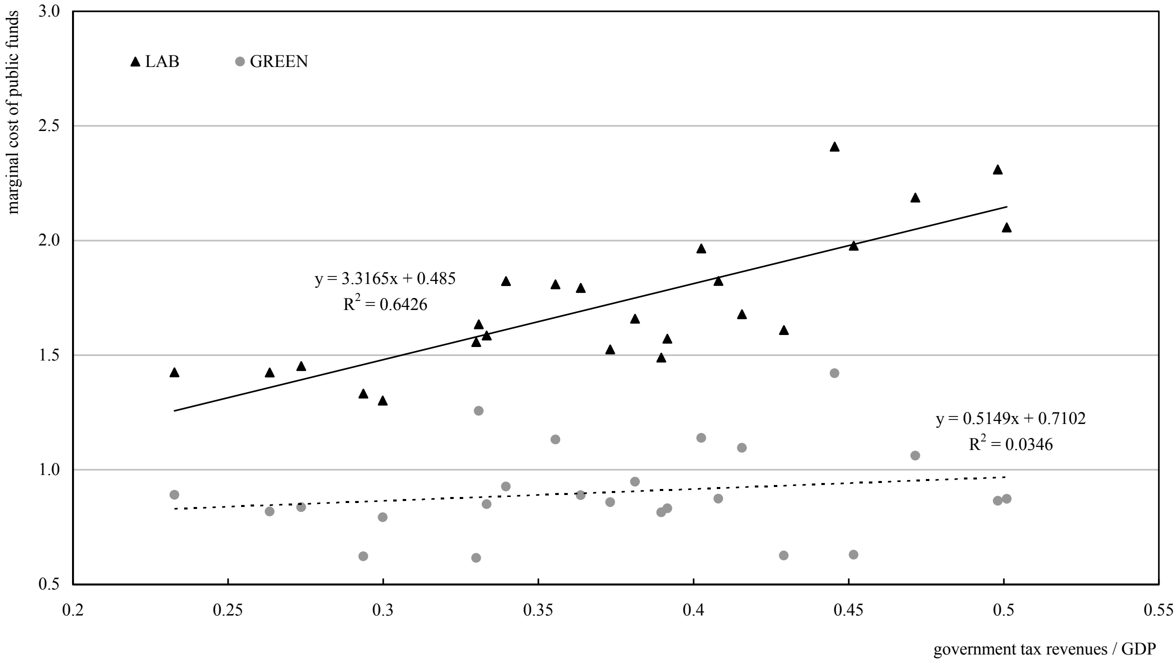
Share of Tax Revenues in GDP: Values Used for the Calibration of the GEM-E3 Model

Country	Total Tax Revenues	Labour Taxes*	Green Taxes**
Austria	40.8%	26.6%	1.5%
Belgium	45.2%	29.1%	1.0%
Bulgaria	33.0%	13.3%	2.8%
Czech Republic	39.0%	20.9%	1.7%
Denmark	49.8%	26.6%	1.4%
Estonia	30.0%	29.0%	1.0%
Finland	42.9%	16.2%	1.3%
France	44.6%	18.1%	1.3%
Germany	40.3%	19.9%	1.8%
Greece	33.3%	26.1%	1.0%
Hungary	37.3%	26.9%	2.0%
Ireland	29.4%	19.8%	0.8%
Italy	41.6%	14.7%	2.1%
Latvia	26.3%	23.7%	1.4%
Lithuania	27.4%	15.3%	0.6%
Netherlands	39.2%	14.3%	1.4%
Poland	33.1%	21.7%	1.4%
Portugal	34.0%	16.8%	1.6%
Romania	23.3%	18.1%	1.1%
Slovakia	47.1%	13.0%	1.5%
Slovenia	38.1%	29.7%	1.9%
Spain	36.4%	20.5%	1.0%
Sweden	50.1%	16.0%	1.3%
United Kingdom	35.6%	21.0%	1.7%

* Households' social security contributions + labour income tax.
** Energy taxes paid by households.

Figure 2

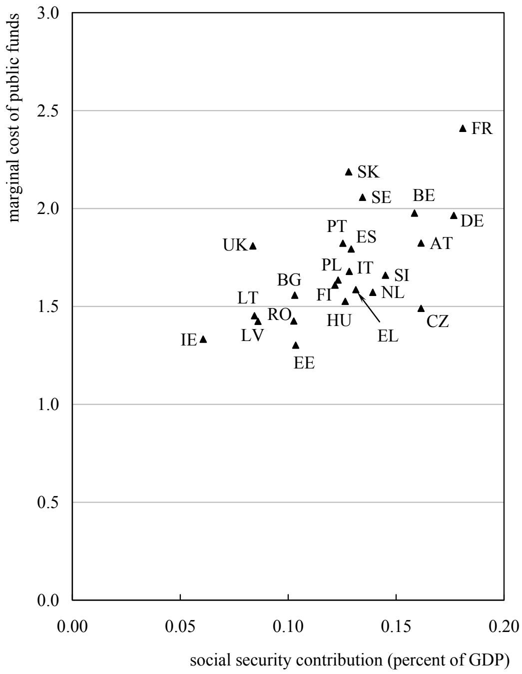
Marginal Cost of Public Funds Vs. Total Tax Revenues



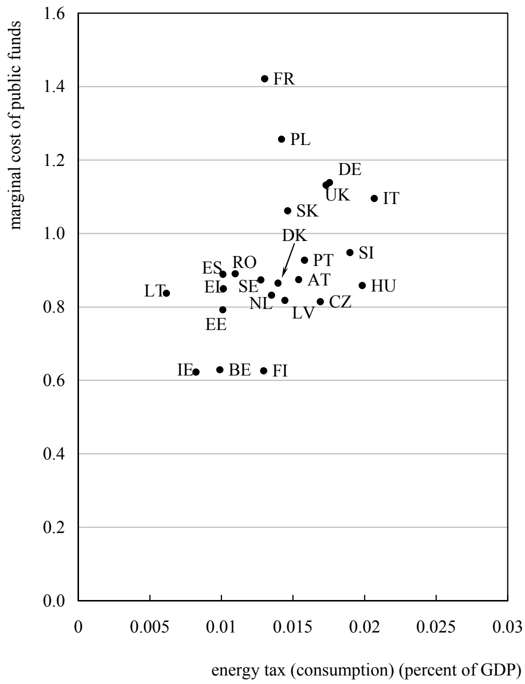
Source: GEM-E3 simulations.

Country Details for Labour and Energy Taxes

MCF Labour Vs. Labour Tax (SSC)
(percent of GDP)



MCF Green Vs. Green Tax Revenues
(percent of GDP)



2 Results

The results presented here focus firstly on the comparison of the MCF for labour and green taxes both across the EU and for individual countries, as well as the notion of tax shifting from labour to green taxes. Secondly, the impacts of each country changing their tax rates on the rest of the EU – the spillover effects – are considered. Thirdly, the investigation into the important of labour market flexibility is reported. Lastly, a robustness check on the values of the labour supply elasticity, Armington elasticities, and revenue-recycling strategies are carried out.

2.1 The marginal cost of public funds for labour versus green taxes: Individual country and EU-wide results

The MCF is calculated for each EU country introducing each tax unilaterally. The key results are reported in Table 2, which compares the GDP-weighted value for the within country MCF (corresponding to equation 1 above) for labour and energy taxes. These results show that the efficiency losses from green taxes are far smaller than for labour taxes. Considering EU-wide figures, the value for labour taxes of 1.90 implies that to raise an additional 1 euro of revenue, the average efficiency loss would be 0.90 euros. In contrast, raising an additional 1 euro of revenue from energy taxes, leads to an average efficiency loss of only 8 cents. Note that these values obtained for the MCF are broadly in line with the existing literature commented in Section 1. The result is also consistent with economic theory, which suggests that taxing relatively inelastic goods, such as energy, will result in only small distortions. This is not the case for labour if one is faced with a labour supply curve that is at least somewhat elastic. Furthermore, increased unemployment also requires additional social security payments from the government, which is also incorporated in the model. The detailed country results also bring results in line with prior expectations whereby countries with high starting level of taxation have also the highest values of the MCF. An important point to note regarding the energy taxes is that it is possible for MCF values to fall below one in some countries. This reflects the situation where a good is, in effect, under-taxed from an efficiency perspective, and raising the tax improves the overall efficiency of the economy. Tax efficiency, in this sense, is similar to the notion first put forward by Ramsey (1927), which proposed that consumption taxes for a particular good should be proportional to the inverse of the price elasticity of demand. The relative inelasticity of demand for energy taxes tends to make them good candidates for efficient taxation.

Regarding the MCF of labour taxes, there is a fair range across different countries from only 1.30 in Estonia to 2.41 in France. For the MCF of green taxes, the range is from 0.62 in Bulgaria to 1.42 in France. An important point to notice is that in every country, the MCF for labour taxes is higher than for green taxes, suggesting that all countries would see an efficiency gain from switching from labour to green taxes. These country values are compared with the total tax share of GDP in each country in Figure 2. For example, the highest potential losses from tax hikes are found for France, which has a MCF of 2.41 for labour taxes and a tax share of GDP of 44.6 per cent. Focusing firstly on labour taxes (the triangles), there is a tendency for those countries with a higher tax share of GDP to also have a higher MCF. This is consistent with the notion of the Laffer Curve, which suggests that as overall taxes rise, further taxation at the margin becomes progressively less efficient. Interestingly, this notion does not hold for green taxes where there is no clear relationship between the overall tax burden and the MCF, suggesting that (on average) green taxes are especially efficient in comparison to labour taxes for countries that have a high overall tax share. It is also interesting to note that the effect of green tax appears to be more heterogeneous across countries than labour taxes which could be explained by the original diverse taxation of energy-intensive products in EU Member States contrary to rather homogeneous factor labour. This

Table 2

Marginal Cost of Public Funds for Labour Taxes and Energy Taxes

Country	Labour Taxes	Green Taxes
Austria	1.82	0.87
Belgium	1.98	0.63
Bulgaria	1.56	0.62
Czech Republic	1.49	0.81
Germany	1.96	1.14
Denmark	2.31	0.86
Estonia	1.30	0.79
Greece	1.59	0.85
Spain	1.79	0.89
Finland	1.61	0.63
France	2.41	1.42
Hungary	1.53	0.86
Ireland	1.33	0.62
Italy	1.68	1.10
Lithuania	1.45	0.84
Latvia	1.42	0.82
Netherlands	1.57	0.83
Poland	1.63	1.26
Portugal	1.82	0.93
Romania	1.43	0.89
Sweden	2.06	0.87
Slovenia	1.66	0.95
Slovakia	2.19	1.06
United Kingdom	1.81	1.13
EU average (GDP-weighted)	*1.90*	*1.08*
Simple average	*1.73*	*0.90*
Coefficient of variation	*17.38%*	*22.21%*

point is illustrated by considering separately the values of the MCF against the initial tax burden of labour and energy tax separately in the country-specific results reported in Figure 2.

Raising tax rates in a single country primarily affects welfare in that country, but there are also spillover effects to other EU countries. Comparing the individual country results for MCF with the EU-wide results shows the extent of these spillover effects. The EU-wide MCF is calculated according to Equation 2 above. Table 3 compares the individual country MCF with the EU-wide MCF for labour taxes. The spillover effect reported here refers to the percentage of the total EU-wide MCF that is *not* accounted for in the individual country MCF. For example, for Germany the EU-wide MCF is 2.04, of which 1.96 is the individual country effect. Therefore, in percentage terms the spillover effect is 3.6 per cent of the total effect.[6] As can be seen, the spillover effects are typically modest for labour taxes. The countries with the highest percentage spillover effects (Belgium, Denmark and the Netherlands) are relatively small countries, with high trade to GDP shares. Table 4 reports the individual country and EU-wide MCFs for energy taxes and calculates the spillover effects. One difference in comparison to the comparable values for labour taxation in Table 3 is that the spillover effects, on average, represent a much higher percentage of the total EU-wide MCF. This reflects that energy-intensive goods tend to be more intensively traded than the average of the economy.

Finally one should note that the results reported in Table 1 do not allow us to say anything about the importance of each country on the magnitude of a welfare change given that the MCF measure is the ratio between this variable and the tax revenue variation. In order to check this we have calculate the share of each country in the welfare variation and the tax revenue variation of the spillover component of equation (4). These calculations indicated that some countries have a more prominent role because of their size (Germany, France and the UK are the salient cases) or because of their degree of openness to the rest of EU economies (which is the case for Belgium or the Netherlands). We also looked at the role of each separate country on the EU-wide spillovers considering separately positive and negative effects on welfare and tax revenues. As in the case of labour taxes, we again observed that the large EU countries generate most of the spillovers although here some relatively small albeit open countries tend to play a bigger role (e.g., Belgium and the Netherlands in particular). The sign of the spillover effect was predominantly negative, thus suggesting that, *ceteris paribus*, a tax increase in a given country deteriorates the overall EU economic efficiency.

More generally, our results suggest overwhelmingly that should tax increases be considered in EU countries, energy taxes represent a better candidate than labour taxes. One possible reason for this could be that labour taxes have a bearing on labour supply and production levels. Green taxes in turn only impact on consumption and only indirectly on labour supply (through the level of post-tax increases level of income). In a second best world, a new distortion balances other distortions and the equalisation of the MCF across tax categories suggests that energy is relatively under-taxed compared to labour taxes, at least in the EU countries considered here. This result is not necessarily surprising given that the MCF is known to increase linearly with the level of taxation, see Dahlby (2008) such that it is generally a better option to increase low- burden tax rates rather than increasing tax rates which are already at a high level. Our investigation of the cross-country spillovers on energy taxes provides more nuanced results, however. Adopting the view of a benevolent EU-tax policy makers would certainly advocate for increasing the green rather than the labour tax, although the advantage of the former over the latter becomes less important once cross-country spillovers are considered. Indeed our analysis shows that these spillovers are potentially more important for energy rather than for labour taxes. This result in a way illustrates the theoretical finding by Bovenberg and De Moij (1994) who showed that the

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[6] The calculation is: (2.04 – 1.96) / 2.04 = 3.6%.

Table 3

MCF of Labour Taxes: Country Vs EU-wide Effects

Country	Country-level MCF	EU-level MCF	Spillover Effect*
Austria	1.82	1.91	4.30%
Belgium	1.98	2.29	13.52%
Bulgaria	1.56	1.59	1.77%
Czech Republic	1.49	1.50	0.97%
Germany	1.96	2.04	3.63%
Denmark	2.31	2.56	9.69%
Estonia	1.30	1.36	4.20%
Greece	1.59	1.60	0.88%
Spain	1.79	1.84	2.37%
Finland	1.61	1.66	2.77%
France	2.41	2.50	3.71%
Hungary	1.53	1.58	3.71%
Ireland	1.33	1.41	5.27%
Italy	1.68	1.68	–0.19%
Lithuania	1.45	1.49	2.47%
Latvia	1.42	1.49	4.27%
Netherlands	1.57	1.69	7.00%
Poland	1.63	1.63	–0.36%
Portugal	1.82	1.93	5.34%
Romania	1.43	1.42	–0.56%
Sweden	2.06	2.15	4.37%
Slovenia	1.66	1.78	6.80%
Slovakia	2.19	2.22	1.46%
United Kingdom	1.81	1.86	2.76%
EU (GDP-weighted)	*1.90*	*1.97*	*3.49%*
Simple average	*1.73*	*1.80*	*4.04%*
Coefficient of variation	*17.38%*	*18.99%*	

* Calculated as the percentage of the second term in the right hand side of equation (2) divided by the MCPF measured for the EU. The change in the labour tax concerns total social security contribution paid by the employers and the employees. The tax increase is equal to 0.05 percentage points.

Table 4

The MCF of Green Taxes: Country Vs EU-wide Effects

Country	**Country-level MCF**	**EU-level MCF**	**Spillover Effect**[*] *(percent of total MCF)*
Austria	0.87	1.07	18.3%
Belgium	0.63	0.87	27.9%
Bulgaria	0.62	0.64	4.6%
Czech Republic	0.81	0.87	6.5%
Germany	1.14	1.24	8.2%
Denmark	0.86	0.93	6.5%
Estonia	0.79	0.92	13.5%
Greece	0.85	0.90	5.5%
Spain	0.89	0.98	9.5%
Finland	0.63	0.70	10.6%
France	1.42	1.54	7.7%
Hungary	0.86	1.01	14.6%
Ireland	0.62	0.88	29.5%
Italy	1.10	1.14	3.6%
Lithuania	0.84	0.95	11.8%
Latvia	0.82	0.84	2.1%
Netherlands	0.83	0.97	14.4%
Poland	1.26	1.27	1.1%
Portugal	0.93	1.06	12.9%
Romania	0.89	0.95	6.0%
Sweden	0.87	0.95	8.0%
Slovenia	0.95	1.10	13.7%
Slovakia	1.06	1.17	9.5%
United Kingdom	1.13	1.17	3.6%
EU (GDP-weighted)	*1.08*	*1.17*	*7.8%*
Simple average	*0.90*	*1.00*	*10.2%*
Coefficient of variation	*22.21%*	*19.02%*	

[*] Calculated as the percentage of the second term in the right hand side of equation (2) divided by the MCPF measured for the EU. The change in the Energy tax concerns the energy consumption by households (in real terms). The tax increase is equal to 0.05 percentage points.

optimal level of environmental taxes lied below the Pigouvian level once tax interactions were considered. Our results show similarly that when countries' interactions are considered the advantage of raising green versus labour taxes is reduced although green taxes increases remain a better option than labour tax increases thus suggesting that potential tax shifting between labour and energy taxes would yield significant benefits in terms of economic efficiency.

2.2 *The role of labour market flexibility*

The degree of labour market flexibility reflects the extent to which a change in wages resulting from a tax increase affects the supply of labour. By altering the degree of labour market flexibility, we address the question of whether the real wage reflects the marginal product of labour or whether wage rigidity, linked to labour market imperfection, hinders such an adjustment (see, in particular, Boeters and Savard, 2011, for a review of the literature, and Hutton and Ruocco, 1999, for an example of analysis of the impact of tax changes with efficiency wage in a CGE model). In the labour market setting adopted here, the tax change will not be fully reflected in the real wage because of the existence of a wage premium of certain categories of workers. In such a setting the interaction between the tax system and the labour market setting can be non-negligible, especially, though not exclusively, when considering labour tax changes.[7] The version of GEM-E3 used in this paper includes a labour market setting consistent with the efficiency wage theory of Shapiro and Stiglitz (1987). This theory posits, firstly, that the productivity of labour has a positive correlation with wages leading firms to offer a wage premium, and secondly, that this wage premium increases with lower employment. In periods of high unemployment firms have less need to offer high wages to attract more productive workers or to increase productivity of existing workers. The wage setting in such model is given by the following expression:

$$w \cdot \frac{PCI}{\overline{PCI}} = \overline{w}\overline{r} + e + \frac{e}{q} \cdot \left[\left(\frac{b}{u} \right)^{eg} + r \right] \tag{3}$$

where PCI is the consumer price index and eg an adjustment parameter to reflect the different labour market flexibility conditions that prevail in each country, b is the quit from job rate, u is the actual unemployment rate, r is the interest rate, w is the wage rate, e is the disutility from working (for the "shirker" e=0) and q measures the efficiency of the workforce, see European Commission (2012) for more details on the derivation of equation (3). In this equation, the degree of labour market flexibility in the model is captured in the parameter eg, which can be adjusted. A higher eg indicates a higher degree of labour market flexibility, *i.e.*, according to equation (3) the higher the transmission of the quit rate and the lower the impact of unemployment changes on the real wage level.[8] Re-running the model with different values of eg allow an investigation into the

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7 Note that in our model there is only one representative individual and only one tax rate for each tax category based on the calibration using the data contained in the SAMs. For the labour market in particular we thus consider only one country average effective tax rate for each tax category. Therefore the progressivity of tax systems is not accounted for. Studies tend to show that the labour tax progressivity can have non-trivial effects on labour supply and therefore on the MCF (see in particular Lockwood and Manning, 1993).

8 There is arguably no specific reason for choosing a specific value for eg against another one, as the highly stylised representation of the labour market used in the version of GEM-E3 allow us to say little about whether this is convenient or not. One could argue, for instance, that since the eg parameter should represent as closely as possible the degree of flexibility of the labour market, country-specific values should be set in accordance to "estimated", e.g., by the labour market literature. In fact, this is only partly true in the labour market setting outlines in Appendix 2, given that, while the parameter eg is set at an *ad hoc* value, the level of unemployment used is taken from observed data. Instead of trying to stick to some *ad hoc* country-specific measure of labour market flexibility, we chose instead to keep the same value of this parameter across countries and rather to check whether the MCF estimates change when the degree of flexibility is higher or lower than in our benchmark cases, without inferring too much about whether this degree of flexibility reflects the reality of EU countries labour markets. In adopting this approach, we are therefore more interested in the change in the value of the MCF on average across EU countries rather than on whether the country-specific degrees of "flexibility" are correctly reflected.

impact of labour market flexibility on the MCF.[9] Our high flexibility scenario involved doubling *eg*, whereas our low flexibility scenario involved halving *eg*. These are large hypothetical changes in order to allow us to explore the responsive of the MCF values without being intended to reflect possible policy changes affecting the labour market. Table 5 shows the results for the high and low labour market flexibility cases for the labour tax MCF and green tax MCF respectively for the EU as a whole. These results clearly shows a large impact on the MCF for labour taxes, with a less flexible labour market raising the EU average MCF (GDP-weighted) by 33.6 per cent to 2.54 and a more flexible labour market reducing it by 13.6 per cent to 1.64. These results should not come as a surprise given that labour market flexibility affects directly the way the change in wage costs is transmitted to the employment level, such as from a marginal rise in labour taxes. Nevertheless, the results do demonstrate the importance of labour market flexibility for the MCF of labour taxes. By contrast, the effect on the MCF of energy taxes is much less pronounced. On average, the MCF rises by less than 5 per cent under less flexible labour market conditions and is reduced by just over 3 per cent under more flexible conditions. The country-specific results are shown in Tables 13 and 14 in the Appendix. These show some interesting features, however given that in some cases the efficiency wage assumption does not fully capture the degree and nature of the rigidity of each specific labour market, we feel that the country-specific results should be interpreted with care. For example, Spain barely experiences a change in its MCF while this country is known to have especially distorted labour market, whereas other large countries, especially France and Germany, show large fluctuations in the MCF for labour taxes.

3 Robustness checks

We provide a number of additional results to the analysis carried out above in order to verify their robustness to alternative assumptions regarding the values of the labour supply elasticities, which may ultimately affect the number of hours worked in our model where time worked is chosen against leisure or unemployment. In addition, given that we consider EU economies, which are closely linked together through international trade, we also provide alternative estimates of the MCF depending on the degree of substitution between domestic production and imported goods. This is done by specifying alternative assumption regarding the Armington elasticities. Finally we also consider alternative hypotheses regarding the recycling of the extra-tax revenues yielded from the marginal tax increases in order to check whether our central benchmark case (*i.e.*, through a direct income transfer to the rest of the world) does not influence our results.

In order to investigate the impact of the labour supply elasticities on the MCF values, we replaced the labour supply elasticities with values from the literature, where available, and average values otherwise. Specifically, we took the values for labour supply elasticity from Evers *et al.* (2008). This study reports estimates of labour supply elasticity for selected countries for men and women separately. We took these values and weighted them by gender share in the workforce to give an overall value using Eurostat data for 2005. This gave us estimates for France, Sweden, Germany, Italy and the Netherlands. Two further countries, UK and Finland, have values for women only. Using the average ratio of the elasticity of men to women, we further completed the missing estimates for the overall elasticity in these two countries. For the rest of the EU, we took an average of these values. We then recalibrated our model to have these labour supply elasticities, and re-ran the simulations to calculate the MCF for labour and energy taxes. The values of the base labour supply elasticities are compared with those used in this robustness check in Table 6.

As can be seen from Table 7, the average, GDP-weighted MCF is lower when using these elasticities – the individual country average falls from 1.90 to 1.62 and the EU-wide average falls

[9] Note that, in this case, the values for *ef* must be recalibrated.

Table 5

The Marginal Cost of Public Funds and Labour Market Flexibility: The Case of Labour Tax

	MCF, Benchmark Case	Less Flexible Labour Market	More Flexible Labour Market
Labour Taxes	**1.90**	**2.54**	**1.64**
EU average (GDP-weighted)			
percent change vs. benchmark		*+33.6%*	*–13.6%*
Green Taxes	**1.08**	**1.13**	**1.04**
EU average (GDP-weighted)			
percent change vs. benchmark		*+4.6%*	*–3.3%*

Table 6

Labour-supply Elasticities: Base Vs. Robustness-check Values

Country	Base L-supply Elasticity Values*	New L-supply Elasticity Values*
Austria	0.520	0.346
Belgium	0.761	0.346
Bulgaria	0.474	0.346
Czech Republic	0.405	0.346
Germany	0.611	0.024
Denmark	0.814	0.346
Estonia	0.511	0.346
Greece	0.646	0.346
Spain	0.820	0.346
Finland	0.709	0.019
France	0.657	0.179
Hungary	0.533	0.346
Ireland	0.471	0.346
Italy	0.481	1.173
Lithuania	0.685	0.346
Latvia	0.691	0.346
Netherlands	0.521	0.554
Poland	0.577	0.346
Portugal	1.154	0.346
Romania	0.601	0.346
Sweden	0.670	0.389
Slovenia	0.778	0.346
Slovakia	0.532	0.346
United Kingdom	0.816	0.085

* Base values calculated from GEM-E3 model; new values derived from Evers *et al.* (2008, see text above).

Table 7

MCF with Different Labour-supply Elasticities: Labour Taxes

Country	**Country-level MCF**		**EU-level MCF**	
	Base L-supply Elasticity	**New L-supply Elasticity**	**Base L-supply Elasticity**	**New L-supply Elasticity**
Austria	1.82	1.69	1.91	1.72
Belgium	1.98	1.59	2.29	1.68
Bulgaria	1.56	1.60	1.59	1.62
Czech rep.	1.49	1.51	1.50	1.51
Germany	1.96	1.32	2.04	1.24
Denmark	2.31	1.66	2.56	1.72
Estonia	1.30	1.31	1.36	1.34
Greece	1.59	1.47	1.60	1.47
Spain	1.79	1.88	1.84	1.86
Finland	1.61	1.51	1.66	1.44
France	2.41	1.75	2.50	1.73
Hungary	1.53	1.48	1.58	1.50
Ireland	1.33	1.35	1.41	1.41
Italy	1.68	1.96	1.68	2.01
Lithuania	1.45	1.51	1.49	1.49
Latvia	1.42	1.42	1.49	1.44
Netherlands	1.57	1.48	1.69	1.62
Poland	1.63	1.61	1.63	1.58
Portugal	1.82	1.61	1.93	1.62
Romania	1.43	1.52	1.42	1.48
Sweden	2.06	1.82	2.15	1.86
Slovenia	1.66	1.56	1.78	1.60
Slovakia	2.19	2.29	2.22	2.27
United Kingdom	1.81	1.51	1.86	1.52
EU (GDP-weighted)	*1.90*	*1.62*	*1.97*	*1.61*
Simple average	*1.73*	*1.60*	*1.80*	*1.61*
Coefficient of variation	*17.4%*	*13.7%*	*19.0%*	*13.9%*

from 1.97 to 1.61. Note that the net spillover effects are near-zero when using the new elasticities. Nevertheless, the pattern is quite closely related to the base case with a correlation coefficient for the individual country values of 0.58. In the case of energy taxes, shown in Table 8, the GDP-weighted values for the EU also fall from 1.08 to 1.01 for individual country MCF, and from 1.17 to 1.06 for the EU-wide MCF. The values for MCF closely reflect the base values with a correlation coefficient of 0.97 for the individual country MCFs. Considering both Table 7 and 8, one notes that the relative size of the MCF for labour and energy taxes tells the same story as our base case, strongly suggested that our main result – that energy taxes are generally less distortionary than labour taxes – is robust to these new specifications.

As noted, an important feature of our CGE model, GEM-E3, is the modelling on international trade. The price sensitivity of these trade flows is determined primarily by the trade elasticities in the model. These elasticities are always somewhat uncertain, and therefore, it is good practice to test the robustness of our results against alternative values. Four extra model runs are carried out for each tax type and the MCF re-estimated. These are (i) increased then (ii) decreased import (Armington) elasticities, and then (iii) increased then (iv) decreased export elasticities. Tables 9 and 10 show the EU average results (GDP-weighted). The values reported as "base trade elasticity" are the benchmark results (as reported in Table 2). One can detect a minor tendency for higher trade elasticities to cause higher MCF estimates. However, the main observation is that the value of the trade elasticities have little impact on the MCF, and so the conclusions are robust to such changes.

As explained in Section 2, the calculation of the MCF involves implementing a marginal increase in the tax rate. Our preferred methodology for dealing with the extra revenue raised is to give it to the rest of the world, so there is no domestic benefit from additional government spending. Nevertheless, it is sensible to try an alternative closure of the model in order to assess whether this choice unduly influences our results. With this in mind, we ran the model with the additional revenues being returned to household by means of a lump sum transfer. This was run for both labour and energy taxes, with the results being reported in Tables 11 and 12. Note that in this case, the MCF values obtained are not one plus the distortion ($1 + \alpha$), but simply the distortion itself (α), as the 1 extra-tax revenues is transferred back to households already. In order for the results tables to be comparable to the earlier values, a one has been added to the MCF estimates obtained. Evidently, the different closure rule results in a smaller MCF for labour taxes, both at the individual country and the EU-wide levels. Otherwise, the variation across countries is similar to the standard values; the correlation coefficient for the individual country MCFs is 0.68. Regarding the MCF for green taxes, again the different closure rule reduces the estimates. However as for labour taxes, the variation across countries is similar with a correlation coefficient for the individual country MCFs of 0.80. From this robustness check, we can clearly see that our main result holds – that the MCF for labour is considerably higher than for green taxes. The magnitude of the MCF in this specification is lower. We choose to rely more on our standard estimates, because with this closure, the measurement of the MCF is altered as one must now take into account the benefits from additional spending.

4 Conclusions

Our research provides some useful evidence for EU countries that are considering how to approach fiscal consolidation. Firstly, the modelling work makes a strong case that the economic distortions caused by labour taxes are greater than for green taxes. This is an important consideration when seeking to promote economic recovery. Assuming that the revenue yield would be the same, relying on energy taxation to raise revenues, rather than labour taxation, would be expected to be more efficient for the economy as a whole. This result holds for all EU member

Table 8

MCF with Different Labour-supply Elasticities: Green Taxes

Country	Country-level MCF		EU-level MCF	
	Base L-supply Elasticity	New L-supply Elasticity	Base L-supply Elasticity	New L-supply Elasticity
Austria	0.87	0.81	1.07	0.97
Belgium	0.63	0.59	0.87	0.78
Bulgaria	0.62	0.61	0.64	0.64
Czech Republic	0.81	0.80	0.87	0.85
Germany	1.14	0.99	1.24	1.01
Denmark	0.86	0.87	0.93	0.89
Estonia	0.79	0.81	0.92	0.98
Greece	0.85	0.84	0.90	0.87
Spain	0.89	0.91	0.98	0.99
Finland	0.63	0.68	0.70	0.71
France	1.42	1.26	1.54	1.32
Hungary	0.86	0.81	1.01	0.95
Ireland	0.62	0.57	0.88	0.81
Italy	1.10	1.11	1.14	1.17
Lithuania	0.84	0.85	0.95	0.79
Latvia	0.82	0.85	0.84	0.85
Netherlands	0.83	0.76	0.97	0.91
Poland	1.26	1.25	1.27	1.25
Portugal	0.93	0.89	1.06	0.98
Romania	0.89	0.91	0.95	0.95
Sweden	0.87	0.84	0.95	0.87
Slovenia	0.95	0.91	1.10	1.06
Slovakia	1.06	1.05	1.17	1.12
United Kingdom	1.13	1.08	1.17	1.10
EU (GDP-weighted)	*1.08*	*1.01*	*1.17*	*1.06*
Simple average	*0.90*	*0.88*	*1.00*	*0.95*
Coefficient of variation	*22.2%*	*20.5%*	*19.0%*	*17.2%*

Table 9

MCF with Different Trade Elasticities: Labour Taxes
(EU averages)

	Country-level MCF			EU-level MCF		
	High Trade Elasticity	Base Trade Elasticity	Low Trade Elasticity	High Trade Elasticity	Base Trade Elasticity	Low Trade Elasticity
Different import elasticities	1.91	1.90	1.88	1.97	1.97	1.96
Different export elasticities	1.90	1.90	1.89	1.97	1.97	1.96

Table 10

MCF with Different Trade Elasticities: Green Taxes
(EU averages)

	Country-level MCF			EU-level MCF		
	High Trade Elasticity	Base Trade Elasticity	Low Trade Elasticity	High Trade Elasticity	Base Trade Elasticity	Low Trade Elasticity
Different import elasticities	1.10	1.08	1.05	1.17	1.17	1.16
Different export elasticities	1.09	1.08	1.07	1.17	1.17	1.17

states modelled and despite the fact that potential welfare-enhancing effect of pollution abatement are cancelled out in our model.

Nevertheless, further investigation showed that this result is somewhat less strong when one considers the spillover effects between countries, as these are more pronounced (in relative terms) for green taxes. This suggests that close coordination across EU countries would be beneficial, especially in the case of green taxation. Another key result from our research is that the flexibility of the labour market has important effects on the level of distortion: more flexible labour markets are associated with lower distortions. As one would expect, the effect is more pronounced for labour taxes, though there is also some effect for green taxes. The implication is that were EU countries to undertake structural reforms (especially in the labour market), this would help to minimise the efficiency losses from tax-driven fiscal consolidations. A final consideration, not addressed in the current paper, is the progressivity of the different tax types, which would be an interesting avenue to explore in future research.

Table 11

MCF of Labour Taxes: Alternative Tax Recycling

Country	Country-level MCF		EU-level MCF	
	Standard Closure Rule	Alternative closure rule (with 1 Added)	Standard Closure Rule	Alternative Closure Rule (with 1 Added)
Austria	1.82	1.39	1.91	1.49
Belgium	1.98	1.28	2.29	1.48
Bulgaria	1.56	1.32	1.59	1.37
Czech Republic	1.49	1.29	1.50	1.38
Germany	1.96	1.64	2.04	1.75
Denmark	2.31	1.41	2.56	1.52
Estonia	1.30	1.18	1.36	1.24
Greece	1.59	1.48	1.60	1.51
Spain	1.79	1.40	1.84	1.46
Finland	1.61	1.36	1.66	1.41
France	2.41	1.78	2.50	1.87
Hungary	1.53	1.31	1.58	1.40
Ireland	1.33	1.14	1.41	1.19
Italy	1.68	1.38	1.68	1.42
Lithuania	1.45	1.21	1.49	1.29
Latvia	1.42	1.25	1.49	1.31
Netherlands	1.57	1.15	1.69	1.29
Poland	1.63	1.37	1.63	1.43
Portugal	1.82	1.45	1.93	1.56
Romania	1.43	1.37	1.42	1.42
Sweden	2.06	1.41	2.15	1.48
Slovenia	1.66	1.37	1.78	1.48
Slovakia	2.19	1.34	2.22	1.43
United Kingdom	1.81	1.37	1.86	1.41
EU (GDP-weighted)	*1.90*	*1.48*	*1.97*	*1.56*
Simple average	*1.73*	*1.36*	*1.80*	*1.44*
Coefficient of variation	*17.4%*	*10.4%*	*19.0%*	*10.2%*

Table 12

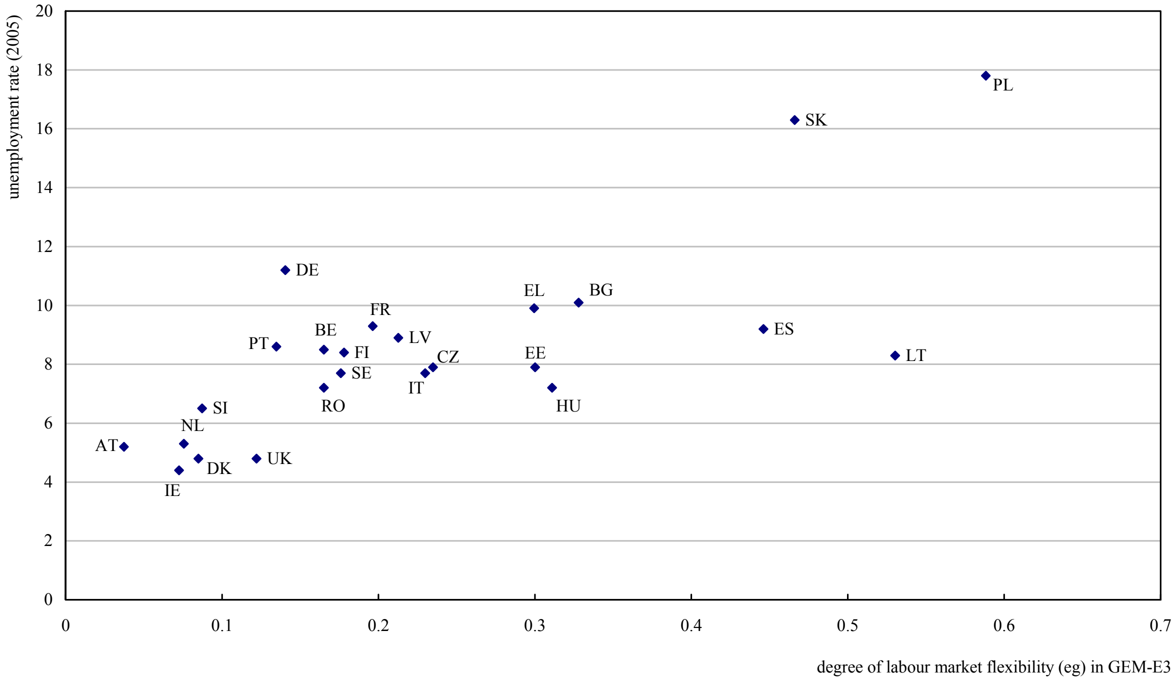
MCF of Energy Taxes: Alternative Tax Recycling

Country	Country-level MCF		EU-level MCF	
	Standard Closure Rule	Alternative closure rule (with 1 Added)	Standard Closure Rule	Alternative Closure Rule (with 1 Added)
Austria	0.87	0.70	1.07	0.85
Belgium	0.63	0.55	0.87	0.73
Bulgaria	0.62	0.58	0.64	0.66
Czech Republic	0.81	0.72	0.87	0.84
Germany	1.14	0.97	1.24	1.10
Denmark	0.86	0.86	0.93	0.90
Estonia	0.79	0.79	0.92	0.86
Greece	0.85	0.79	0.90	0.84
Spain	0.89	0.73	0.98	0.82
Finland	0.63	0.71	0.70	0.78
France	1.42	1.05	1.54	1.17
Hungary	0.86	0.75	1.01	0.88
Ireland	0.62	0.61	0.88	0.77
Italy	1.10	0.89	1.14	0.96
Lithuania	0.84	0.70	0.95	0.78
Latvia	0.82	0.74	0.84	0.74
Netherlands	0.83	0.65	0.97	0.80
Poland	1.26	1.01	1.27	1.10
Portugal	0.93	0.71	1.06	0.81
Romania	0.89	0.85	0.95	0.93
Sweden	0.87	0.77	0.95	0.82
Slovenia	0.95	0.83	1.10	0.94
Slovakia	1.06	0.58	1.17	0.68
United Kingdom	1.13	0.89	1.17	0.92
EU (GDP-weighted)	*1.08*	*0.88*	*1.17*	*0.97*
Simple average	*0.90*	*0.77*	*1.00*	*0.86*
Coefficient of variation	*22.2%*	*17.3%*	*19.0%*	*14.7%*

APPENDIX

Figure 3

Labour Market Flexibility in GEM-E3 and Actual Unemployment Rates, 2005



Sources. GEM-E3 calibration and Ameco (European Commission, DG ECFIN).

Table 13

MCF and Labour-market Flexibility: The Case of Labour Tax

EU Results			
	MCF, Benchmark Case	**Less Flexible Labour Market**	**More Flexible Labour Market**
EU *percent of change vs. benchmark*	1.9	2.54 *33.60%*	1.64 *–13.60%*

Country Results			
Country	**MCF, Benchmark Case**	**Less Flexible Labour Market**	**More Flexible Labour Market**
Austria	1.82	2.41	1.6
Belgium	1.98	2.98	1.64
Bulgaria	1.56	1.51	1.6
Czech Republic	1.49	1.63	1.42
Germany	1.96	3.07	1.56
Denmark	2.31	4.85	1.75
Estonia	1.3	1.29	1.33
Greece	1.59	1.77	1.43
Spain	1.79	1.8	1.8
Finland	1.61	1.77	1.52
France	2.41	3.64	1.91
Hungary	1.53	1.7	1.43
Ireland	1.33	1.27	1.38
Italy	1.68	1.92	1.52
Lithuania	1.45	1.44	1.47
Latvia	1.42	1.44	1.41
Netherlands	1.57	2.43	1.31
Poland	1.63	1.78	1.53
Portugal	1.82	2.05	1.66
Romania	1.43	1.4	1.46
Sweden	2.06	2.57	1.79
Slovenia	1.66	1.84	1.55
Slovakia	2.19	2.3	2.13
United Kingdom	1.81	2	1.66

Table 14

MCF and Labour-market Flexibility: The Case of Green Taxes

EU Results			
	MCF, Benchmark Case	**Less Flexible Labour Market**	**More Flexible Labour Market**
EU	1.08	1.13	1.04
percent of change vs. benchmark		*4.60%*	*–3.30%*
Country Results			
	MCF, Benchmark Case	**Less Flexible Labour Market**	**More Flexible Labour Market**
Austria	0.87	0.88	0.87
Belgium	0.63	0.61	0.65
Bulgaria	0.62	0.61	0.64
Czech Republic	0.81	0.82	0.82
Germany	1.14	1.24	1.07
Denmark	0.86	0.87	0.88
Estonia	0.79	0.81	0.93
Greece	0.85	0.87	0.84
Spain	0.89	0.86	0.92
Finland	0.63	0.61	0.65
France	1.42	1.55	1.33
Hungary	0.86	0.87	0.85
Ireland	0.62	0.59	0.65
Italy	1.1	1.13	1.07
Lithuania	0.84	0.87	0.88
Latvia	0.82	0.83	1.02
Netherlands	0.83	0.85	0.82
Poland	1.26	1.29	1.23
Portugal	0.93	0.93	0.91
Romania	0.89	0.86	0.91
Sweden	0.87	0.88	0.84
Slovenia	0.95	0.96	0.94
Slovakia	1.06	1.06	1.06
United Kingdom	1.13	1.16	1.11

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QUALITY OF GOVERNMENT AND LIVING STANDARDS: ADJUSTING FOR THE EFFICIENCY OF PUBLIC SPENDING

Francesco Grigoli[*] *and Eduardo Ley*[**]

*It is generally acknowledged that the government's output is difficult to define and its value is hard to measure. The practical solution, adopted by national accounts systems, is to equate output to input costs. However, several studies estimate significant inefficiencies in government activities (*i.e.*, same output could be achieved with less inputs), implying that inputs are not a good approximation for outputs. If taken seriously, the next logical step is to purge from GDP the fraction of government inputs that is wasted. As differences in the quality of the public sector have a direct impact on citizens' effective consumption of public and private goods and services, we must take them into account when computing a measure of living standards. We illustrate such a correction computing corrected per capita GDPs on the basis of two studies that estimate efficiency scores for several dimensions of government activities. We show that the correction could be significant, and rankings of living standards could be re-ordered as a result.*

1 Introduction

> "*Citizens, especially poor people, who ultimately consume the education and health services generated by the public system are the clients. They have a direct relationship with frontline service providers, such as teachers in public schools and health care workers in public health facilities – the short route of accountability. Crucially, however, the service providers generally have no direct accountability to the consumers, unlike in a market transaction. Instead, they are accountable only to the government that employs them. The accountability route from consumers to service providers is therefore through the government – the long route. To hold service providers accountable for the quantity and quality of services provided, citizens must act through the government a process that is difficult for poor people especially because they can seldom organize themselves and be heard by policy makers. Moreover, the government rarely has enough information or indeed the mechanisms to improve service provider performance*". Global Monitoring Report, *World Bank*, 2011; p. 74.

Despite its acknowledged shortcomings, GDP per capita is still the most commonly used summary indicator of living standards. Much of the policy advice provided by international organizations is based on macroeconomic magnitudes as shares of GDP, and framed on cross-country comparisons of per capita GDP. However, what GDP does actually measure may differ significantly across countries for several reasons. We focus here on a particular source for this heterogeneity: the quality of public spending. Broadly speaking, the "quality of public spending" refers to the government's effectiveness in transforming resources into socially valuable outputs.

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The opening quote highlights the disconnect between spending and value when the discipline of market transactions is missing.

Everywhere around the world, non-market government accounts for a big share of GDP[1] and yet it is poorly measured – namely the value to users is assumed to equal the producer's cost. Such a framework is deficient because it does not allow for changes in the amount of output produced per unit of input, that is, changes in productivity (for a recent review of this issue, see Atkinson *et al.*, 2005). It also assumes that these inputs are fully used. To put it another way, standard national accounting assumes that government activities are on the best practice frontier. When this is not the case, there is an overstatement of national production. This, in turn, could result in misleading conclusions, particularly in cross-country comparisons, given that the size, scope, and performance of public sectors vary so widely.

Moreover, in the national accounts, this attributed non-market (government and non-profit sectors) "value added" is further allocated to the household sector as "actual consumption". As Deaton and Heston (2008) put it: "[...] there are many countries around the world where government-provided health and education is inefficient, sometimes involving mass absenteeism by teachers and health workers [...] so that such 'actual' consumption is anything but actual. To count the salaries of AWOL[2] government employees as 'actual' benefits to consumers adds statistical insult to original injury". This "statistical insult" logically follows from the United Nations System of National Accounts (SNA) framework once "waste" is classified as income – since national income must be either consumed or saved. Absent teachers and health care workers are all too common in many low-income countries (Chaudhury and Hammer, 2004; Kremer *et al.*, 2005; Chaudhury *et al.*, 2006; and World Bank, 2004). Beyond straight absenteeism, which is an extreme case, generally there are significant cross-country differences in the quality of public sector services. World Bank (2011) reports that in India, even though most children of primary-school age are enrolled in school, 35 per cent of them cannot read a simple paragraph and 41 per cent cannot do a simple subtraction.

It must be acknowledged, nonetheless, that for many of government's non-market services, the output is difficult to define, and without market prices the value of output is hard to measure. It is because of this that the practical solution adopted in the SNA is to equate output to input costs. This choice may be more adequate when using GDP to measure economic activity or factor employment than when using GDP to measure living standards.

Moving beyond this state of affairs, there are two alternative approaches. One is to try to find indicators for both output quantities and prices for direct measurement of some public outputs, as recommended in SNA 93 (but yet to be broadly implemented). The other is to correct the input costs to account for productive inefficiency, namely to purge from GDP the fraction of these inputs that is wasted. We focus here on the nature of this correction. As the differences in the quality of the public sector have a direct impact on citizens' effective consumption of public and private goods and services, it seems natural to take them into account when computing a measure of living standards.

To illustrate, in a recent study, Afonso *et al.* (2010) compute public sector efficiency scores for a group of countries and conclude that "[...] the highest-ranking country uses one-third of the inputs as the bottom ranking one to attain a certain public sector performance score. The average input scores suggest that countries could use around 45 per cent less resources to attain the same

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1 Note that public expenditure (which includes transfers) is a different concept than the public sector's contribution to GDP (which excludes transfers). For instance, in France, in 2003, while the former amounted to 54 per cent of GDP, the latter was a smaller 16 per cent of GDP as social transfers (including pensions) are a substantial share of French public spending (see, e.g., Lequiller and Blades, 2006).

2 AWOL is an acronym meaning: "absent without official leave".

outcomes if they were fully efficient". In this paper, we take such a statement to its logical conclusion. Once we acknowledge that the same output could be achieved with less inputs, output value cannot be equated to input costs. In other words, *waste* should not belong in the living-standards indicator – it still remains a cost of government but it must be purged from the *value* of government services. As noted, this adjustment is especially relevant for cross-country comparisons.

The remainder of this paper is structured as follows. Section 2 discusses the measurement of living standards and the measurement of waste. Section 3 illustrates the empirical size this correction for waste would entail, and Section 4 concludes.

2 Measuring living standards

Per capita Gross National Income (GNI)[3] is the statistic that defines who is who in development rankings. The World Bank uses it to classify economies in groups. For a country to be eligible for international development assistance[4] (e.g., services which include grants and low-cost loans), it must satisfy two criteria, one of which is the relative poverty defined as GNI per capita below an established threshold that is updated annually. The cutoff for fiscal year 2011 is a 2009 GNI per capita of US$1,165. Likewise, to be eligible for International Bank for Reconstruction and Development (IBRD) lending, in 2011, a country must have a 2009 GNI per capita of between US$1,165 and US$6,885.[5]

While, under general circumstances, the GDP may be a suitable indicator for tracking economic activity for a given country over time,[6] its shortcomings in measuring economic welfare are well known. As it is often pointed out, GDP does not, for example, capture differences in leisure or in longevity; it does not reflect differences in inequality or in poverty; and it does not take into account the effect of economic activity on the environment. This has led to alternative attempts to enlarge the concept of GDP, one of the earliest being the "Measure of Economic Welfare" developed by Nordhaus and Tobin (1973). The recent *Report by the Commission on the Measurement of Economic Performance and Social Progress* prepared for the French government by Stiglitz *et al.* (2010) presents an insightful up-to-date summary of the issues.[7] Some of the report's main recommendations include (i) using net income- or consumption-based measures, together with wealth, rather than gross production-based aggregates, (ii) to broaden measures to non-market activities, and (iii) to consider a dashboard of indicators for the quality of life, environment, and sustainability. In addition, in the context of the public sector, many government activities (e.g., police, defense, sanitation services, road maintenance) are intermediate inputs[8] for production activities rather than genuine final outputs. Government services used by firms are called "instrumental expenditures" in Nordhaus and Tobin (1973). Similarly, in the private sphere, commuting to work would also be an "instrumental expenditure". These *instrumental expenditures* should be appropriately deducted from the aggregate measure of net income. Several government

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3 Gross National Income (GNI) differs from Gross Domestic Product (GDP) by the net factor income of nationals (net primary income from rest of the world). Adding official transfers and remittances (net current transfers from the rest of the world) we obtain Gross National Disposable Income (GNDI). All the issues that we raise pertaining to the measurement of GDP apply to the measurement of GNI.

4 The International Development Association (IDA) is the part of the World Bank that helps the world's poorest countries. It currently provides the world's poorest 79 countries with interest-free loans and grants.

5 See http://data.worldbank.org/about/country-classifications.

6 Nonetheless, for new issues posed by the growth of services at the expense of manufacturing, see Abraham (2005).

7 See also Dasgupta (2001).

8 See Hicks and Hicks (1939) for a summary of the early debate on what ought to be included in the national income (which, at the time, was a considered a welfare concept rather than a production concept as in the SNA).

functions that provide public goods – e.g., justice and defense – are arguably better classified as instrumental expenditures rather than goods and services for final household consumption notwithstanding the importance of these several issues, we restrict ourselves here to the SNA framework where GDP is taken as a measure of production, not welfare. We also ignore the issue of netting out "instrumental expenditures" from output.

In this context, as noted, the standard practice is to equate the value of government outputs to its cost, notwithstanding the SNA 93 proposal to estimate government outputs directly. The value added that, say, public education contributes to GDP is based on the wage bill and other costs of providing education, such as outlays for utilities and school supplies.[9] Similarly for public health, the wage bill of doctors, nurses and other medical staff and medical supplies measures largely comprises its value added. Thus, in the (pre-93) SNA used almost everywhere, non-market output, by definition, equals total costs. Yet the same costs support widely different levels of public output, depending on the quality of the public sector.

Atkinson *et al.* (2005, p. 12) state some of the reasons behind current SNA practice: "Wide use of the convention that (output = input) reflects the difficulties in making alternative estimates. Simply stated, there are two major problems: (a) in the case of collective services such as defense or public administration, it is hard to identify the exact nature of the output, and (b) in the case of services supplied to individuals, such as health or education, it is hard to place a value on these services, as there is no market transaction".

Murray (2010) also observes that studies of the government's *production* activities, and their implications for the measurement of living standards, have long been ignored. He writes: "Looking back it is depressing that progress in understanding the production of public services has been so slow. In the market sector there is a long tradition of studying production functions, demand for inputs, average and marginal cost functions, elasticities of supply, productivity, and technical progress. The non-market sector has gone largely unnoticed. In part this can be explained by general difficulties in measuring the output of services, whether public or private. But in part it must be explained by a completely different perspective on public and private services. Resource use for the production of public services has not been regarded as inputs into a production process, but as an end in itself, in the form of public consumption. Consequently, *the production activity in the government sector has not been recognized*" (our italics.)

The simple point that we make in this paper is that once it is recognized that the effectiveness of the government's "production function" varies significantly across countries, the simple convention of equating output value to input cost must be revisited. Thus, if we learn that the same output could be achieved with less inputs, it is more appropriate to credit GDP or GNI with the *required* inputs rather than with the *actual* inputs that include waste.[10] While perceptions of government effectiveness vary widely among countries as, e.g., the World Bank's Governance indicators attests (Kaufmann *et al.*, 2009), getting reliable measures of government actual effectiveness is a challenging task as we shall discuss below.

In physics, *efficiency* is defined as the ratio of useful work done to total energy expended, and the same general idea is associated with the term when discussing production. Economists simply replace "useful work" by "outputs" and "energy" by "inputs". Technical efficiency means the adequate use of the available resources in order to obtain the maximum product. Why focus on

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9 Note that value added is defined as payments to factors (labor and capital) and profits. Profits are assumed to be zero in the non-commercial public sector. As for the return to capital, in the current SNA used by most countries, public capital is attributed a *net* return of zero – *i.e.*, the return from public capital is equated to its depreciation rate. This lack of a net return measure in the SNA is not due to a belief that the net return is actually zero, but to the difficulties of estimating the return.

10 Among others, Prichett (2000), and Keefer and Knack (2007) have called attention to the quality of public investment where spending often may not translate into genuine asset-building. See also Tanzi and Davoodi (1997) and Gupta *et al.* (2011).

technical efficiency and not other concepts of efficiency, such as price or allocative efficiency? Do we have enough evidence on public sector inefficiency to make the appropriate corrections?

The reason why we focus on technical efficiency in this preliminary inquiry is twofold. First, it corresponds to the concept of waste. Productive inefficiency implies that some inputs are wasted as more could have been produced with available inputs.[11] In the case of allocative inefficiency, there could be a different allocation of resources that would make everyone better off but we cannot say that necessarily some resources are unused – although they are certainly not aligned with social preferences. Second, measuring technical inefficiency is easier and less controversial than measuring allocative inefficiency. To measure technical inefficiency, there are parametric and non-parametric methods allowing for construction of a best practice frontier. Inefficiency is then measured by the distance between this frontier and the actual input-output combination being assessed.[12]

Indicators (or rather ranges of indicators) of inefficiency exist for the overall public sector and for specific activities such as education, healthcare, transportation, and other sectors. However, they are far from being uncontroversial. Sources of controversy include: omission of inputs and/or outputs, temporal lags needed to observe variations in the output indicators, choice of measures of outputs, and mixing outputs with outcomes. For example, many social and macroeconomic indicators impact health status beyond government spending (Spinks and Hollingsworth, 2009, and Joumard *et al.*, 2010) and they should be taken into account. Most of the output indicators available show autocorrelation and changes in inputs typically take time to materialize into outputs' variations. Also, there is a trend towards using outcome rather than output indicators for measuring the performance of the public sector. In health and education, efficiency studies have moved away from outputs (e.g., number of pre-natal interventions) to outcomes (e.g., infant mortality rates). When cross-country analyses are involved, however, it must be acknowledged that differences in outcomes are explained not only by differences in public sector outputs but also differences in other environmental factors outside the public sector (e.g., culture, nutrition habits).

Empirical efficiency measurement methods first construct a reference technology based on observed input-output combinations, using econometric or linear programming methods. Next, they assess the distance of actual input-output combinations from the best-practice frontier. These distances, properly scaled, are called *efficiency measures* or scores. An input-based efficiency measure informs us on the extent it is possible to reduce the amount of the inputs without reducing the level of output. Thus, an efficiency score, say, of 0.8 means that using best practices observed elsewhere, 80 per cent of the inputs would suffice to produce the same output.

We base our corrections to GDP on the efficiency scores estimated in two papers: Afonso *et al.* (2010) for several indicators referred to a set of 24 countries, and Evans *et al.* (2000) focusing on health, for 191 countries based on WHO data. These studies employ techniques similar to those used in other studies, such as Gupta and Verhoeven (2001), Clements (2002), Carcillo *et al.* (2007), and Joumard *et al.* (2010).

- Afonso *et al.* (2010) compute public sector performance and efficiency indicators (as performance weighted by the relevant expenditure needed to achieve it) for 24 EU and emerging economies. Using DEA, they conclude that on average countries could use 45 per cent less resources to attain the same outcomes, and deliver an additional third of the fully efficient

[11] A related concept is "productive public spending" (see IMF, 1995), however this deals with the contribution of spending to capital formation, accumulation and its depreciation.

[12] While technical efficiency focuses on "doing things right", allocative efficiency focuses on the harder question of "doing the right things".

output if they were on the efficiency frontier. The study included an analysis of the efficiency of education and health spending that we use here.

- Evans *et al.* (2000) estimate health efficiency scores for the 1993-97 period for 191 countries, based on WHO data, using stochastic frontier methods. Two health outcomes measures are identified: the disability adjusted life expectancy (DALE) and a composite index of DALE, dispersion of child survival rate, responsiveness of the health care system, inequities in responsiveness, and fairness of financial contribution. The input measures are health expenditure and years of schooling with the addition of country fixed effects. Because of its large country coverage, this study is useful for illustrating the impact of the type of correction that we are discussing here.

We must note that ideally, we would like to base our corrections on input-based technical-efficiency studies that deal exclusively with inputs and outputs, and do not bring outcomes into the analysis. The reason is that public sector outputs interact with other factors to produce outcomes, and here cross-country hetereogenity can play an important role driving cross-country differences in outcomes. Unfortunately, we have found no technical-efficiency studies covering a broad sample of countries that restrict themselves to input-output analysis. In particular, these two studies deal with a mix of outputs and outcomes. The results reported here should thus be seen as illustrative. Furthermore, it should be underscored that the level of "waste" that is identified for each particular country varies significantly across studies, which implies that any associated measures of GDP adjusting for this waste will also differ.

3 Corrected GDP

Let y_i be country i's per capita GDP (or GNI):

$$y_i = g_i + x_i$$

where g_i is the government's value added (*i.e.*, its contribution to national income), and x_i is the contribution of the non-government sector. If country i had an overall efficiency score of ε_i for the public sector, then the corrected per-capita GDP is given by:

$$\widetilde{y}_i = \varepsilon_i g_i + x_i$$

Arguably, $\widetilde{y}_i$ is a better measure of living standards, as it removes the waste, $(1-\varepsilon)g_i$, from y_i – and, consequently, from household consumption. Note that this correction is not needed for the private x_i as its value is assessed directly by the consumers in their market transactions.

This correction may be carried out in a more disaggregated way when efficiency scores for different government functions are available. For illustrative purposes, we shall first use the efficiency scores estimated in Afonso *et al.* (2010), rescaled to lie in [0,1]. In their paper, they estimate public sector efficiency indicators for different categories – *i.e.*, administration, human capital, health, distribution, stability, and economic performance. We focus here on the ones corresponding to the functional categories of health and education.

Let ε_i^h and $\varepsilon_i^\varepsilon$ be the corresponding (rescaled) efficiency scores, and let H_i and E_i be country i's public expenditure in health and education (h_i and e_i as percentages of GDP). If the fraction $\omega_i^h = (1-\varepsilon_i^h)$ of resources is wasted, then:

$$\widetilde{H}_i = (Health\ Expenditures - Waste = (1-\omega_i^h)H_i$$

is the corrected estimate of the contribution of public health services to GDP. Similarly, with education we have public waste equal to $\omega_i^\varepsilon\ E_i$, and effective expenditures of $\widetilde{E}_i = (1-\omega_i^\varepsilon)E_i$.

Next we purge $\omega_i^h H_i$ and $\omega_i^\varepsilon E_i$ from GDP using the average (1998-2002) functional shares reported in Table 1 of Afonso *et al.* (2010).[13]

Table 1 shows the percentage-of-GDP losses due to public waste in education and health – *i.e.*, $\omega^\varepsilon e_i$ and $\omega^h h_i$. Overall, the size of the correction is quite remarkable; the average loss amounts to 4.1 percentage points of GDP, while averages for education and health are 1.5 and 2.6. Given an average spending of 4.6 per cent of GDP on education and 4.0 per cent of GDP on health, this means that 32.6 and 65.0 per cent of the inputs are wasted in the respective sectors. Note that the best-practice frontier that is used as reference to compute the efficiency scores is constructed on the basis of this set of 24 countries. Increasing the reference group to a larger set of countries can only make these efficiency scores worse, as the reference technology becomes richer.

Figure 1 plots the GDP losses against the corresponding per capita GDPs. For this set of countries, there is no strong discernible pattern, as the points scatter rather uniformly over the plot area. Perhaps it could be argued that the range of correction sizes increases with the level of income – the lower envelope of the scatter slopes negatively while the upper envelope slopes positively.

Another matter of interest is whether the per-capita-GDP ranking is altered at all due to the correction (*i.e.*, whether any country changes relative position). This re-ordering happens in 9 occasions out of the 24 countries. In the scatter plot (Figure 1), the candidates are pairs of countries where one is almost vertically on top of each other, but slightly to the right, and where the vertical (correction) distance is substantial. For example, Korea overtakes Cyprus; Cyprus, in turn, almost catches up with Greece, Brazil overtakes Lithuania, and Poland overtakes Estonia.

We turn now to the WHO study by Evans *et al.* (2000) covering health in both advanced and developing economies. The average GDP loss is 0.9 percentage points (the median is 0.8 per cent of GDP). This is lower than the estimate in Table 1 for health, reflecting the lower level of health spending in the wider country dataset used in the WHO study. The losses are uniformly distributed over the per-capita-GDP range. Baldacci *et al.* (2008) find that in countries suffering from poor governance, the positive effects of increased spending on education is reduced, and those of higher health spending can be completely negated. Rajkumar and Swaroop (2008) also show that, in a context of low quality of governance, increased expenditures in health and education are not reflected in improved social outcomes. Given the high correlation between income and governance, poorer countries tend to have more ineffective governments. At the same time, they tend to spend less on health. The combined effect is a broadly uniform distribution of waste, as Figure 2 shows.

While we recognize that inefficiency scores are sector-specific, we perform a "virtual experiment" by asking what would be the implications if these inefficiencies applied, on average, throughout all public-sector activities. What would be the extent of the "missing" GDP? Figure 3 shows the distribution of the correction vs. per capita GDP and technical efficiency scores. Technical efficiency is positively correlated with per capita GDP. As before, the correction is roughly uniformly distributed across the range of per capita GDP. The effects of lower efficiency scores and lower spending broadly compensate for each other. Thus, poorer countries with more ineffective government also spend a smaller share of GDP in public services, so any correction of the sort discussed here is going to be small. The scatter of technical efficiency vs. total waste displays an upper envelope: the estimated waste is bounded by the efficiency score.

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[13] Note that the percent correction is a linear operation and, thus, can be applied either to components and ratios. If, e.g., we are considering per-capita GDP, then $\widetilde{y}_i = \dfrac{\widetilde{Y}_i}{N_i} = \dfrac{\varepsilon_i Y_i}{N_i} = \varepsilon_i y_i$.

Table 1

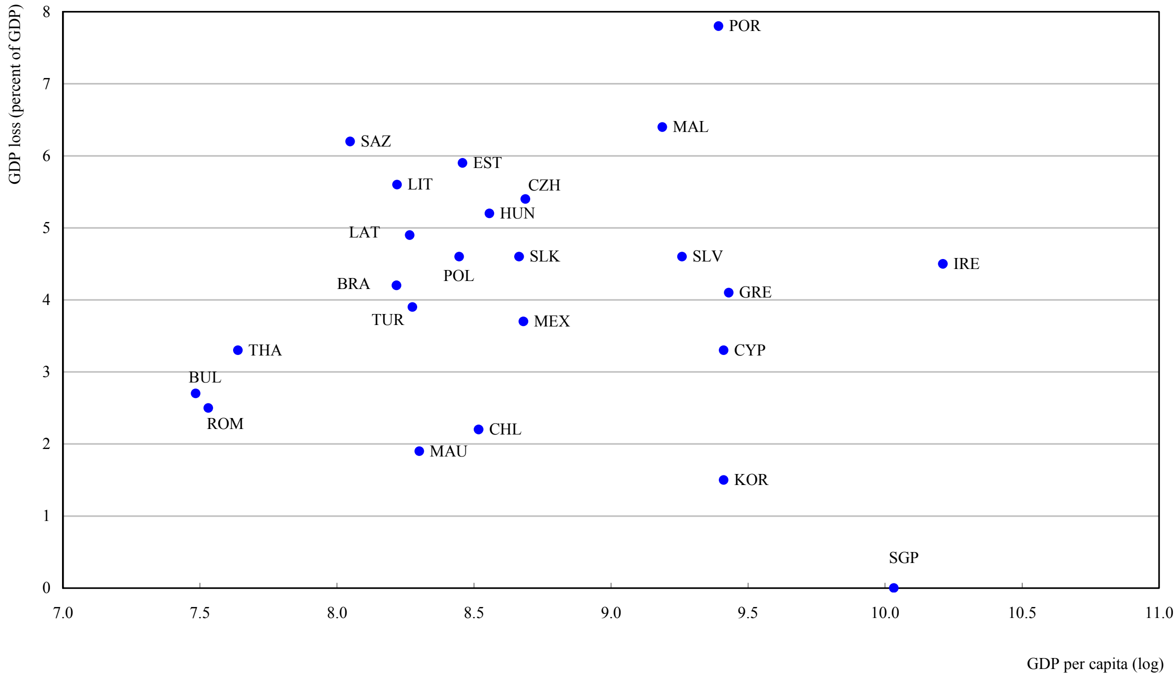
GDP Losses Associated with Wasted Public Resources
(averages 1998-2002, percent of GDP)

Country	Education	Health	Sum
Brazil	2.2	2.0	4.2
Bulgaria	0.1	2.6	2.7
Chile	1.2	1.0	2.2
Cyprus	2.2	1.1	3.3
Czech Republic	0.6	4.8	5.4
Estonia	2.8	3.0	5.9
Greece	0.5	3.6	4.1
Hungary	1.3	3.9	5.2
Ireland	1.0	3.5	4.5
Korea, Rep.	0.5	1.0	1.5
Latvia	2.8	2.1	4.9
Lithuania	2.5	3.1	5.6
Malta	1.7	4.7	6.4
Mauritius	1.2	0.7	1.9
Mexico	2.4	1.2	3.7
Poland	1.8	2.8	4.6
Portugal	3.1	4.8	7.8
Romania	0.0	2.5	2.5
Singapore	0.0	0.0	0.0
Slovak Republic	0.8	3.8	4.6
Slovenia	0.0	4.6	4.6
South Africa	3.7	2.5	6.2
Thailand	2.3	1.0	3.3
Turkey	1.2	2.6	3.9
Average	1.5	2.6	4.1

Source: Authors' calculations based on efficiency scores in Afonso *et al.* (2010).

Figure 1

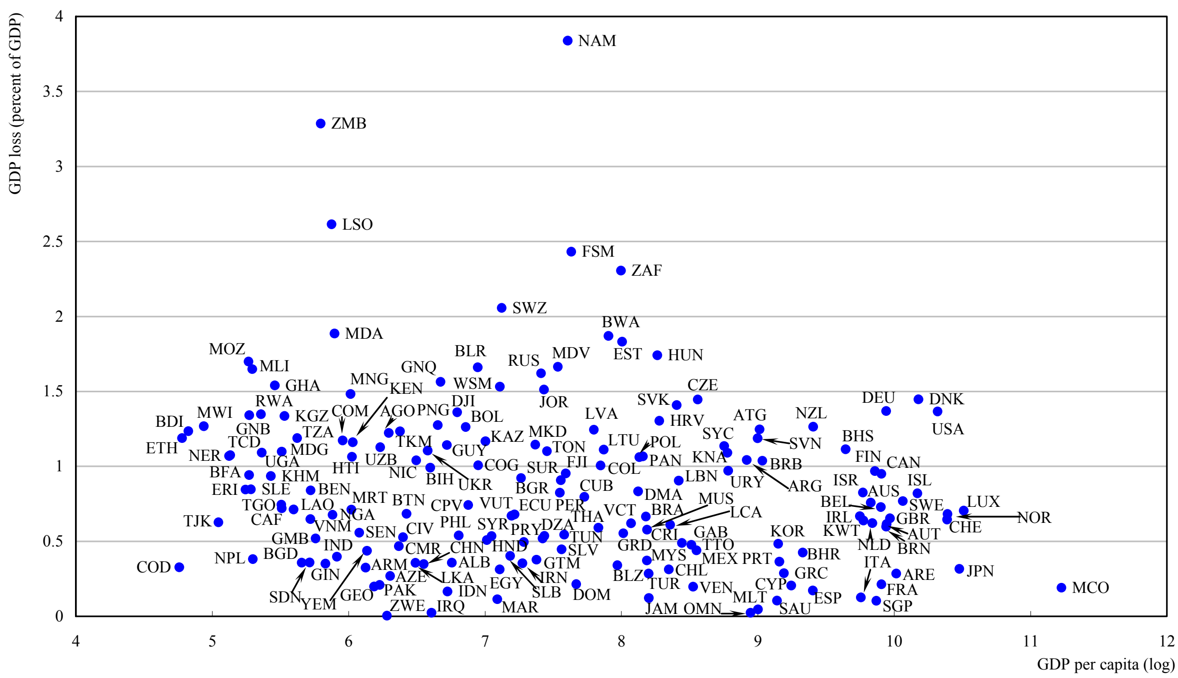
GDP Loss Due to Health and Education Waste *vs.* Per Capita GDP



Source: Authors' calculations based on efficiency scores in Afonso *et al.* (2010).

Figure 2

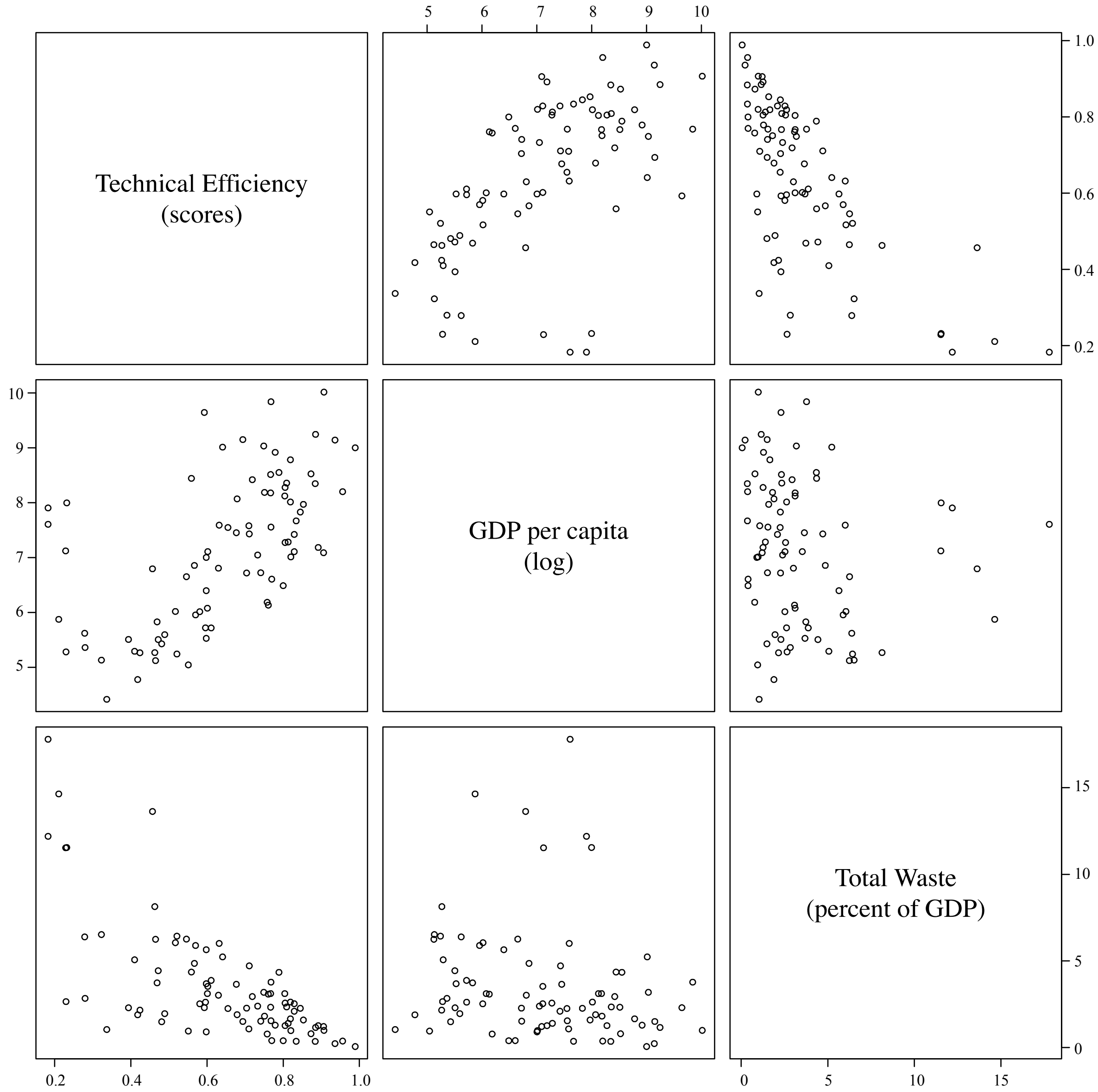
GDP Loss Due to Health Waste *vs.* Per Capita GDP



Source: Authors' calculations based on efficiency scores in Evans *et al.* (2000).

Figure 3

Technical Efficiency Scores, per Capita GDP, and Total Loss



Source: Authors' calculations based on efficiency scores in Evans *et al.* (2000).

Finally, we turn our attention to the country rankings of living standards, the GNI per capita computed using the World Bank's Atlas methodology.[14] As noted, this is the measure that the World Bank uses for classifying countries in income groups, as well as to set lending eligibilities.

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[14] The Atlas method converts countries GNI in US dollars applying the Atlas conversion factor. This consists of a three-year average of exchange rates to smooth effects of transitory exchange rate fluctuations, adjusted for the difference between the rate of inflation in the country and that in a number of developed countries. For more details see: http://data.worldbank.org/indicator/NY.GNP.PCAP.CD.

What is the effect on the ranking of the corrections that we are discussing here? Let us consider the correction based on the health efficiency scores of Evans *et al.* (2000) applied to the value added of public administration and defense for the 2009 GNI. The result is a re-ordered country ranking where 51 countries out of 93 change their relative positions. Since the value added variable is available only for non-developed countries, we perform the same correction on the wage bill – to cover a larger set of countries. The portion of reordered countries is still higher than 50 per cent, as 59 of 116 countries are repositioned. In both corrections, about 70 per cent of the reordering happens in the lower half of the original ranking and the average shift is approximately equal to two positions.

How does this relate to governance indicators? There are several governance indicators available, all of which are highly correlated. The broadest coverage set is probably the Worldwide Governance Indicators (WGI) by Kaufmann *et al.* (2009). This database draws together information on perceptions of governance from a wide variety of sources, and organizes them into six clusters corresponding to the six broad dimensions of governance. These are voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, and control of corruption. Other very important sources of governance indicators are Freedom House and Transparency International.

The indicator "Government Effectiveness" attempts to capture perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.[15] Figure 4 plots the "government effectiveness" WGI against technical efficiency scores, GDP loss due to health waste, and per capita GDP. The WGI is positively correlated with GDP per capita, and, as a result, with the efficiency scores. Its relationship with estimated waste is less clear-cut. The biggest waste is associated with intermediate values of the government effectiveness indicator. Waste is biggest in inefficient countries that spend significant resources on health. Otherwise, waste is limited in inefficient countries that do not allocate significant resources to health spending.

4 Concluding remarks

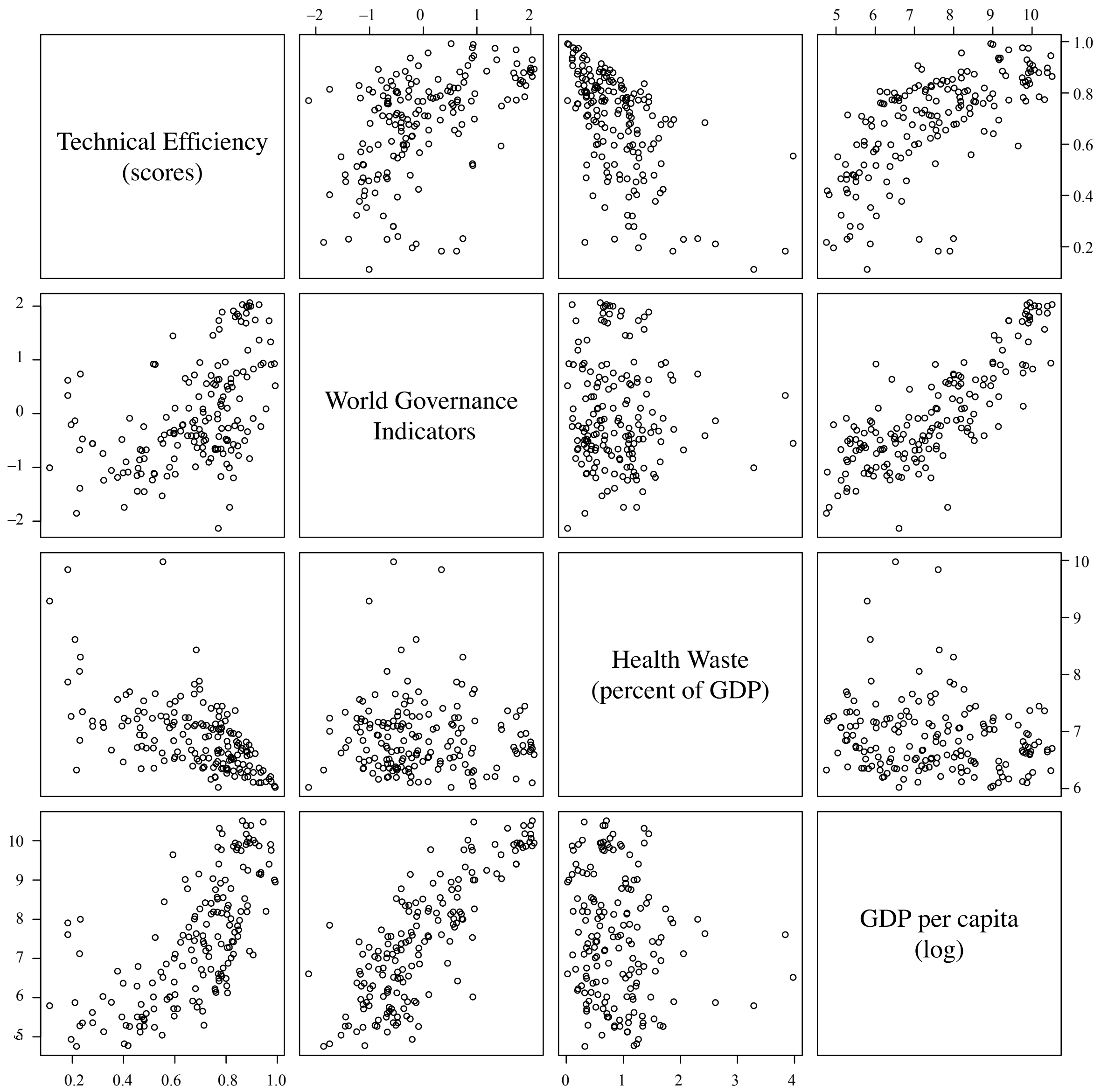
We have argued here that the current practice of estimating the value of the government's non-market output by its input costs is not only unsatisfactory but also misleading in cross-country comparisons of living standards. Since differences in the quality of the public sector have an impact on the population's effective consumption and welfare, they must be taken into account in comparisons of living standards. We have performed illustrative corrections of the input costs to account for productive inefficiency, thus purging from GDP the fraction of these inputs that is wasted.

Our results suggest that the magnitude of the correction could be significant. When correcting for inefficiencies in the health and education sectors, the average loss for a set of 24 EU member states and emerging economies amounts to 4.1 percentage points of GDP. Sector-specific averages for education and health are 1.5 and 2.6 percentage points of GDP, implying that 32.6 and 65.0 per cent of the inputs are wasted in the respective sectors. These corrections are reflected in the GDP-per-capita ranking, which gets reshuffled in 9 cases out of 24. In a hypothetical scenario where the inefficiency of the health sector is assumed to be representative of the public sector as a whole, the rank reordering would affect about 50 per cent of the 93 countries in the sample, with 70 per cent of it happening in the lower half of the original ranking. These results, however, should

[15] See Kaufmann *et al.* (2010) for details on methodology, data sources, and interpretation of the indicators.

Figure 4

Technical Efficiency Scores, WGI's Government Effectiveness, GDP Loss Due to Health Waste, and Per Capita GDP



Source: Authors' calculations based on efficiency scores in Evans *et al.* (2000).

be interpreted with caution, as the purpose of this paper is to call attention to the issue, rather than to provide fine-tuned waste estimates.

A natural way forward involves finding indicators for both output quantities and prices for direct measurement of some public outputs. This is recommended in SNA 93 but has yet to be implemented in most countries. Moreover, in recent times there has been an increased interest in outcomes-based performance monitoring and evaluation of government activities (see Stiglitz *et al.*, 2010). As argued also in Atkinson (2005), it will be important to measure not only public sector outputs but also outcomes, as the latter are what ultimately affect welfare. A step in this direction is suggested by Abraham and Mackie (2006) for the US, with the creation of "satellite" accounts in specific areas as education and health. These extend the accounting of the nation's productive inputs and outputs, thereby taking into account specific aspects of non-market activities.

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INCOME TAXATION, TRANSFERS AND LABOUR SUPPLY AT THE EXTENSIVE MARGIN

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This paper estimates the effect of income taxation on labour supply at the extensive margin, i.e.*, the labour force participation. We extend existing structural form methodologies by considering the effect of both taxes and transfers. Non-labour income contains the (hypothetical) transfer amount someone gets when out of work, while the wage is replaced by the sum of net wages and the amount of lost transfers due to taking up a job (gains to work, GTW). Using data from the Hungarian Household Budget Survey (HKF), we find that participation probabilities are strongly influenced by transfers and the GTW, particularly for low-income groups and the elderly. Moreover, the same change in the net wage leads to a much larger change in the GTW for low earners, making them even more responsive to wages and taxation. Our parametric estimates can be readily utilized in welfare evaluations, or microsimulation analyses of tax and transfer reforms.*

1 Introduction

This paper presents a unified parametric approach to estimate the impact of taxes and transfers on the participation decision (the extensive margin of labour supply). In our framework, participation probabilities are determined by the comparison of disposable income in and out of the labour force, consisting of the (often non-observed) amount of transfers and non-labour income an individual gets if not working and the gains to work (GTW; change in disposable income if accepting a job offer, the sum of net wages and lost transfers). Identification is achieved by utilizing a multitude of tax and transfer reforms. Unlike in the existing literature, our results allow a general assessment of the efficiency and effectiveness of government interventions into the labour market, and more importantly, a micro-based prediction of the impact of tax and welfare reforms.

There is a multitude of existing studies which establish that taxes and the welfare system influence the participation decision. There is, however, a notable heterogeneity in terms of implied elasticity measures. Arrufat and Zabalza (1986) do a cross section estimation on the U.K. General Household Survey dataset, and find a participation elasticity (the change in the probability of being active in response of a unitary shock in net wages) of 1.41 for married women. Dickert *et al.* (1995), conducting a cross-section estimation on the Survey of Income and Program Participation (SIPP) to analyse a large expansion of the Earned Income Tax Credit (EITC) in the U.S., find an elasticity of $\eta = 0.2$ for single parents. Eissa and Liebman (1996) follow a program evaluation methodology (difference in differences) using the Current Population Survey to analyse the same episode of EITC expansion. They find that single mothers increased their participation rate by 2.8 percentage points relative to single women without children. Kimmel and Kniesner (1998) adopt a panel estimation on SIPP, and find elasticities of [0.6; 2.4; 1.8; 1.1] for single men, single women, wives and husbands respectively. Finally, Aaberge *et al.* (1999) follow a cross section

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estimation based on the Survey on Household Income and Wealth (Italy), and obtain average elasticities for men and women as [0.04; 0.65] respectively.

From our point of view, these findings have important shortcomings. First, most of them focus on special subgroups and tend to follow a reduced form approach (program evaluation methodology, see Moffitt, 2002, for a review). Though such approaches are capable of precisely estimating the impact of a particular tax or transfer reform episode, they are not suitable for evaluating the impact of future (hypothetical) scenarios. There is also a substantial heterogeneity in the way after-tax wages are controlled for (if at all). Meyer and Rosenbaum (2001) is an example of a structural approach, but is not suitable for simulations either: wages are proxied, so the results do not imply a wage elasticity.

Second, the existing literature usually focuses on either taxes or transfers. Though the meta-analysis of Chetty *et al.* (2012) provides a "new consensus estimate" of extensive margin elasticities of 0.25, this result still does not necessarily control for the entire tax and transfer system. As argued by Blundell (2012), it is important to take taxes and transfers into account simultaneously and combine them into effective tax wedges. Besides influencing non-labour income (income at zero hours worked), transfers also show characteristics resembling both marginal and average tax rates. Suppose that a certain benefit is means tested with a gradual phaseout. For example, every extra income earned as wage reduces transfers by 20 per cent. In that case, it is equivalent to a 20 per cent extra marginal tax rate. Once the individual has lost all of this means tested benefit, lost transfers become similar to an average tax rate: the total amount of lost transfers decreases the payoff from work, just like the average tax rate does.

One major reason for the lack of structural studies is that it is not obvious how to incorporate all the relevant features of the tax and transfer system into a theory-based framework of labour supply. This paper presents an extension of the standard labour supply model that can incorporate both the marginal and participation tax rate aspect of transfers, but at the expense of constraining the participation decision to a fixed job size. Jobs usually have a fixed minimum size (half-time, or in some cases even full-time), which implies that an interior solution at a too low number of hours might also be practically infeasible. In that case, the labour supply choice of individuals is determined by the average tax rate at her initial gross monthly earnings and the total amount of transfers. The overall summary measure in this case is the gains to work, which consists of the net wage (for the fixed size of the job) minus the amount of lost transfers.

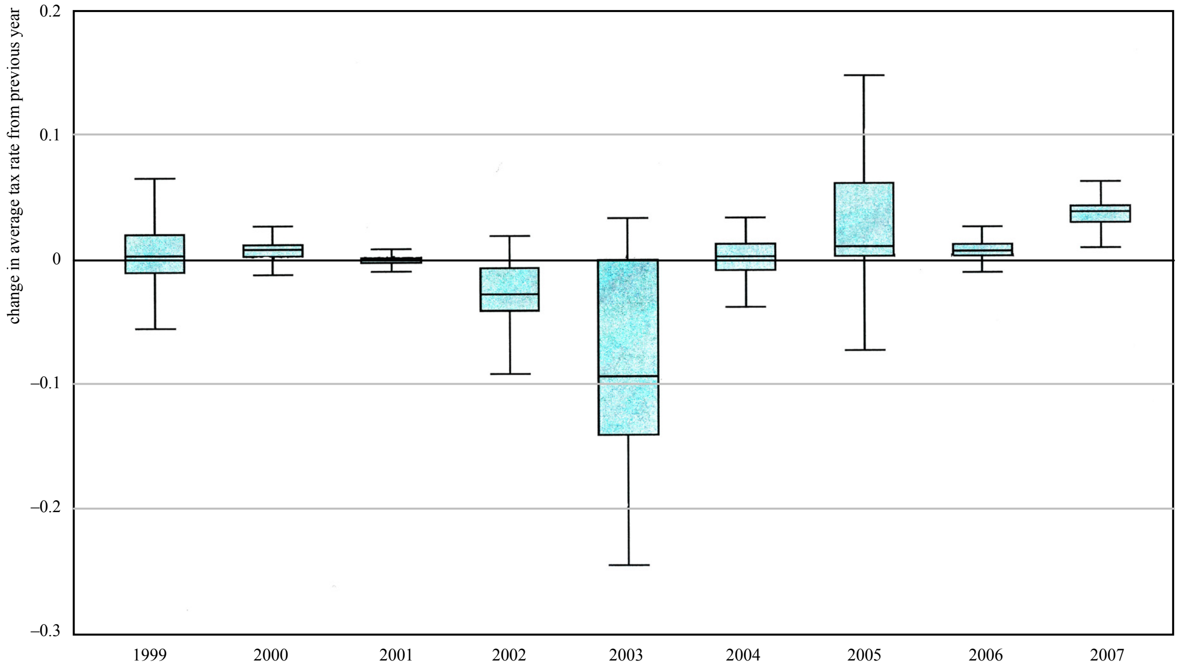
We carry out our estimation on the Hungarian Household Budget Survey (HKF), containing detailed income and consumption measures of individuals for the years 1998-2008. Numerous policy measures on both income tax rates and transfers adopted during this period provide enough cross-sectional and time variation for the estimation of the elasticity of participation probabilities with respect to gains to work. Figure1 show how individuals' average tax rates would have changed if their real income remained unchanged over time. It is seen that minor income tax changes occurred every year and major changed occurred in 1999 and between 2002 and 2005. The right graph show that tax changes affected lower income earners to a greater extent. As for the transfers, Figure 1 illustrates the impact of various transfer reforms on the Hungarian participation rate. The simple decomposition exercise of Kátay and Nobilis (2009) clearly demonstrates that transfer changes do impact the participation rate, providing us with sufficient exogenous variation in transfers to identify our specification.

The underlying theory – presented in Section 2 – leads to a structural probit equation which relates participation probabilities to gains to work from a full time job, the total amount of non-labour income (including the hypothetical amount of transfers one gets or would get at zero hours worked) and other individual characteristics. The unobserved hypothetical amount of transfers are backed up using individual characteristics and the welfare system's details for every given year.

Figure 1

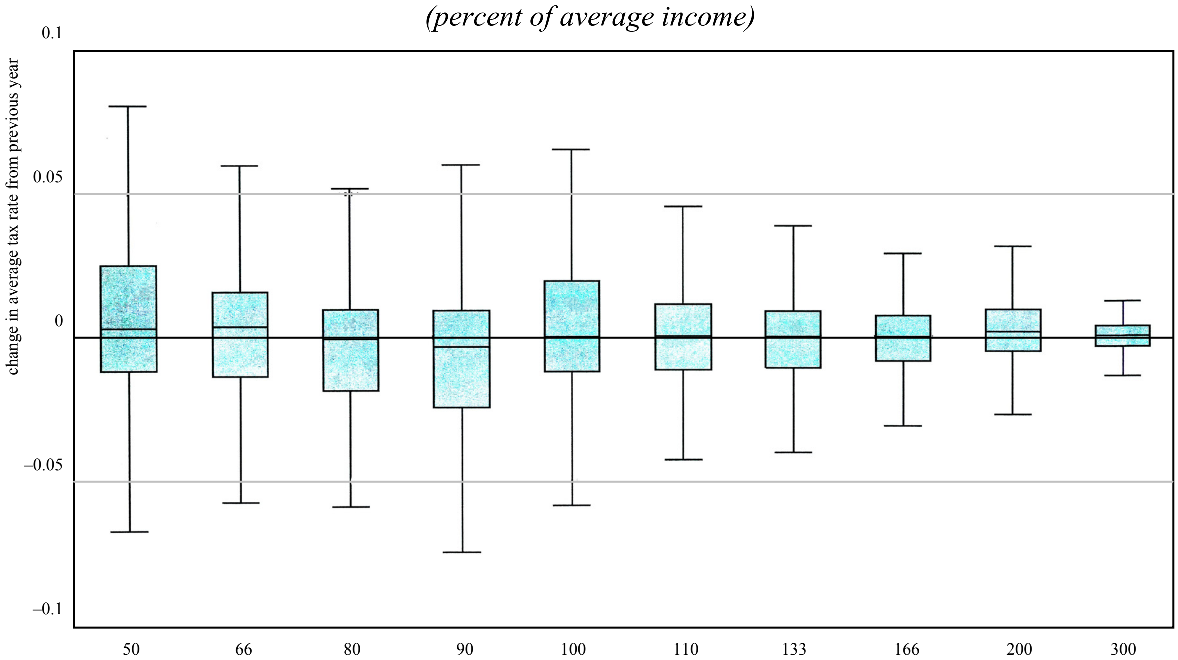
Variation in the Changes in Average Tax Rates (ATR)*

a) Yearly Changes in ATR



b) Changes in ATR by Income Categories

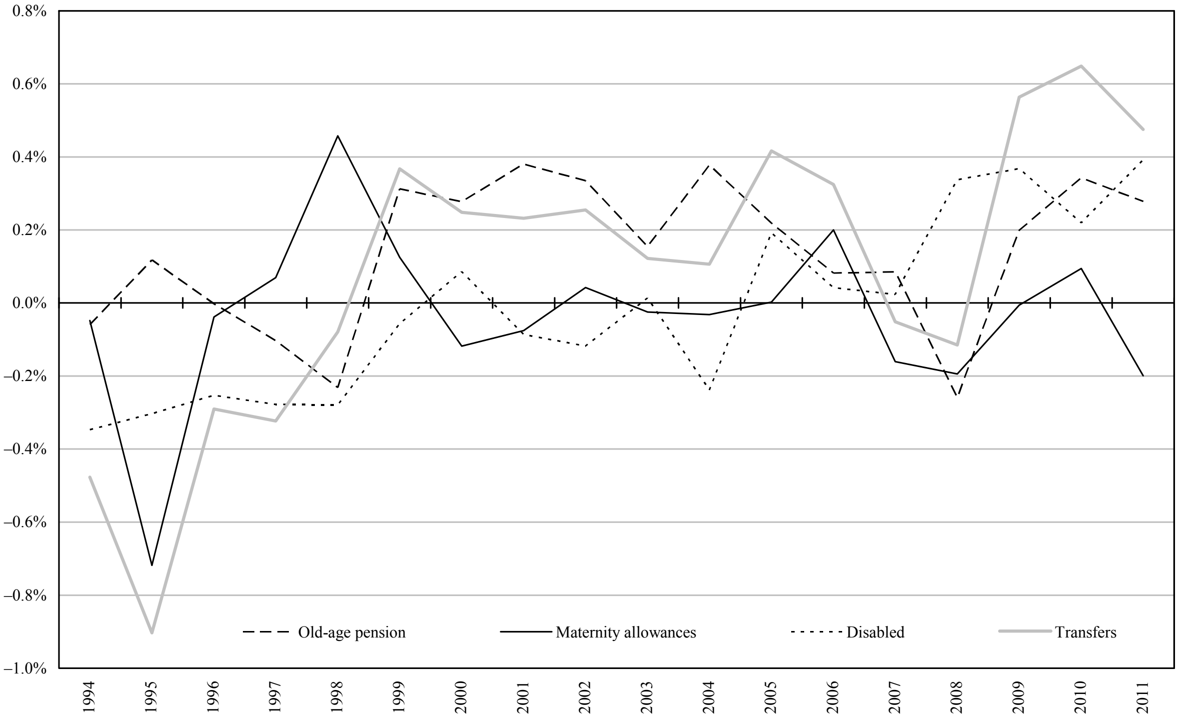
(percent of average income)



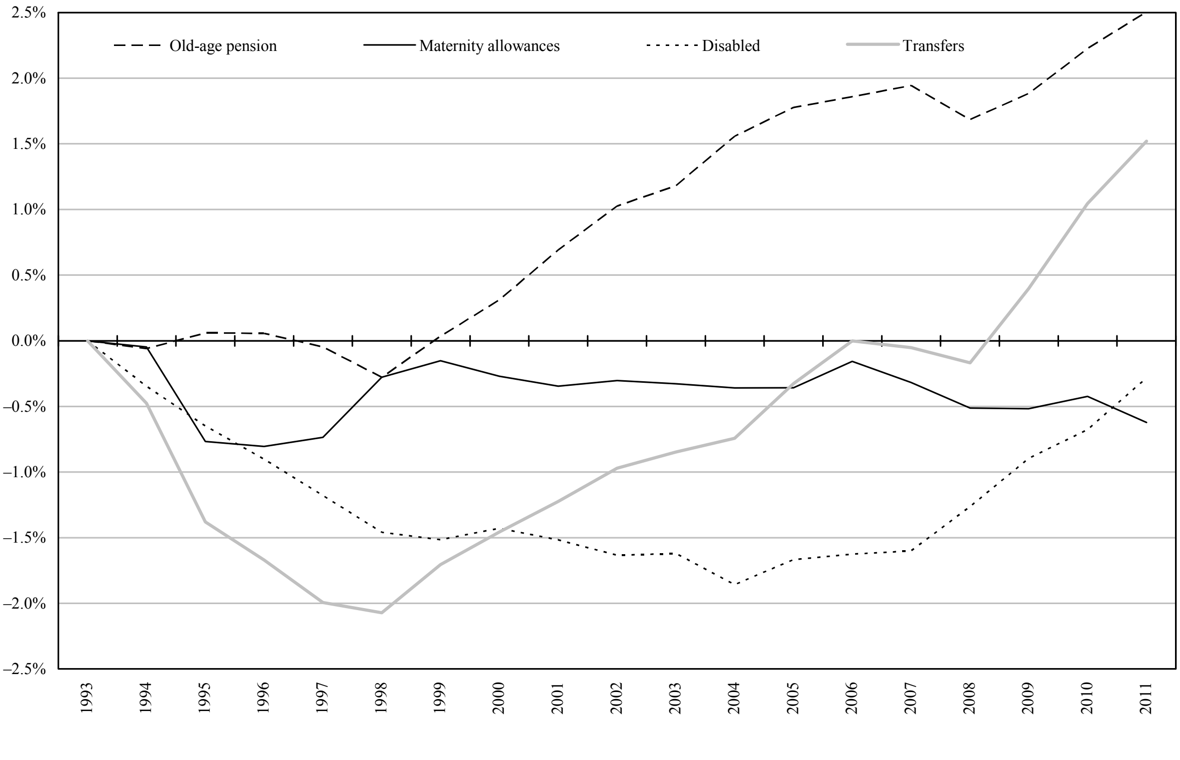
Graphs show the yearly changes in average tax rates between 1998 and 2008 for the individuals observed in 2008, assuming that their real income did not change during this period. Outside values are excluded in both graphs.
Source: Household Budget Surve and own calculations.

Figure 2

Decomposition of the Aggregate Participation Rate*
a) Year-to-year Percentage Point Changes



(b) Cumulative Changes



Source: Kátay and Nobilis (2009), updated.

The estimation process – described in Section 3 – follows the often used three step procedure, as, e.g., in Kimmel and Kniesner (1998). The key element of the identification is the careful choice of labour demand shifters, *i.e.*, the variables which have no (or negligible) impact on labour supply directly, but strongly impact the wage and hence impacts activity indirectly. In Section 4, we argue that county dummies and (once we control for individuals' lifecycle position with a large set of dummy variables) individuals' age are such variables.

Section 5 presents the estimation results. We find that a single equation can already explain a large heterogeneity of individual responsiveness to taxes and transfers: there are large differences among subgroups, driven partly by a composition effect, and partly by a different share of lost transfers in the GTW. The most responsive subgroups are low-skilled, (married) women at child-bearing age and elders, while prime-age higher educated individuals are practically unresponsive to tax and transfer changes at the extensive margin. As argued for example by Kátay (2009), Hungary's labour participation deficit compared to other EU members is mostly due to these special groups.

2 Theory

2.1 The underlying theory

The usual approach is to define the reservation wage, which is the threshold for accepting a job offer. Let us start from a standard utility maximization problem:

$$\begin{cases} \max \dfrac{c^{1-\psi}-1}{1-\psi} + \chi \dfrac{(1-l)^{1-\phi}-1}{1-\phi} \\ \text{s.t.}: c + w(1-l) = w + T, \end{cases}$$

where c is consumption, l is labour, w is the wage, and T denotes transfers and other non-labour income. The total time endowment is normalized to *l*, so leisure is $1-l$. The optimality condition can be written as:

$$\chi(1-l)^{-\phi} = wc^{-\psi}$$

The reservation wage corresponds to the case where $1-l^{*}=1$. Then $c=T$, so:

$$\chi = w_{res}T^{-\psi}$$

defines the reservation wage. The participation decision is then determined by $w \geq w_{res}$, or, in logs:

$$\log w \geq \log \chi + \psi \log T$$

Finally, we expand $\log \chi_i$ as $Z_i A' + \varepsilon_i$, where Z_i is a vector of observable individual characteristics and $\varepsilon_i \sim N(0,\sigma^2)$:

$$\log w_i - Z_i A' - \psi \log T_i \geq \varepsilon_i$$

The probability of someone working given a wage offer w_i, non-labour income T_i and individual characteristics Z_i is then:

$$P = \Phi\left(\frac{\log w_i - Z_i A' - \psi \log T_i}{\sigma}\right) = \Phi\left(\gamma \log w_i + Z_i \alpha' - \overline{\psi} \log T_i\right) \tag{1}$$

yielding the standard structural probit specification.[1]

The next step is to add taxes and transfers. One the one hand, we have to modify the wage rate by the effective tax rate (marginal rate, at zero labour income), including taxes, social contributions, and the phaseout of social transfers (if applicable). On the other hand, there are certain transfers which get lost immediately at taking up any job. In such a case, there is a discrete downward jump in T for any nonzero hours worked. One could try to redefine the reservation wage similarly to before, as the level that could still induce an epsilon amount of work. This is, however, not feasible: from Roy's identity, the welfare gain from a marginal wage increase is the same as the income gain from the extra income due to the higher wage. But there is no such income gain at zero hours worked, so the income equivalent gain is zero, while there is a nonzero income loss due to the drop in T. In other words, the reservation wage is infinite (this can also be established formally by total differentiation).

Instead, we redefine the reservation wage by constraining the participation decision to a fixed "job size"l^* – in our empirical specification, it will be a full time job.[2] The reservation wage is thus set by the following comparison:

• Do not work: then $c = T, 1-l = 1$, welfare is $\dfrac{T^{1-\psi}-1}{1-\psi}$

• Work l^* : then $c = T - \Delta T + wl^*,\ 1-l = 1-l^*$, welfare is $\dfrac{\left(T-\Delta T+wl^*\right)^{1-\psi}-1}{1-\psi}+\chi\dfrac{\left(1-l^*\right)^{1-\phi}-1}{1-\phi}$

Introducing the notation $W = wl^* - \Delta T$ (gains to work, GTW), the comparison becomes:

$$\frac{(T+W)^{1-\psi}-1}{1-\psi}+\chi\frac{\left(1-l^*\right)^{1-\phi}-1}{1-\phi}\geq\frac{T^{1-\psi}-1}{1-\psi}$$

$$\frac{(T+W)^{1-\psi}-1}{1-\psi}-\frac{T^{1-\psi}-1}{1-\psi}\geq-\chi\frac{\left(1-l^*\right)^{1-\phi}-1}{1-\phi} \tag{2}$$

One can also give a simple graphical representation (see Figure 2): draw the indifference curve going through $(C = T, l = 0)$, find the point of this curve where $l = l^*$, and connect this with point $(C = T - \Delta T, l = 0)$. Its slope is then the reservation wage: at such a wage level, the individual is just indifferent between not working and getting the full amount of transfers ($C = T, l = 0$), or working l^* hours and getting only $T - \Delta T$ as transfers ($C = T - \Delta T + W, l = l^*$).

To derive a formal expression for the probability of being active (the analogue of (1)), let us linearize the left hand side of (2):

$$\frac{(T+W)^{1-\psi}-1}{1-\psi}-\frac{T^{1-\psi}-1}{1-\psi}\approx WT^{-\psi},$$

[1] One could repeat the same exercise using a growth-consistent utility function of the form $\frac{(c\cdot\exp(f(1-l)))^{1-\psi}-1}{1-\psi}$. Assuming that $f(1-l)=\frac{(1-l)^{1-\phi}-1}{1-\phi}$, we would get an almost identical probit equation, with an extra constraint of $\gamma=\overline{\psi}$.

[2] Once working, an individual may decide to work more than l^*. We assume, however, that it is not known in advance whether there would be opportunities for overtime or performance bonuses, so the activity decision is determined by the base salary.

so the comparison becomes:

$$WT^{-\psi} \geq \chi \underbrace{\frac{1-\left(1-l^{*}\right)^{1-\phi}}{1-\phi}}_{Q} = \chi Q$$

The individual works if:

$$\log W - \psi \log T - \log \chi - \log Q \geq \varepsilon$$

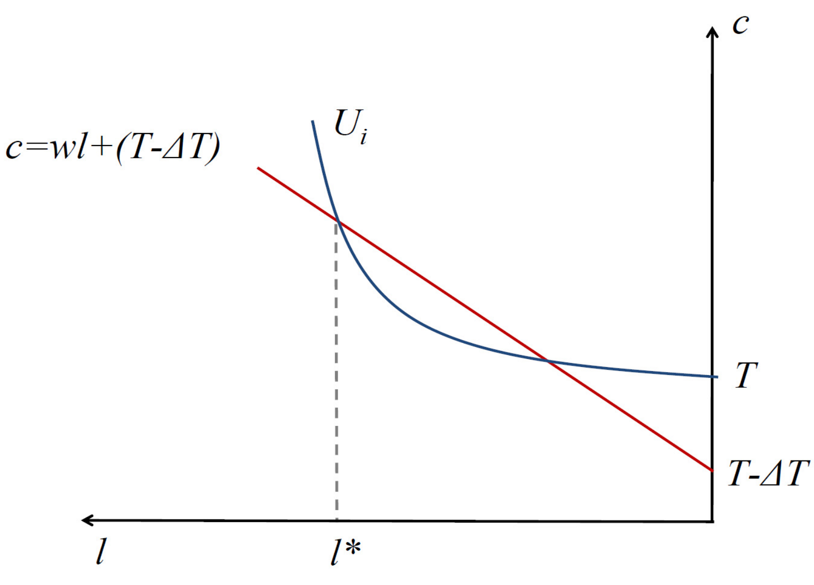
yielding again a structural probit of the form:

$$P = \Phi\left(\gamma \log W_i + Z_i \alpha' - \overline{\psi} \log T_i\right) \tag{3}$$

Let us compare the two structural probit equations (1) and (3). First, W_i in (3) represents the gains to work (from a full time job): $W_i = w_i\, l^* - \Delta T$, as opposed to the net wage w_i. Second, T_i is the hypothetical amount of transfers one gets (or would get) at zero hours worked.

Figure 3

The Reservation Wage when There Is a Discrete Drop in Transfers



From a practical point of view, T is not directly observable for the employed, since they get T- ΔT; while ΔT is not observed for the inactive, since they get T. Using individual characteristics and the welfare system's details (for every given year), however, one can back up T and ΔT. This essentially requires a microsimulation tool. For those who work, we determine T based on their characteristics and welfare regulations for the given year, and then obtain $\Delta T = T - T_{obs}$. For those who do not work, we determine ΔT by again applying welfare rules, while $T = T_{obs}$.

3 Econometric issues

Here we closely follow Kimmel and Kniesner (1998), up to a certain point. We want to estimate a structural probit equation:

$$P(\text{employed/active}) = \Phi\left(\gamma \log W_i + Z_i \alpha' - \overline{\psi} \log T_i\right)$$

where $W_i = w_i\, l^* - \Delta T_i$. Here the vector Z_i contains individual characteristics which shift the labour supply of an individual. As usual in the literature on participation, there is a missing data issue: the wage is unavailable for those who do not work. The solution is to use a predicted W for the inactives: run

$$\log W_i = X_i\beta' + \mu_i$$

for the employed, and use the predicted wage $\hat{W} = X_i\hat{\beta}$ for the unemployed. Here the vector X_i contains individual characteristics which are relevant for defining an individual's wage. Note that the two vectors X_i and Z_i may overlap, but there can be elements in each of them which are excluded from the other set. This regression, however, is run on a nonrandom sample, since the employment and the W error terms might be correlated. The solution is thus to adopt a Heckman-type correction, yielding a three step procedure.

In variant A, we thus adopt the following procedure:

1) Run a reduced form probit:

$$P(\text{employed}) = \Phi\left(X_i\beta'_{RF} + Z_i\alpha'_{RF} - \psi_{RF}\log T_i\right)$$

2) Use the inverse Mills ratio $\lambda(x) = \dfrac{\phi(x)}{\Phi(x)}$ as a correction in the log GTW regression:

$$\log W_i = X_i\beta' + \delta\lambda\left(X_i\hat{\beta}'_{RF} + Z_i\hat{\alpha}'_{RF} - \hat{\psi}_{RF}\log T_i\right) + \mu_i$$

3) Use the predicted log GTW $lo\hat{g}W_i = X_i\hat{\beta}'$ in the structural probit equation:

$$P(\text{employed/active}) = \Phi\left(\gamma\log\hat{}W_i + Z_i\alpha' - \overline{\psi}\log T_i\right)$$

Notice that here $X \supseteq Z$, since there is practically no observable characteristics which would not be related to transfer measures, which are there in $\log W$.

In variant B, we slightly modify the previous procedure:

1) Run a reduced form probit

$$P(\text{employed}) = \Phi\left(X_i\beta'_{RF} + Z_i\alpha'_{RF} - \psi_{RF}\log T_i\right)$$

2) Use the inverse Mills ratio $\lambda_i(x) = \dfrac{\phi(x)}{\Phi(x)}$ as a correction in the *wage* (more precisely: monthly income) regression:

$$\log w_i = X_i\beta' + \delta\lambda\left(X_i\hat{\beta}'_{RF} + Z_i\hat{\alpha}'_{RF} - \hat{\psi}_{RF}\log T_i\right) + \mu_i$$

3) If W_i is also lognormal with some mean and a variance σ_W^2, then one can show that:

$$E\left(log(W_i)\middle|X_i, Z_i\right) = log\left(E\left(W_i\middle|X_i, Z_i\right)\right) - \frac{1}{2}\sigma_W^2 = log\left(e^{X_i\beta_1 + \frac{1}{2}\sigma_1^2} - \Delta T_i\right) - \kappa$$

Thus we can use the predicted log wage $\log\hat{}w_i = X_i\hat{\beta}'$, add the standard error correction for lognormals, exponentiate, subtract ΔT_i and take logs again to obtain the predicted log GTW for the structural probit equation:

$$P(\text{employed/active}) = \Phi\left(\gamma\log\hat{}W_i + Z_i\alpha' - \overline{\psi}\log T_i\right)$$

Four remarks are in order. The first is regarding endogeneity and measurement error of the gains-to-work variable. In the structural probit, $\log W$ can be endogenous, since the wage error term can be correlated with the participation decision error term. Moreover, $\log W$ can also contain measurement error: in case of an individual working only for some part of the year, her reported wage is less than the true annual wage. Alternatively, unreported wage income can also lead to a mismeasurement of wages. Notice, however, that we are in fact running an IV-probit in step 3, which offers a remedy to both of these problems (as long as there are variables in X_i which are excluded form Z_i, an issue we address in the data section).

The second issue is whether the selection correction is identified only through a functional form assumption. This is indeed the case when $X \supseteq Z$ in the wage equation, since the inverse Mills ratio is then just a nonlinear reshuffling of the right hand side variables in the wage equation (variant A). On the other hand, the inverse Mills ratio does contain additional variation if $X \not\supseteq Z$, which is the case in Variant B. This means that we are free from the functional-form criticism in Variant B, but it applies for the wage equation in Variant A. In that case, however, there is no alternative: if a variable impacts the participation equation directly, it is also likely to impact the GTW ($\log W$) at least through the change in transfers term ΔT. For the structural probit equation (3) however, we are again on safe grounds: though the predicted $\log W$ contains the variables X, Z and their nonlinear combinations (in the inverse Mills ratio), X is excluded from the structural equation, so we are identifying γ from variations both in X and the inverse Mills ratio. In other words, the key element of the identification method is the existence of controls for labour demand included in X_i and excluded form Z_i.

Third, the use of generated regressors in the third stage calls for an adjustment of standard errors. Usual Heckman correction implementations do incorporate necessary corrections for the second but not for the third step. In practice, such a correction often leads to minor changes; hence it is common to ignore the issue (Kimmel and Kniesner, 1998, also follow this route). As one alternative, one could implement a full-blown correction of the third step standard errors, along the lines of Fernandez *et al.*. We instead opted for bootstrapping the standard errors, which should be more robust in case of noisy data or misspecification problems.[3]

Finally, there is a tradeoff between adopting Variant A or B. The latter would seem more appealing, since it allows for $X \not\supseteq Z$, hence even the wage equation is free from functional form criticisms. The drawback, however, is that nothing guarantees that our estimated $\hat{W}_i = e^{X_i\hat{\beta}_1 + \frac{1}{2}\hat{\sigma}_1^2} - \Delta T_i$ is positive, causing a nonrandom sample selection issue in our third step. One could produce better second stage regressions for $\log w_i$, taking for example the impact of the minimum wage into account.[4] That would mean, however, a Tobit-type truncated regression in the second stage, making our procedure even more complicated and potentially four-step. For this reason, we proceed only with Variant A; also recalling that although the wage equation is subject to a functional form criticism, is is much less of an issue in the structural probit equation.

Since our "wage" measure in the structural estimation is the GTW, the calculation of regular wage elasticities requires one more step. The structural probit gives us a log GTW coefficient γ. Since the probit is a nonlinear function, one has to evaluate it at a certain vector Z and $\log T$ to obtain the marginal impact of a percentage change in the GTW. Even then, however, it is still the

[3] In particular, our reported standard errors are calculated as the standard deviation of the point estimates from the three-step estimation procedure performed on 200 bootstrapped random samples (with replacement, and of the same size as the estimation sample).

[4] It was indeed the case in our sample that the predicted wage was too low for the low-skilled, where the minimum wage is often binding, making their predicted $\hat{W}_i$ negative.

impact of a change in W, not w.

To obtain the impact of the wage itself, note that:

$$\frac{\partial \log(w-\Delta T)}{\partial \log w}=\frac{\partial \log\left(e^{\log w}-\Delta T\right)}{\partial \log w}=\frac{e^{\log w}}{e^{\log w}-\Delta T}=\frac{w}{w-\Delta T}$$

So:

$$\frac{\partial \Phi}{\partial \log w}=\frac{\partial \Phi}{\partial \log W}\frac{\partial \log W}{\partial \log w}=\frac{\partial \Phi}{\partial \log W}\frac{w}{w-\Delta T} \tag{4}$$

Notice that the marginal effect of $\log W$ gets magnified if $w - \Delta T = w$; which is the case for transfer-dependent people (low skill, around retirement, etc.).

4 Data

We use data from the Hungarian Household Budget Survey (HKF), years 1998-2008. This is in principle a rotating panel database with a one-third renewing part every year, but it is very difficult to make the actual connections between consecutive waves. For this reason, we only use it as a pooled cross-section. The dataset contains detailed income and consumption measures of broadly 25,000 individuals per year.

The key challenge is to define the counterfactual transfers: First, how much would someone who is currently working receive in transfers if that individual is laid off? Second, how much would someone who is currently inactive lose if that individual takes up a full time job? Calculating these measures requires the detailed coding of the full transfer system, basically a microsimulation model. We detail the major tax expenditure and cash transfer items in the Appendix. With one exception, the database contained all the relevant information to deduct the counterfactual transfer entitlements or losses of each individual. The exception was the work history of individuals, on which certain transfers depend (for example, eligibility to the more generous maternity support schedule GYED). To resolve this issue, we used a predicted value based on the Labour Force Survey database (a conditional expectation based on observable characteristics).

The main left hand side variable was labour force participation,[5] though we also ran the same estimations with employment. All wage variables (w and W) refer to annual net wage income calculated from the gross wages reported by survey participants. The right hand side measures form two major groups: labour-supply shifters (Z_i) and wage equation controls ($X_i \backslash Z_i$). Following MaCurdy (1985), MaCurdy (1987), and Kimmel and Kniesner (1998), labour-supply shifters contain personal and family characteristics, while the vector X_{it} includes variables which determine the market wage (labour demand shifters). In particular, the first group consists of the following variables: log of non-labour income, education dummies, household head, mother with infant (<3 years old), attending full-time education, household size (number of persons), pensioner, family status (husband, wife, child, single, divorced,...), age-group dummies (15-24, 25-49, 50-) and year dummies. The second group contains county dummies, and interactions of age and age square with education.

One needs to justify the choice for variables in $X_i \backslash Z_i$, since those variables serve both as instruments for treating endogeneity and measurement error issues about our wage measure (see the first remark at the end of Section 3), and also as a source of additional variation to identify the

5 It is the "most typical" status for the given year, self-reported by survey respondents. Unemployment is defined along the ILO classification.

Table 1

Main Results

	(A) Estimation Results			
	Participation (1)		**Employment (2)**	
	Coeff.	**Std. Err.**	**Coeff.**	**Std. Err.**
gains to work	0.820	*0.099*	0.761	*0.089*
non-labour income	–0.844	*0.110*	–0.702	*0.098*
	(B) Conditional Marginal Effects			
	dy/dx	**Std. Err.**	**dy/dx**	**Std. Err.**
gains to work	0.290	*0.028*	0.301	*0.031*
non-labour income	–0.298	*0.030*	–0.277	*0.035*
net wage	0.395	*0.038*	0.410	*0.042*
transfer	–0.136	*0.013*	–0.137	*0.015*

Notes: Three-step estimates, as described in the paper. Standard errors are bootstrapped with 200 replications. Structural probit equation includes: log of gains to work, log of non-labour income, mother with infant (less then three years-old), full time student, education dummies (less then elementary school, elementary school, vocational, secondary education, tertiary education), age-group dummies (15-24, 25-49, ≥50), pensioner, gender, head of household dummy, household size, family status dummies (single, married living together, married living separately, widow(er), divorced), household membership status dummies (husband, wife, companion, single parent, child, ascendant, other relation, non-relation, single), year dummies. Controls included in the reduced-form probit and the wage equation which are missing from the structural probit are: county dummies, interaction of age and age square with education dummies.
Source: Household Budget Survey database, 1998-2008.

parameter γ (remark two of the same section). In our view, county dummies represent regional differences in economic conditions, which has an indirect effect on activity (through different wages) but no direct effect (two individuals with identical individual characteristics and wage but living in different regions should exhibit the same attitude towards economic activity). For the interaction of age and age square with education, our argument is the following. Age has two main effects on the likelihood of activity: one is through an impact on the lifecycle position (student, prime age and nearing retirement), and another through increased experience (an upward sloping relationship between age and wages). The first effect is a labour-supply shifter, which we capture by a large set of dummies that controls for individuals' lifecycle position, such as age-group, family status (single, married, divorced...), attending full-time education, mother with infant and others. On top of that, we argue that an extra year has a negligible impact on labour supply directly, but it strongly impacts the wage and hence impacts activity indirectly (a labour demand shifter).

5 Results

This section reports and discusses our empirical results. We focus mostly on the participation margin: with employment, we only report the results of the main specification but no detailed conditional marginal effects by subgroups (they are available upon request). The main parameters of interest are the coefficient of gains to work and non-labour income (always in logs). Table 1 displays our baseline results, following the econometric methodology of Variant A. Panel A reports the estimates for the structural probit equation (3). Most point estimates have the expected sign and are significant. A higher GTW increases the probability of being active, while non-labour income has the opposite effect (both are in logs). From the additional controls (unreported but available upon request), education has a mixed but insignificant effect. Being a household head or having a larger family increases the probability of being active, while being a mother with small children, full-time student or pensioner decreases it. Age has the usual hump-shaped effect on activity. The results are quite similar when the left hand side variable is employment.

Since the probit function is nonlinear, the point estimates in Panel A are not indicative about the conditional marginal effect of variables of interest on activity. Panel B displays these numbers, evaluated at the sample means. Numbers here are already semi-elasticities: a 10 per cent increase in the GTW leads to a 2.9 per cent increase in the probability of being active. As explained by equation (4), the same increase in the net wage (as opposed to the net wage minus transfers) leads to a potentially larger effect. The difference is quite substantial at the sample mean, as the effect is about 36 per cent higher. The opposite happens with non-labour income: transfers are only part of them, so a 10 per cent change in transfers implies a smaller increase in non-labour income.

The conditional marginal effects presented in Table1 are not directly comparable to the "consensus" 0.25 value of aggregate net wage elasticity reported by Chetty *et al.* (2012): these marginal effects indicate the effect of one percent increase in net wage on the "average individual's" probability of being active (or on the participation rate) in percentage points, as opposed to the elasticity measures in Chetty *et al.* (2012) indicating the percentage change in total employment to the same shock. To produce the equivalent of the exercise by Chetty *et al.* (2012), one needs to increase the net wage of all individuals by one percent and look at its employment effect. The resulting 0.28 per cent increase in total employment implies an elasticity of 0.28, quite in line with the consensus.

Next we look at the conditional marginal effects by subgroups to see how much they differ from each other. Table 1 presents two variants, a full and a restricted sample estimate. The full sample means that all observations are included (as in Table 2), but the marginal effects are evaluated at a subgroup-specific mean. The restricted sample means that the entire estimation procedure is carried out only on the subsample at hand, so even the structural probit estimates can be different.

Notice that the net wage (or even the GTW) elasticity of activity is highly different across the three educational groups even in the full sample estimation case, when the only reason is a different conditional mean of the subgroups. The probit estimates somewhat differ between the full and the restricted sample, though the latter is also much less precisely estimated. Still, the conditional marginal effects are quite similar. This result is noteworthy, as it means that one can explain the heterogeneity of participation elasticities without an underlying difference in the utility functions (*i.e.*, the parameters γ and $\overline{\psi}$ in equation (3)).

If those two parameters are common across individuals, than labour supply elasticities at the intensive margin are also common: one can show that for a fixed income share $W/(W+T)$ and expenditure share (1 $\alpha = c/(c+w(1-\bar{l})$, the impact of a change in the net wage or transfers is the same on the hours worked decision of every individual. This homogeneity is however partial, since individuals with different gross wages (productivity) or transfers (non-labour income in general) will have different income and expenditure shares. When there is no non-labour income (T=0), this homogeneity becomes even more complete, as the labour supply elasticity depends only on common parameters and original hours worked ($\alpha = \bar{l}$). So if individuals differ in their characteristics but their original hours worked is the same, so is their intensive margin labour supply elasticity. If utility is linear in consumption ($\psi = 0$), then the elasticity (of leisure) to net wages is common across all individuals (full homogeneity).

Table 2

Probit Estimates and Conditional Marginal Effects by Subgroups

		Full Sample (1)		Restricted Sample (2)	
		dy/dx	**Std. Err.**	**dy/dx**	**Std. Err.**
elementary school or less	gains to work (probit)	0.820	*0.099*	0.583	*0.082*
	non-labour income (probit)	–0.844	*0.110*	–0.639	*0.111*
	gains to work	0.212	*0.064*	0.175	*0.085*
	non-labour income	–0.218	*0.068*	–0.192	*0.101*
	net wage	0.294	*0.089*	0.275	*0.133*
	transfer	–0.093	*0.028*	–0.109	*0.053*
secondary education	gains to work (probit)	0.820	*0.099*	0.710	*0.151*
	non-labour income (probit)	–0.844	*0.110*	–0.715	*0.165*
	gains to work	0.219	*0.022*	0.213	*0.031*
	non-labour income	–0.225	*0.024*	–0.214	*0.034*
	net wage	0.310	*0.031*	0.286	*0.041*
	transfer	–0.118	*0.012*	–0.098	*0.014*
tertiary education	gains to work (probit)	0.820	*0.099*	0.915	*0.323*
	non-labour income (probit)	–0.844	*0.110*	–0.856	*0.326*
	gains to work	0.110	*0.012*	0.130	*0.029*
	non-labour income	–0.113	*0.012*	–0.121	*0.031*
	net wage	0.139	*0.015*	0.156	*0.035*
	transfer	–0.045	*0.005*	–0.043	*0.010*

Notes: Column (1) reports probit estimates and conditional marginal effects computed from the estimation on the full sample and evaluated at the subgroup-specific mean values of the covariates. Column (2) reports similar marginal effects, but computed from the estimations on the restricted samples.

Table 2 further explores the prime-age sample, checking whether education status also matters there. The low overall elasticity of this age group splits into a sizeable elasticity for the "elementary school or less" group (a group which is also highly welfare dependent) and a smaller but still significant number for prime-age individuals with secondary education. Estimations suggest that prime-age higher educated individuals are inelastic to tax and transfer changes at the extensive margin. The restricted samples yield similar though smaller differences, both for structural probit parameters and conditional marginal effects.

Table 3 displays the conditional marginal effects for the two remaining main welfare dependent social groups, the elderly and women of child-bearing age. The group of age above 50 exhibits a very substantial elasticity – this partly explains the large gap between the elasticity of the entire population and the prime-age group. This finding is quite important, as it shows that taxes and transfers have a strong impact on activity around retirement age, and that the tax and social insurance system can contribute to the large activity gap of the elderly in Hungary. Women at child-bearing age show a smaller wage elasticity, though they are still more responsive than the overall prime-age group. This is also true about the impact of transfers.

Table 3

Probit Estimates and Conditional Marginal Effects by Subgroups, Prime-age Subsample

		Full Sample (1)		Restricted Sample (2)	
		dy/dx	**Std. Err.**	**dy/dx**	**Std. Err.**
full prime-age sample	gains to work (probit)	0.820	*0.099*	0.646	*0.122*
	non-labour income (probit)	–0.844	*0.110*	–0.620	*0.129*
	gains to work	0.088	*0.010*	0.086	*0.008*
	non-labour income	–0.091	*0.010*	–0.083	*0.008*
	net wage	0.127	*0.014*	0.124	*0.011*
	transfer	–0.054	*0.006*	–0.051	*0.005*
prime-age, elementary school or less	gains to work (probit)	0.820	*0.099*	0.323	*0.164*
	non-labour income (probit)	–0.844	*0.110*	–0.299	*0.185*
	gains to work	0.249	*0.025*	0.109	*0.051*
	non-labour income	–0.256	*0.026*	–0.101	*0.058*
	net wage	0.409	*0.040*	0.180	*0.085*
	transfer	–0.194	*0.019*	–0.084	*0.041*
prime-age, secondary education	gains to work (probit)	0.820	*0.099*	0.403	*0.182*
	non-labour income (probit)	–0.844	*0.110*	–0.364	*0.192*
	gains to work	0.081	*0.008*	0.057	*0.017*
	non-labour income	–0.084	*0.008*	–0.051	*0.019*
	net wage	0.122	*0.012*	0.084	*0.025*
	transfer	–0.054	*0.005*	–0.036	*0.011*
prime-age, tertiary education	gains to work (probit)	0.820	*0.099*	–0.206	*0.420*
	non-labour income (probit)	–0.844	*0.110*	0.217	*0.400*
	gains to work	0.038	*0.003*	–0.019	*0.041*
	non-labour income	–0.039	*0.003*	0.020	*0.040*
	net wage	0.050	*0.004*	–0.023	*0.051*
	transfer	–0.019	*0.001*	0.008	*0.017*

Notes: Column (1) reports probit estimates and conditional marginal effects computed from the estimation on the full sample and evaluated at the subgroup-specific mean values of the covariates. Column (2) reports similar marginal effects, but computed from the estimations on the restricted samples.

Finally, Table 3 also report results for the usual classification by sex and marital status. Consistently with most of the previous empirical findings, women are, in general, more responsive to tax and transfer changes than men. Married women, the group mostly studied in the literature exhibits the highest marginal elasticity, while married men seem to be the less responsive group.

In summary, we have found that wages, taxes and transfers have a large impact on the participation decision, particularly for elders, the low-skilled, married women and women at child-bearing age. Moreover, these differences can be largely explained by different group characteristics, leading to different conditional marginal effects of the same structural probit estimates, and also to a different multiplication of a net wage change into the change in the GTW.

Table 4

Conditional Marginal Effects by Selected Subgroups

		dy/dx	std. err.
elder (>=50)	gains to work	0.311	*0.052*
	non-labour income	–0.320	*0.057*
	net wage	0.392	*0.065*
	transfer	–0.103	*0.017*
women at child-bearing age (25-49)	gains to work	0.146	*0.013*
	non-labour income	–0.151	*0.014*
	net wage	0.231	*0.021*
	transfer	–0.108	*0.010*
prime-age, single men	gains to work	0.069	*0.008*
	non-labour income	–0.071	*0.009*
	net wage	0.096	*0.012*
	transfer	–0.038	*0.005*
prime-age, single women	gains to work	0.113	*0.013*
	non-labour income	–0.116	*0.013*
	net wage	0.168	*0.019*
	transfer	–0.076	*0.008*
prime-age, married men	gains to work	0.028	*0.003*
	non-labour income	–0.029	*0.004*
	net wage	0.039	*0.005*
	transfer	–0.016	*0.002*
prime-age, married women	gains to work	0.183	*0.016*
	non-labour income	–0.189	*0.017*
	net wage	0.290	*0.025*
	transfer	–0.133	*0.012*

We now demonstrate how our results can be utilized for the simulation of the labour supply (participation) effect of a personal income tax and transfer reform. The main step is to calculate the probability of being active for a given hypothetical wage, tax and transfer system. First we obtain the pre- and post-reform aftertax wage income of everyone in our sample, using predicted wages. Then we calculate the pre- and post-reform hypothetical "zero hours worked" transfer level for everyone, and construct the log of the GTW (log$W$) before and after the reform.

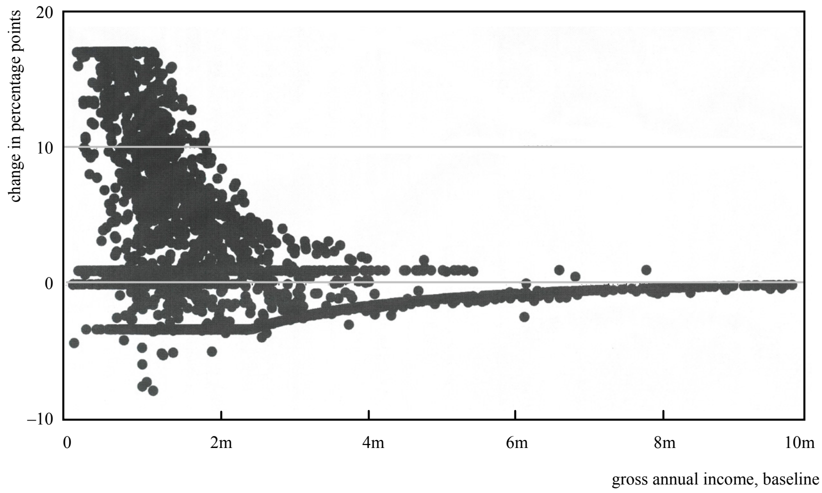
Equipped with these, we form:

$$\Phi\left(\hat{\gamma}\log W_i + Z_i\hat{\alpha}' - \hat{\bar{\psi}}\log T_i\right)$$

before and after the reform. The change in its value is the change in the probability of individual i being active. Finally, we add up the probabilities in the sample (weighted) to get an estimate for the change in the aggregate activity rate. This gives us the shift of the labour supply curve: in equilibrium, labour demand might be downward sloping so the equilibrium wage may change, offsetting partly the change in labour supply.

Figure 4

Change of Average Effective Tax Rates (AETR)



As an illustration, we fed the main changes of the Hungarian personal income tax and transfer system of 2012 into this framework. The particular measures are the following: the complete elimination of the employee tax credit (ETC) scheme, a 27 per cent reduction in the tax rate (from 20.3 to 16 per cent) below the average monthly income of 202,000 HUF, and a 1 percentage point increase in the social contribution rate. As illustrated by Figure 3, these changes have a very heterogeneous effect on the average tax rate of taxpayers: the abolishment of the ETC pushes up the average tax rate for low earners, for which they are partly compensated by the cut in the tax rate. Medium earners, who were not or at most partially eligible for the ETC gain by a reduction in their tax rate. High earners also gain a little due to the reduction in the tax rate on their first 202,000 HUF income per month. Finally, there is a common loss from increased social contributions.

As a result, aggregate activity decreases by 0.97 per cent, from which the elimination of the ETC is responsible for 2.09 per cent,[6] the increase in social contributions leads to another 0.34 per cent reduction, which are partly offset by an increase of 1.51 per cent due to the rate cut.[7] Overall, this illustrates both the usefulness of our parametric approach for assessing the impact of tax and transfer reforms, and the economic significance of our parameter estimates.

6 Conclusion

This paper presents a first (at least to our knowledge) structural form estimation of labour supply at the extensive margin that simultaneously takes into account taxes and transfers. We show that one has to modify the net wage by deducting the amount of lost transfers to get the measure which determines the participation decision (the gains to work). This implies, however, that the same change in the net wage leads to a very different change in the GTW if lost transfers are a different share of the net wage.

We find that a single equation can already explain a large heterogeneity of individual responsiveness to taxes and transfers: there are large differences among subgroups, driven partly by

[6] There is a subtle issue here: under the Hungarian tax code, a large part of social transfers are also affected by personal income taxes and the ETC. Consequently, the elimination of the ETC also decreases the net value of many social transfers. Thanks to our integrated treatment of taxes and transfers, we can take this into account in our calculation. Without the corresponding cut in the net value of transfers, there would be an even more substantial reduction in participation.

[7] The sum of the effects of these measures may differ to the total effect due to interactions.

a composition effect, and partly by a different share of lost transfers in the GTW. These highly responsive subgroups are exactly the ones who are mostly responsible for Hungary's low participation rate (low-skilled, women at child-bearing age, elders), implying that a reform of the tax and transfer system can be a powerful tool to boost employment.

Our results directly lend themselves to reform simulations. We demonstrated how our model can be utilized to calculate the labour supply shift of a complex personal income tax reform. In related work (Benczúr *et al.*, 2012), we build a model where this labour supply block is expanded by an intensive margin adjustment (based on a combination of Bakos *et al.*, 2008; and Á. Kiss and Mosberger, 2011), and then it is embedded in a small general equilibrium macro model. With such a fully fledged model, we were able to evaluate at depth the 2011-12 Hungarian tax and transfer reforms as well (Benczúr *et al.*, 2011).

APPENDIX
SUMMARY OF CASH TRANSFERS AND TAX EXPENDITURES TAKEN INTO ACCOUNT IN THE ESTIMATION

This Appendix summarizes the basic features of tax expenditures and the cash transfers and tax expenditures taken into account in the estimation. In particular, we discuss child care (family) benefits and unemployment (welfare) benefits. We treated old-age and disability benefits as exogenous and, accordingly, did not include these benefits in the summary. This rests on the assumption that if an individual is entitled for these benefits (due to age or health status), we will observe that he/she is a recipient. This looks like a natural assumption in the case of disability benefits. In the case of old-age benefits, this treatment is justified by the fact that during the sample period old-age pension recipients were allowed to work without any penalty. Thus they did not face a choice between pensions and earnings.

1 Tax expenditures in the PIT

a) *Employee tax credit (adójóváírás),*[8] *ETC* is a non-refundable tax credit applying to wage income. The ETC was modest in size until its expansion in 2002. During the period 2003-11 it made the minimum wage nearly PIT-free. The ETC was phased out in most years at a rate of 9 per cent in an income range around the average wage. Until its abolishment in 2012, its exact parameters were adjusted each year.
b) *Family tax credit (családi adókedvezmény).* The Hungarian PIT has been an individual-based (as opposed to a family-based) tax system during the sample period. One of the parents can deduct the family tax credit from his or her tax payment (or both can share the credit) based on the number of children in the household. Starting in 2006, families with one or two children were not eligible for the tax credit (until the tax credit was expanded in 2011).
c) *Other tax credits* were abundant in the tax code until 2006; since then they have been gradually eliminated. We use information in the Household Budget Survey to assess the tax credits each individual can take advantage of.
d) *Tax base issues*. During the sample period, insurance-based benefits were generally treated as wage income by the tax code while universal benefits were tax exempt. During the years 2007-10 pension income constituted part of the tax base although it was not taxed itself (it pushed other incomes into the upper tax bracket). Benefits 2c and 2d were treated similarly during the whole sample period.

2 Family benefits

a) *Maternity benefit (TGYÁS)* is an insurance-based benefit that mothers are entitled to receive for 5 months around child-birth. Its condition is current employment (at the time of applying for the benefit). The monthly benefit is equal to 70 per cent of past monthly wage. The recipient may not engage in paid work while receiving this benefit. No couple can receive two of benefits 2a-d at the same time.
b) *Child-care benefit I (GYED)* is an insurance-based benefit that one of the parents is entitled to receive until the second birthday of the youngest child. Its condition is at least 12 months of

[8] There is considerable heterogeneity in the official and scientific publications regarding the English translation of the various benefits. In this table we chose to use the simplest English translations that reflect the nature of the given benefit; we included the official Hungarian designations so that the benefits can easily be identified.

employment in the 24 months before the child is born. The monthly benefit is equal to 70 per cent of past monthly wage but it may not exceed 140 per cent of the minimum wage. The recipient may not engage in paid work while receiving this benefit. No couple can receive two of benefits 2a-d at the same time.

c) *Child-care benefit II (GYES)* is not conditional on employment (social insurance) history. One of the parents is entitled to receive the benefit until the third birthday of the youngest child. The benefit is pegged to the so-called "minimum pension benefit", equal to HUF 28500 (around 40 per cent of the minimum wage) in 2008. Recipients are restricted from working full time in the first year of this benefit. (The employment restrictions were loosened for the second and third year during the period of study.) No couple can receive two of benefits 2a-d at the same time.

d) *Child-care benefit III (GYET):* A parent is entitled to this benefit if he or she raises at least 3 children until the 8th birthday of the youngest child, independently of employment (social insurance) history. The benefit is pegged to the 'minimum pension benefit' (see 2c). Recipients of this benefit are restricted from working full time. No couple can receive two of benefits 2a-d at the same time.

e) *Family supplement (sometimes called "family allowance"; családi pótlék)* is a universal benefit all families with children are entitled to receive. The sum of the benefit depends on the number of children, whether there are twins among the children, and whether any of the children is chronically ill. It was equal to HUF 12,200 (around 18 per cent of the minimum wage) for a family with one child in 2008.

3 Unemployment benefits

a) *Unemployment benefit I (1998-2005: munkanélküli járadék; 2006-: álláskeresési járadék):* Individuals who lost their jobs are eligible for the insurance-based unemployment benefit (renamed as "job-seekers' benefit" in 2006). Its maximum duration was shortened from 12 months to 9 months in 2000. Until 2006 it was equal to 65 per cent of the previous wage (capped at 180 per cent of the "minimum pension benefit", see 2c). After 2006 it had two phases. The first phase lasted 3 months, during which the recipient received 60 per cent of his/her past wage (capped at 120 per cent of the minimum wage). The second phase lasted 6 months, during which the benefit was equal to 60 per cent of the minimum wage. (If the individual did not have a full employment history in the four years before the job loss, the duration of the benefit could be shorter. The second phase was abolished in 2012.)

b) *Unemployment benefit II (2003-05: álláskeresést ösztönzõ juttatás; 2006-: álláskeresési segély):* Established in 2003, this was a fixed-sum benefit for individuals whose unemployment benefit I expired but still did not find a job. It was conditional on cooperation with the local unemployment administration. Between 2003-05 the benefit lasted a maximum of 6 months; it was reduced to 3 months in 2006. From that year onwards the benefit was equal to 40 per cent of the minimum wage. (It was abolished in 2012).

c) *Pre-retirement unemployment benefit (Nyugdíj elõtti álláskeresési segély):* Individuals are entitled for this insurance-based benefit (which used to be a sub-case of benefit 3b after 2006) if they lose their job in the five years before the statutory pension age. The benefit is equal to 40 per cent of the minimum wage. The benefit payment is suspended if the individual finds employment.

d) *Regular social benefit (1998-2000: jövedelempótló támogatás; 2001-: rendszeres szociális segély)* is a a welfare benefit individuals can receive if they are not eligible to any other unemployment (or disability or child-care) benefit (any more). For most of the sample period it was means-tested. The details of the means-testing changed in 2006. After 2006 the benefit supplemented a family's income to 90 per cent of the "minimum pension benefit" per consumption unit but could not exceed the net minimum wage. (Its predecessor in the years 1998-2000 was a fixed-sum transfer and it was succeeded by a fixed-sum transfer in 2010.)

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AN EVALUATION OF THE 1997 FISCAL DECENTRALIZATION REFORM IN MEXICO: THE CASE OF THE HEALTH SECTOR

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This paper studies the impact of the health decentralization of funds and responsibilities that took place in Mexico in 1997 on state level health outcomes. It renders two main results. First, the magnitude of transfers from the federal government to states failed to take into account state-specific needs; instead, transfers were mainly determined by the pre-reform health expenditures of the federal government in each state. Second, decentralization did not boost the advances in health outcomes already achieved under the centralized health sector regime. We conclude by discussing potential reasons for the results found in this paper.

1 Introduction

Fiscal decentralization has been part of the reform agenda in many developing countries for the last two decades. Theoretically, state and local fiscal autonomy is founded on the idea that public policy decisions by lower tiers of governments would bring about more efficient outcomes in the provision of public goods (Oates, 1972). It is argued that sub-national governments are better able to identify the needs and preferences of citizens. Under fiscal decentralization, taxpayers are closer to authorities, allowing them to better demand transparency, accountability, and efficiency in the use of public resources. As a result, decentralization is expected to generate economic growth and improvements in the welfare of the population.[1] Having these positive effects in mind, Mexico undertook a profound reform in the 1990s to modify the expenditure responsibilities of the federation and state governments. The main aim of the reform was to transfer financial resources and responsibilities to state and local governments for the provision of specific public goods. By 1998, five earmarked funds were created (one for basic education, one for health services, one for social infrastructure, one for municipal strengthening, and one for multiple destinations);[2] these were financed through federal transfers to sub-national governments.[3]

This paper focuses on one of these earmarked funds: the Health Services Fund[4] (FASSA, for its acronym in Spanish). Particularly, we analyze the consequences that such fund had over the health of the population according to specific health outcomes. We present results for infant mortality rate at the state level, a broadly used health indicator; but our results are robust to the use of other health indicators. The reform entitled the states to organize, control, coordinate, evaluate, and monitor the supply of health services, facilities and medical attention for the non-insured

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1 However, the outcomes of fiscal federalism may be the opposite if political economy considerations are included in the analysis (Prud'homme, 2004 and Weingast, 2009).

2 In 1999 two more funds were added: one for public safety and the other one for technological and adult education.

3 It is important to address that the reform focused on changing the expenditures assignments between states and federation but it did not modify tax collection responsibilities among tiers of governments. Federal government is still responsible for collecting more than 90 per cent of the public revenue of the country, but after unconditional and earmarked federal transfers, sub-national governments spend around 50 per cent of the public expenditure in Mexico.

4 In Spanish, Fondo de Aportaciones para Servicios de Salud (FASSA).

population[5] in the following areas: maternity care; visual and hearing health; nutrition; epidemiology; among others. In this context, FASSA's aim was to endow states with resources to meet the new health responsibilities that came with the decentralization of the sector. Decentralization meant that the medical attention of the non-insured (and therefore more vulnerable) population would now become the responsibility of state health authorities. Likewise, states were responsible for the administration of state hospitals for primary health care that used to be operated by the federal Ministry of Health (MofH hereafter) before the reform. One particular feature of the decentralization reform is that during the first years of its implementation, the amount of funds received by the states from FASSA was similar to what the federal MofH used to spend for non-insured population, via Ramo12, in each state before the reform took place. Another interesting feature is that the allocation of FASSA among states did not respond to the particular health needs of each state. These two facts, besides being clearly surprising, allow us to identify the impact on health indicators when health budget is spent by state governments rather than by the federal one.

We explore whether the decentralization of health provision in Mexico can account for the improvements of state level health indicators experienced in the last twenty years. First, we discuss whether the institutional arrangement of health decentralization is appropriate to maximize the impact of each peso spent. For instance, the Law of Fiscal Coordination determines a formula that specifies the factors used to calculate the share of FASSA assigned to each state, but does not present the weights given to each factor. Even more importantly, the factors determining what every state receives do not include health needs or rewards to those states that are spending efficiently. In order to address these issues, we present regressions that analyze the determinants of FASSA. Surprisingly, we find that the money spent by the federal government in each state in 1997, that is, the year before the reform was implemented, is the strongest predictor of what each state receives from the FASSA in any given year. We also found that health outcome variables, like infant mortality rate and deaths by infectious and parasitic diseases, do not show stable or significant coefficients. Medical resources are, in general, statistically insignificant, contrary to what the formula of FASSA stipulates. Population is the variable that more consistently shows a negative sign. We also perform similar regressions to look at the determinants of the non-insured health expenditure made by the federal government (Ramo12) before the reform. The results are very similar to the FASSA regressions and we conclude that the most important determinant driving health expenditure is the expenditure made in prior to decentralization.

The second part of our empirical strategy studies whether transferring health resources from the federal government to states has an effect on the infant mortality rate. For this purpose, we rely on different empirical exercises. We first compare FASSA to the federal budget on health, *i.e.*, Ramo12, by estimating the effect each budget had over the infant mortality rate for the years after the reform and for the years before the reform, respectively. This allows us to make a comparison between how state governments performed between 1998 and 2003 relative to how the federal government did between 1993 and 1997. The former exercise is an important comparison because the decentralization reform consisted in transfers of resources and responsibilities from the federal to state governments. We find no significant difference between the efficiency of Ramo12 and that of FASSA. Perhaps one reason we do not find a significant effect is that some states did very well whereas others underperformed, neutralizing the gains when averaging across states. Thus, in our second set of estimates, we test whether states that received more FASSA resources observed better health outcomes than those that received less resources when comparing the years after the reform with the years before the reform. Again, we find no significant difference between the high FASSA group relative to the low FASSA group. In another set of estimations that do not use infant

[5] The non-insured is the fraction of the population that is not covered by an insurance mechanism; however they can access health care services at less than full-cost prices in Ministry of Health and state health facilities (OECD, 2005, pp. 29-30).

mortality rate but fetal death rate[6] and that take as control group that fraction of the population that is insured, we find that the fetal death rate among the non-insured population did not have a significant change after 1997 when compared to the fetal death rate in the insured population. However if we compare the expenditure efficiency (as measured by the effect of health expenditure on the infant mortality rate) for the non-insured with that of the insured population, we find that the former became more efficient after the decentralization reform. Thus, excluding the last specification, the evidence suggests that the decentralization of the health sector did not have an effect on the well-being of the population.

This paper has four main contributions. The first two are empirical ones. In the first place, this is the first work studying the effects of decentralizing the health sector in Mexico as well as the determinants of the distribution of health funds across states. Second, to the best of our knowledge, this paper is the only one that compares the efficiency in the provision of health services between the federal and state governments in two different federalist settings: centralized and decentralized. The other two contributions are related to the methodology. First, our identification strategy allows us to overcome some problems of endogeneity between decentralization and health outcomes, an issue seldom discussed in the literature. Finally, our measure of health decentralization is the actual health expenditure made by the state governments (from federal transfers), which, we consider, is a cleaner way to analyze efficiency issues relative to previous literature as we will discuss below.

The results of the present work may give important lessons about the conditions under which fiscal decentralization maximizes its impact on people's welfare. We argue that successful decentralization may be related to some necessary conditions: revenue collection decentralization, the strengthening of transparency and accountability of state governments, and improving institutional checks and balances.

The structure of the paper is as follows. Next section reviews previous literature related to health decentralization. The third section discusses briefly some characteristics of the health system in Mexico and the evolution of the main health indicators in the last two decades. The fourth section presents a description of the process of health decentralization and an analysis of how FASSA is allocated between states. The fifth part describes our empirical strategy followed by the analysis of the effects of decentralization on the infant mortality and fetal death rates. Finally, the paper concludes by discussing some lessons and plausible explanations for the (lack of) results of decentralization.

2 Literature review

Previous work on health decentralization has already pointed out the pros and cons of health provision by local state governments (see Asfaw *et al.*, 2007 and Robalino *et al.*, 2001 for a summary of these arguments). Among the advantages of decentralization the following can be listed: a) local authorities may have access to better information on local circumstances, needs and preferences of citizens; b) information is used more promptly and cuts costs without procedures that require central authorization, thereby enabling a more flexible operation of local governments; and c) it can also promote transparency, accountability, efficiency and community's participation. On the other hand, decentralization may hinder welfare gains due to: a) diseconomies of scale; b) lack of capacity, skills and information of local authorities on how to implement public policies; c) inability to collect own revenue to provide public goods; d) lack of interest from local elites in

[6] In this case, we did not use the infant mortality rate because we cannot divide it between non-insured and insured population. Due to the way fetal deaths are registered, it is possible to construct a fetal death rate for non-insured and insured population. The way we construct these rates is explained in detail in Section 5.

community's needs (capture of rents if there is no transparency and accountability); and e) implementation and coordination problems with national policies across regions.

Notwithstanding the importance of the topic, the empirical evidence on the consequences of decentralization is scarce. In the particular case of the health sector, previous literature has found that a more decentralized health sector is associated with a lower infant mortality rate, results that are opposite to our findings. Countries covered in this literature include India (Asfaw *et al.*, 2007), Argentina (Habibi *et al.*, 2001), China (Uchimura and Jütting, 2007), Canada (Jiménez Rubio, 2011), Spain (Cantarero and Pascual, 2008), Colombia (Soto *et al.*, 2011) and others included in a cross country study (Robalino *et al.*, 2001).

Nevertheless, this empirical research on the effects of decentralization has not provided compelling answers. First, it has had difficulties finding data on health spending by local governments. For instance, Asfaw *et al.* (2007), Robalino *et al.* (2001), Habibi *et al.* (2001), and Uchimura and Jütting (2007) use the proportion of total public expenditure or revenue that is spent or collected by provincial or sub-national governments as a measure of decentralization, even if such resources are used in sectors different than health. This indicator of decentralization clearly fails to deliver credible evidence about the real impact of decentralization in particular sectors, such as the health sector. Moreover, it is common that countries differ in the spheres that are decentralized. For instance, a country may have high local fiscal autonomy in many spheres but health, or it may be that the only type of decentralized expenditure is health (see Jiménez Rubio, 2011), which may lead to an identification problem of the relationship between health decentralization and outcomes. The only works that tackle this issue are Cantarero and Pascual (2008), Jiménez Rubio (2011), and, Soto *et al.* (2011) as they use a health specific decentralization indicator.

An additional issue of just using the percentage of health decentralized resources is that the estimations do not control for the level of health expenditure. This may lead to obtain biased estimates due to omitted variable issues if the share of sub-national resources is correlated to the level of health expenditure – Jiménez Rubio (2011) is an exception. In the absence of health expenditure in the econometric estimation, the results that find a negative relationship between decentralization and infant mortality rate may be capturing the effect of higher health expenditure (see, for instance, Joumard *et al.* (2008), which shows a positive effect of health expenditure on outcomes).[7]

Our paper solves both shortcomings by using the actual money spent by state governments in the health sector from transfers of the federal government as measure of health decentralization, which represents a high portion of health expenditure for non-insured population (around 80 per cent between 1997 and 2003).

Moreover, following Jiménez Rubio (2011), we consider it is important to control for other types of health expenditure (private, federal and social security institutions) that may be also driving health outcomes. The absence of these controls could confound the actual effect of greater local and state government's health expenditures. In order to deal with this issue the econometric estimation presented in Section V controls for a variety of health expenditure made by private and public institutions.

Methodologically, this paper deals with the issue of reverse causality between infant mortality rate and decentralization, a topic seldom discussed in the health decentralization literature. An advantage of this paper is that, for the case of Mexico, there is little evidence to

[7] See also Mosca (2006) and Akin *et al.* (2005), which study the determinants of local health expenditures in Switzerland and Uganda, respectively.

support the hypothesis that the state assignment of decentralized resources is driven by health status, which allows us to have a clean identification strategy.

Finally, to the best of our knowledge, our paper distinguishes itself from previous literature as it is the only one that evaluates the effects on health of a reform that decentralized health provision from the federal government to state government. Therefore, we directly explore whether health state provision had better effects than the provision made by the federal government before the reform. In other words, we depart from the existent literature on health decentralization (which explores whether the degree of decentralization improves health outcomes) using a methodology that allows us to compare explicitly the performance of the health expenditure made by the federal government and state governments.

3 Mexican health system

3.1 Health institutions

The Mexican public health system is highly fragmented, with health services being provided by several institutions. Each institution is different in whether they provide care for the insured or non-insured population. "The insured receive care for free from providers belonging to their social insurance institution […][The] uninsured population, although not covered by an insurance mechanism, can still access health care services at markedly less than full-cost prices in publicly financed Ministry of Health and state health facilities"(OECD, 2005, pp. 29 and 30). Workers in the formal labor market and their families are covered by a set of social security institutions. Basically there are three types of public health insurance institutions: i) the Mexican Social Security Institute (IMSS for its Spanish acronym) provides services to 40 per cent of the population (private formal salaried workers and their families); ii) the Institute of Social Security and Services for Government Workers (ISSSTE) covers 9 per cent of the population (federal government workers and some state workers); and iii) others, which include social security systems for workers of the state-owned oil company (Petróleos Mexicanos, PEMEX), the Navy, the Army, among others, covering around 2 per cent of the population. These institutions are financed through tripartite contributions by the federal government (subsidies), the employer and, employees. Each institution has and operates its own set of clinics and hospitals and employs salaried doctors. The provision of health services is mandatory and there are no cost sharing mechanisms (OECD, 2005).

The responsibility to provide health care to those who do not have access to the social security system (less than half of the population) is shared by the MofH and state governments' health services. The rates charged for health services depend on the patient's income and varies among hospitals and states. The benefits include the provision of primary, secondary and tertiary care, as well as preventive and curative services, but services are subject to the availability of resources. Besides the rates charged, (a small portion of the non-insured expenditure) financing comes from the federal budget (Ramo12[8] and FASSA) and states' own resources (*participaciones*[9] and other own state income). In addition, numerous programs have been implemented in order to improve the access of non-insured and poor people to basic health services.

Finally, a minority of the population (around 3 per cent) has private health insurance (half

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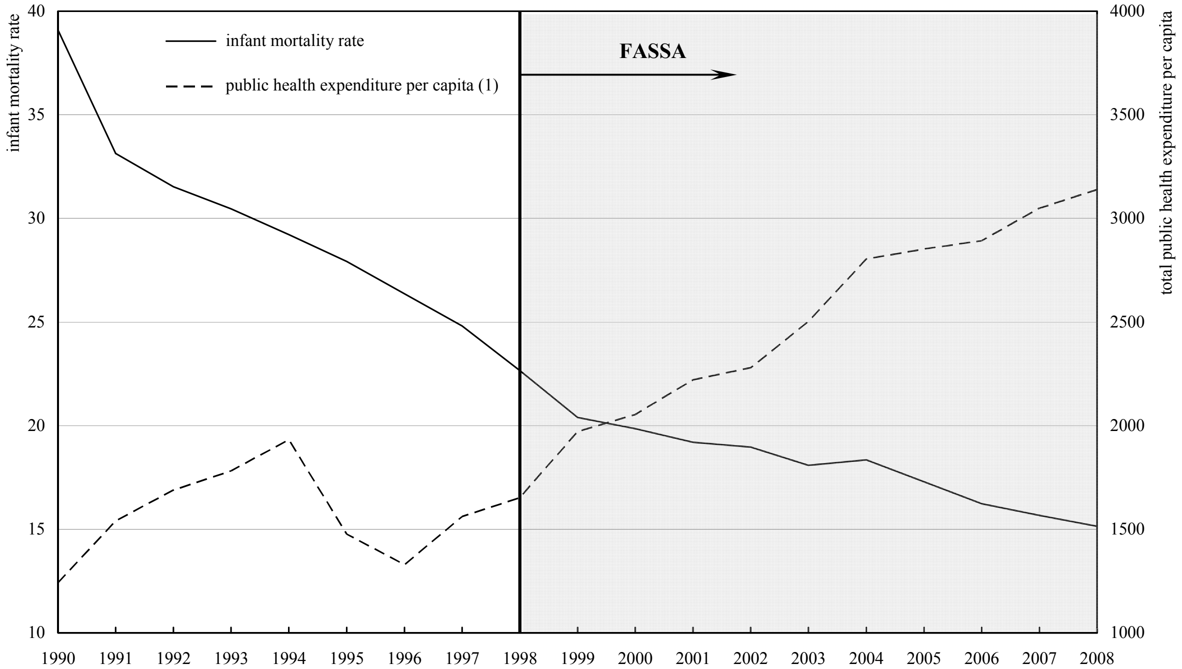
8 Ramo12 is the federal budget assigned for the provision of health services for the non-insured population. It includes the MofH budget, the health component of Oportunidades (an anti-poverty program based on conditional cash transfers), resources for public health programs and some resources for the Seguro Popular, the National Health Institutes and other large hospitals run by the federal government. IMSS-Oportunidades was previously financed through Ramo12 but these resources were directly transferred to the IMSS budget.

9 *Participaciones* are non-earmarked funds transferred from the federal government to state and local governments.

Figure 1

Infant Mortality Rate and Public Health Expenditure Per Capita, 1990-2008



(1) Units expressed in 2010 pesos.
Source: Own elaboration with data from SINAIS.

are financed by employers), which can be deduced from taxable income. There are two main types of private health policies: more than 97 per cent of the private insured population is covered through catastrophic medical insurance policies (*gastos médicos mayores*) for hospital expenses and various treatments for defined diagnoses; the remaining 3 per cent of the insured population on private institution has coverage through Products by Specialized Health Insurance Institutions (ISES), which is a "health care system that assumes or shares both the financial risks and delivery risks associated with providing comprehensive medical services to insured, usually in return for a fixed, prepaid fee" (OECD, 2005, p. 39). ISES offer full health coverage through private providers.

3.2 *Health financing: amounts and evolution*

Mexico spent 6.4 per cent of its GDP in health in 2009, up from 3.1 per cent in 1990. As of 2009, 48 per cent of the financing of the Mexican health system is public (up from 40 per cent in 1990).[10] As Figure 1 shows, the per capita public health expenditure more than doubled between 1990 and 2008. However, total and public health expenditure in Mexico is still the lowest among OECD countries, which on average spent 8.9 per cent of GDP in 2008. Most of the health expenditure in the OECD countries is financed by the public sector (72 per cent).

10 Private health expenditure is mostly (92.3 per cent) done in the form of out-of-pocket payments. Within out-of-pocket expenditures, only a minor fraction is due to public sector cost sharing schemes. Most of the out-of-pocket is spent in the private sector. Just to have a perspective, OECD countries spend around 18.9 per cent of the total expenditure in out-of-pocket payments, versus almost 50 per cent in Mexico.

Covering around half of the population, social security institutions (IMSS, ISSSTE and PEMEX) were responsible of more than 80 per cent of the public health expenditure in 1993 and around two thirds in 2003. In 1993, Ramo12 represented 13.02 per cent of the overall public expenditure on health (0.33 per cent of GDP)[11] and in 2003 its participation decreased to 9.17 per cent of total health expenditure (0.26 per cent of GDP). While state governments (without FASSA)[12] had a share of around 5 per cent of health public expenditure[13] in 2003, FASSA represented about 16.8 per cent of the public health expenditure (0.47 per cent of GDP).

The growth in public health expenditure came along with a deeper penetration of health services in Mexico. Coverage has improved in the last years, as physicians per 1000 people went from 1.06 in 1990 to 1.44 in 2003 and nurses per 1000 increased from 1.55 to 1.76 between 1990 and 2003. Medical consultations also showed an important increase: in 1990, there were 1195 consultations per 1000 people; 13 years later, this indicator grew to 1726. Although these numbers show improvements over the last decade, Mexico still has one of the lowest health coverage among OECD countries.[14]

The expansion in health resources was translated into important progress in health status over the last twenty years. For instance, life expectancy at birth in 2008 was 75 years, up from 70 years in 1990; infant mortality rate went from 39 deaths per 1000 live births (see Figure 1) in 1990 to 15.2 deaths. As these numbers suggest, Mexico experienced great improvements in health but there is still some gap with respect to OECD countries.[15]

Historically, regional differences in health indicators have been important but the progress observed in the last years favored poor states as they have closed the gap. For instance, the state with the highest infant mortality rate in 1990 was Chiapas with 60.72 and Federal District had the lowest (22.36). Thirteen years later, Guerrero had the highest infant mortality rate (25.89) and Nuevo León had the lowest (12.44).

In spite of the recent achievements in health, Mexico still faces important challenges (OECD, 2005). The government has limited economic resources to deal with the demographic and epidemiological (from infectious to degenerative diseases) transition that will increase the demand for health care in the near future. An institutional reform is needed to avoid the current fragmentation of the various social security structures which has led to an inefficient provision of health care as well as to overcome the disparities in health expenditure among several dimensions such as: across states, between social security institutions and the non-insured population, and between federal and state governments. Moreover, it is important to minimize the out-of-pocket expenditure and to increase infrastructure and equipment investment in the sector (Gómez Dantés and Ortiz, 2004).

4 Decentralization and FASSA

4.1 Evolution of Health Decentralization in Mexico

In the last three decades, Mexico undertook two waves of health decentralization, mainly for the coverage of non-insured population. The first wave was in the 1980s but it was not generalized

[11] For the calculations before 1998, it is noteworthy that there is no available data for state governments' expenditure.

[12] Those resources come from own state resources and non-earmarked transfers from the Federation to states.

[13] State governments made an effort equivalent to 8 per cent of the all public sector effort in 2008.

[14] According to OECD data, Mexico had 2 doctors per 1000 population in 2008 and the OECD average was 3. The number of nurses per 1000 population averaged almost 9 in the OECD countries; Mexico had 2.4 nurses. Finally, doctor consultations per capita in Mexico were 2.8 compared to 7.1 among OECD countries.

[15] OECD life expectancy is 79 years old and infant mortality rate is 4.6 deaths per 1000 live births.

since only 14 states[16] out of 32 signed the agreement with the federal government. Although the program included the transfer of responsibilities to states for the operation of some hospitals and administrative tasks and the consolidation of the services provided by IMSS-Coplamar[17] and the MofH, the spending decisions, regulation and policy formulation remained controlled by the MofH (see Cabrero and Martínez Vázquez, 2000 and Merino, 2003). According to Birn (1999), the provision of health services and health outcomes from this attempt of decentralization were not different between the signers and non-signers of the health decentralization agreement of the ’80s.

After some minor decentralizing actions during the administration of President Salinas (1988-94) (see Merino, 2003), a comprehensive decentralization reform was launched in 1996 as part of an important strategy of the Health Sector Reform Program 1995-2000. Centralism in the sector was seen as a cause of several problems such as low efficiency in the allocation of resources; lack of clarity in the responsibilities of each tier of government, excessive bureaucracy, inertia and inequality in the distribution of resources among states and absence of coordination between IMSS-Solidaridad,[18] the MofH and state health authorities (Merino, 2003). In order to tackle these issues, the reform defined clearly the health responsibilities of federal and state governments.[19] The federal government transferred operative functions, along with human, physical and monetary resources to states, thereby providing them with greater autonomy. Former employees of the federal MofH became part of state health units. Although the reform of the 1990s was deeper than the one implemented in the 1980s, Merino (2003) argues that the implementation of health decentralization was uniform across states without taking into account differences in administrative capacity, willingness to take the transfer of responsibilities or characteristics of population, services and geography, among others.

In order to meet their new responsibilities, states were endowed with FASSA, a fund that was created along with others in the context of a federalist reform in 1997. FASSA is a fund that transfers federal resources to states for health provision; it must be spent exclusively on health services for the non-insured population. FASSA represents the main source of financing for states as 77 and 64 per cent of the states’ health expenditures came from this federal fund in 1998 and 2009, respectively.[20] Although FASSA is distributed among states according to criteria such as health infrastructure, health service workers, the budget assigned the previous year and a component that is aimed to equalize health accessibility,[21] the law does not set the weight of each component or the total amount allocated to the fund. Hence, the law does not establish a clear criterion for its distribution, allowing discretionary decisions by legislators and the federal government. Further, the resources obtained by every state were based on the amount originally

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16 Tlaxcala, Nuevo León, Guerrero, Jalisco, Baja California Sur, Morelos, Tabasco, Querétaro, Sonora, Colima, Estado de México, Guanajuato, Aguascalientes and Quintana Roo. Note that, on average, these states are more industrialized, have less population dispersion, and have fewer nutrition, health and education problems.

17 Coplamar stands for “General Coordination of the National Plan for Depressed Zones and Marginalized Groups”, which was a social programs implemented in the seventies.

18 This is a poverty program implemented during the Presidency of Salinas (1988-94).

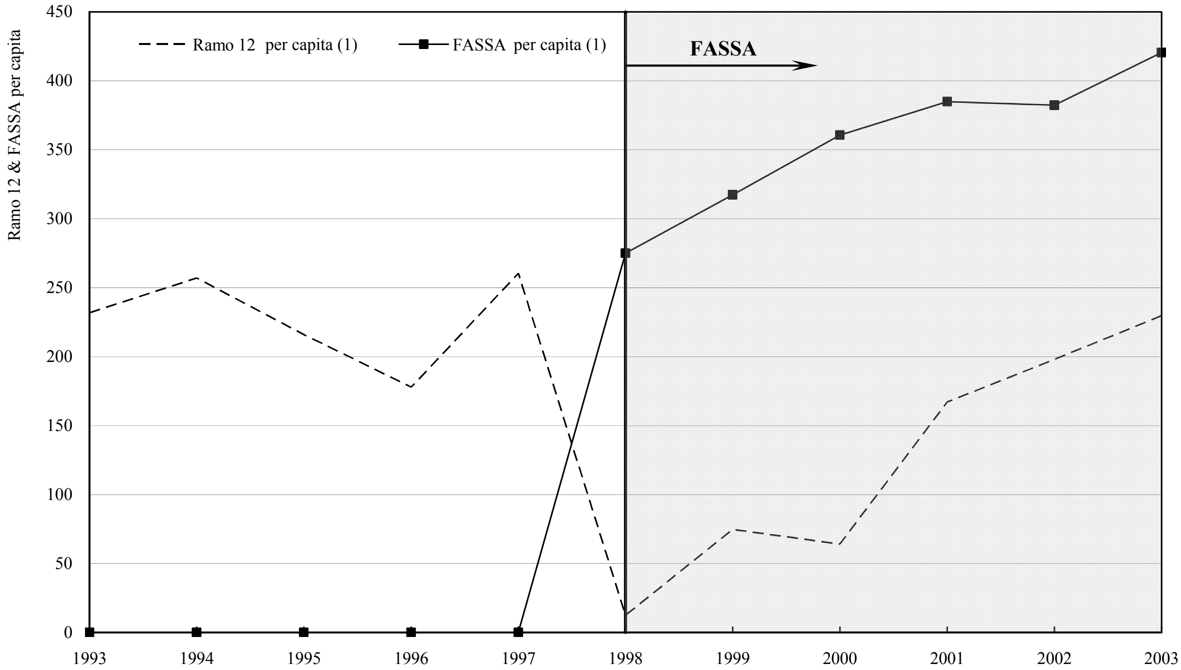
19 Articles 3rd, 13th and 18th of the Health Law establish the responsibilities of both levels of governments. In short, states are in charge of the organization and operation of health establishments and services, prevention of contagious diseases, maternity child care, nutrition, visual and auditive health, among others. The federation, in turn, operates most of the secondary and tertiary hospitals; designs health regulation and policies; watches the use of economic resources, deals with labor relations of the non-insured system, and takes mayor investment decisions.

20 Merino (2003) considers that the high dependence of states on transfers is not optimal for health provision as they have little flexibility to make adjustments to respond to their needs. Moreover, states may limit their health expenditures if they believe that a higher effort would be seen as a lower need for resources and thus less transfers from the federal government.

21 This component receives the remaining of the total budget of FASSA, which represents a low share. For instance, in 2001 its allocation was of only 100 million pesos when the overall FASSA budget was around 25,000 million pesos. The distribution of this component among states has a formula established in the Law and depends on the non-insured population, mortality, marginalization and federal budget (article 31 of the Fiscal Coordination Law). This is the only formula for FASSA in the Law.

Figure 2

Ramo12 and FASSA Per Capita
(national level)



(1) Units expressed in 2010 pesos.
Source: Own elaboration with data from SINAIS and the Ministry of Health.

agreed between the federal government and states in 1997 (Sour *et al.*, 2004), which depended on the expenditure made by the Ministry of Health before decentralization (Merino, 2003).

In fact, FASSA allocation between states in its first year of operation (1998) was very similar to the allocation of the MofH budget in 1997. Later, during the first years of the reform, federal expenditure to states was reduced considerably (see Figure 2). In 1997 MofH distributed resources to states equivalent to 0.34 per cent of GDP while in 1998 the number dropped to 0.02 per cent with 14 states not receiving any resources. In contrast, FASSA budget in 1998 was equal to 0.39 per cent of GDP. We next show the MofH budget for each state in 1997 is a good predictor of FASSA in any given year, suggesting that the fund has a strong inertial component.[22]

4.2 *What explains FASSA allocation among states?*

In this section we provide some empirical evidence on the determinants of expenditure allocation among states for the non-insured population (Ramo12 before 1998 and FASSA after 1997). First, we present the descriptive statistics of this exercise. After which we proceed to describe the empirical strategy and its results.

[22] After 2004, the nature of FASSA changed because it was used by the federal government to finance the operation of a program called Popular Insurance (Seguro Popular) under different expenditure rules. For this reason the analysis of this paper stops in that year.

Table 1

Summary Statistics

Variables	Panel A – Ramo12 (1993-97)				Panel B – FASSA (1998-2003)			
	Mean	Std. Dev.	Min.	Max	Mean	Std. Dev.	Min.	Max
Ramo12	278.77	116.93	100.82	724.83	-	-	-	-
Ramo12 from 1992	253.94	100.6	108.34	583.68	-	-	-	-
FASSA	-	-	-	-	438.36	176.95	178.79	1034.61
Ramo12 from 1997	-	-	-	-	310.96	119.53	173.37	724.83
Infant Mortality Rate	27.51	4.89	16.59	40.87	19.56	3.97	12.44	32.86
DIP	0.25	0.09	0.12	0.73	0.2	0.06	0.09	0.42
DNIP	1.36	1.05	0.51	10.18	1.41	0.61	0.64	3.83
PUP	0.47	0.15	0.15	0.78	0.5	0.14	0.22	0.8
Pop	2.86	2.44	0.35	12.11	3.09	2.63	0.41	13.59
GSP	66.12	31.61	26.76	185.65	76.36	36.35	28.46	213.92
Number of observations	160				192			

Note: The definition and units of the variables are in Table 2.

4.2.1 Descriptive statistics

Table 1 shows the descriptive statistics for the two set of regressions: Ramo12 (1993-97) and FASSA (1998-2003) in per capita terms. The definition, corresponding acronym, units of measure and source for each of these variables is included in Table 2. We use one-year lagged covariates because health budget is allocated at the end of the previous year, when legislators approve the federal budget.

The dependent variables, Ramo12 and FASSA, are on average 279 and 438 pesos per person, respectively (see Table 1). The potential explanatory variables for the non-insured population are some proxies for health needs, resources, and socioeconomic variables. First, we include the infant mortality rate (the sample average is of 27.6 and 19.6 deaths of children younger than 1 year per 1000 live births in the pre and post reform years) and the infectious and parasitic mortality rate which is denoted as DIP_{it} (0.25 and 0.2 deaths per 1000 inhabitants, respectively).[23]

Second, according the Law of Fiscal Coordination, FASSA allocation should be partly determined by the physical and medical infrastructure available in each state. In order to control for these elements, we include total number of doctors assigned for the non-insured population in each state per 1000 non-insured individuals which is represented as $DNIP_{it}$ (1.36 and 1.41 doctors

[23] We also collected other variables like deaths by maternal causes, fetal deaths, deaths by conditions originated in the perinatal period, deaths by diabetes, and deaths by nutritional deficiencies, among others. We do not include these variables as regressors because many of them are highly correlated. However, the results are robust to the use of one specific variable instead of another.

Table 2

Definition of Variables

Variable	Definition	Units	Source
DIP_{it}	Deaths by infectious and parasitic diseases for state *i* and year *t*	Per 1000 inhabitants by state	Ministry of Health
$DNIP_{it}$	Doctors for non-insured population for state *i* and year *t*	Per 1000 inhabitants non-insured	SINAIS
DP_{it}	Population Density for state *i* and year *t*	Inhabitants per Km^2	INEGI
$FASSA_{it}$	Health services fund for state *i* and year *t*	Thousand pesos per capita	Ministry of Health
GSP_{it}	Gross state product for state *i* and year *t*	Thousand pesos per capita (2nd half dec 2010=100)	INEGI
$HBPS_{it}$	Hospital beds in the private health sector for state *i* and year *t*	Per 1000 inhabitants by state	SINAIS
$HEEP_{it}$	Health services expenditure from public institutions (IMSS, ISSSTE,PEMEX) for state *i* and year *t*	Thousand pesos per capita (2nd half dec 2010=100)	Ministry of Health
$I(t>1997)$	Is an indicator function that takes the value of zero before the reform was implemented and one after the reform	N.A.	N.A.
IMR_{it}	Natural logarithm of the infant mortality rate for state *i* and year *t*	Number of deaths of children less than one year old per 1000 live births by state	UN Millennium Development Goals
$IMR_{Biased,\ it}$	Natural logarithm of the infant mortality rate for state *i* and year *t*	Per 1000 live births by state	SINAIS
$IMR_{Ratio,\ it}$	$\log(IMR_{it}) - \log(IMR_{Biased,\ it})$	N.A.	N.A.
FDR_{ijt}	Natural logarithm of fetal deaths for state *i*, year *t*, and group *j* divided by population in state *i*, year *t*, and group *j*[(1)]	Per 100 insured or non-insured population	INEGI
$Ramo12_{it}$	Federal government directly spend on health services for state *i* and year *t*	Thousand pesos per capita	SINAIS
Pop_{it}	Total population for state *i* and year *t*	Total number of inhabitants per state	CONAPO
$PSCR_{it}$	Percentage of students who completed primary school in 6 years for state *i* and year *t*	Percentage	UN Millennium Development Goals
PUP_{it}	Proportion of non-insured population for state *i* and *t*	Between zero and one	Ministry of Health
THE_{ijt}	Total health expenditure for state *i*, year *t* and group *j* divided by population for state *i*, year *t* and group *j*[(1)]	Thousand pesos per insured or non-insured population	Ministry of Health

[(1)] *j* is insured or non-insured group.

Sources: National Population Council (CONAPO), Bureau of Health Information in Mexico (SINAIS), National Institute of Statistics, Geography and Informatics of Mexico (INEGI) and United Nations (UN) Millennium Development Goals Statistics.

before and after 1998).[24] Third, we also include socioeconomic variables such as the annual gross state product per capita (GSP_{it}); the ratio of the non-insured population over the total population, denoted as PUP (47 and 50 per cent), and total population, represented as Pop_{it} (2.9 and 3.1 millions).[25]

Finally, according to the Law of Fiscal Coordination, the allocation of FASSA also depends on the resources received in the previous year. In fact, when the FASSA started to operate, the allocation of such resources among states crucially depended on what the federal government directly spent on each state in 1997 through centralized resources, *i.e.*, Ramo12. This means that as of today, the allocation of FASSA between states still depends on what each state received in 1997 from Ramo12. For this reason, we add the amount of resources that each state received in 1997 through Ramo12 as a regressor. On average, this variable is 311 pesos per capita. Following the same logic in Ramo12 per capita regressions, we include Ramo12 per capita in 1992 (the state average of this variable was of 254 pesos per capita).

4.2.2 Health expenditure 1993-2003

Our empirical strategy aims to unveil the key determinants of the state allocation of non-insured health expenditure: Ramo12 for the previous years of the reform of 1997 and FASSA for the 1998-2003 period in order to check if there was a change in the criteria of assignation once decentralization took place.

For each period (before and after 1997), we run two sets of regressions on state level data. The first one is a pooled data approach, in which we regress per capita FASSA (and Ramo12) flows received by state i in year t in constant pesos, on a set of covariates that presumably determines the amount of resources that each state receives in a specific year. We include year dummies to the specification to control for aggregate time effects. In this estimation, we add a time-invariant regressor: the federal budget on health in 1997 (in 1992 for Ramo12 specifications) because we want to see how important this inertial component is for FASSA allocation, as some authors have suggested. We also include a state fixed effects estimations (removing the Ramo12 per capita component) in order to check whether our results hold under this alternative specification. The second set of estimations are cross section regressions for 1998 and 2003 (results are consistent for 1999, 2000, 2001 and 2002) as we are interested to analyze the criteria of individual years of the Federal Congress in the assignment of FASSA for all the period. We also run a similar set of regressions for the Ramo12 per capita before the reform (between 1993 and 1997) as we want to analyze whether its allocation is correlated to variables that indirectly could be affecting FASSA.

4.2.3 Results

The results for the determinants of FASSA and Ramo12 per capita are shown in Table 3. The results show a strong inertial component for health expenditure, as the coefficient of Ramo12 of 1992 and 1997 is significant at 1 per cent level (specifications 1, 3, 5, 7, 9 and 11). For instance, specification 7 shows that for every peso per capita that every state received from FASSA in 1997,

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[24] We also try other variables including the number of non-insured medical offices and appointments; number of dentists, number of nurses, and number of hospital beds of the Ministry of Health. As before, we do not include these variables as regressors because many of them are highly correlated. However, the results are robust to the inclusion of one of these variables instead of the one included in the specification.

[25] Education was also included in some specifications and the results remain unchanged.

Table 3

Ramo12 and FASSA Determinants

Independent Variables	Panel A – (1993-97)						Panel B – (1998-2003)					
	Dependent Variable is Ramo12 Per Capita						Dependent Variable is FASSA Per Capita					
	Panel Data		Cross Section				Panel Data		Cross Section			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	1993 to 1997	1993 to 1997	1993	1993	1997	1997	1998 to 2003	1998 to 2003	1998	1998	2003	2003
$Ramo12_{i\ 1992}$	0.963***	-	1.083***	-	0.909***	-	-	-	-	-	-	-
	(0.0461)	-	*(0.0582)*	-	*(0.122)*	-	-	-	-	-	-	-
$Ramo12_{i\ 1997}$	-	-	-	-	-	-	1.329***	-	1.401***	-	1.279***	-
	-	-	-	-	-	-	*(0.111)*	-	*(0.0891)*	-	*(0.191)*	-
IMR_{it-1}	0.354	–19.88	–0.571	17.87*	–2.163	11.77	–1.837	–18.11***	–3.637	8.341	7.228	13.52
	(2.638)	*(12.84)*	*(1.81)*	*(8.862)*	*(9.687)*	*(7.554)*	*(2.585)*	*(5.353*	*(2.185)*	*(11.3)*	*(5.234)*	*(15.47)*
DIP_{it-1}	78.12	134.7	56.57	–62.07	–170.6	–419.6	–172.7*	252.6	73.6	–351.5	–319.6**	–639.5
	(51)	*(136.1)*	*(47.42)*	*(158.2)*	*(163.2)*	*(258)*	*(92.49)*	*(211.4)*	*(59.97)*	*(314.7)*	*(146.1)*	*(413.5)*
$DNIP_{it-1}$	6.022	20.72	6.939	64.36	37.94**	89.14*	–7.265	9.011**	–13.19***	22.78	–4.81	145.8**
	(6.964)	*(25.97)*	*(6.42)*	*(43.65)*	*(14.15)*	*(45.2)*	*(4.723)*	*(3.655)*	*(4.709)*	*(23.18)*	*(27.9)*	*(64.1)*
PUP_{it-1}	–4.082	2.082**	–37.91	–126	207	120.9	–89.59	241.2	–208.7*	–310.8	–152.1	80.43
	(61.76)	*(880.3)*	*(64.34)*	*(240.1)*	*(197.7)*	*(288.9)*	*(92.46)*	*(326.7)*	*(105.2)*	*(479.3)*	*(135.8)*	*(389.8)*
Pop_{it-1}	–5.171***	77.86	–3.230*	–24.71**	–5.894*	–21.49**	–4.383*	–45.06	2.182	–34.39**	–7.270*	–30.19*
	(1.874)	*(46.21)*	*(1.731)*	*(11.63)*	*(3.274)*	*(10.04)*	*(2.541)*	*(35.56)*	*(2.172)*	*(16.13)*	*(3.923)*	*(15.43)*
GSP_{it}	–0.0607	0.378	–0.540**	0.201	0.643	0.956	–1.046**	0.986	–1.179**	–0.361	–0.889	–0.329
	(0.2)	*(0.763)*	*(0.224)*	*(0.875)*	*(0.437)*	*(0.926)*	*(0.432)*	*(0.63)*	*(0.45)*	*(1.684)*	*(0.734)*	*(1.752)*
Constant	17.36	–293.3	63.33	–235.6	1.177	–71.49	274.0***	715.1***	184.2***	467.3	218.4*	251.2
	(66.89)	*(401.1)*	*(52.5)*	*(232.8)*	*(158.2)*	*(144.4)*	*(61.69)*	*(202.3)*	*(49.51)*	*(309.4)*	*(117.2)*	*(330.9)*
Year Indicators	Yes	Yes	-	-	-	-	Yes	Yes	-	-	-	-
Fixed Effects	No	Yes	-	-	-	-	No	Yes	-	-	-	-
R^2	0.878	0.565	0.958	0.5	0.847	0.502	0.934	0.805	0.978	0.351	0.923	0.528
Observations	160	160	32	32	32	32	192	192	32	32	32	32

Panel data estimations show state cluster robust standard errors in parentheses & cross section estimations show robust standard errors in parentheses.
Note: The definition and units of the variables are in Table 2. Significance interpretation is as follows: *** p<0.01, ** p<0.05, * p<0.10.

it will get from FASSA 1.33 pesos on average in the 1998-2003 period. The effect is statistically significant at 1 per cent level.

This result remains unchanged in the cross section specifications (3, 5, 9 and 11): the inertial component is crucial for the allocation of health public expenditure for the non-insured population. Probably this result should not be a surprise because there is persistence on health outcomes and resources over time and the initial allocation of expenditure might be capturing the effect of initial outcomes. However, we believe that health outcomes (such as infant mortality rate) should matter independently in how health expenditure was allocated in past years, even if that allocation depended on past health indicators. In this sense, we do not find consistency in the signs and significance of the different potential explanatory variables (even though they are explicitly contained in FASSA's formula) across the different regressions. This result suggests that legislators assign health budget exclusively taking into account the previous year's allocation but no other health fundamentals. The only variable that seems to be consistent in the significance and magnitude is Pop_{it-1}. The sign is negative, implying that more populous states obtained lower health transfers. It could be thought that this sign is due to its correlation with other variables. For instance, it is plausible that a state with high mortality has restricted access to health facilities that are negatively correlated to DP_{it-1}. However, discarding Pop_{it-1} as an explanatory variable does not change our results.

In particular, IMR_{t-1} and DIP_{t-1} yield no significant estimates in most of the cases. In some specifications they even have an opposite expected sign. The result would indicate that states with high health needs would receive fewer resources from FASSA, suggesting a regressive distribution allocation of the health budget.

With respect to the variable related to medical infrastructure ($DNIP_{it-1}$), the coefficient is positive for Ramo12 per capita but only the regressions for 1997 (columns 5 and 6) are significant. Interestingly, for FASSA per capita regressions without Ramo12 per capita for 1997 included, the results for medical infrastructure are positive and significant for the fixed effects and 2003 regressions (columns 8 and 12), which could be related to the FASSA allocation formula stated in the Law of Fiscal Coordination.

Finally, in few specifications, state GDP shows a negative and significant coefficient, indicating that there is some redistributive element in FASSA. However, this result is not consistent across the different specifications. It is surprising that the proportion of non-insured population is not significant because it is precisely the population that should be targeted by non-insured expenditure (either Ramo12 or FASSA).

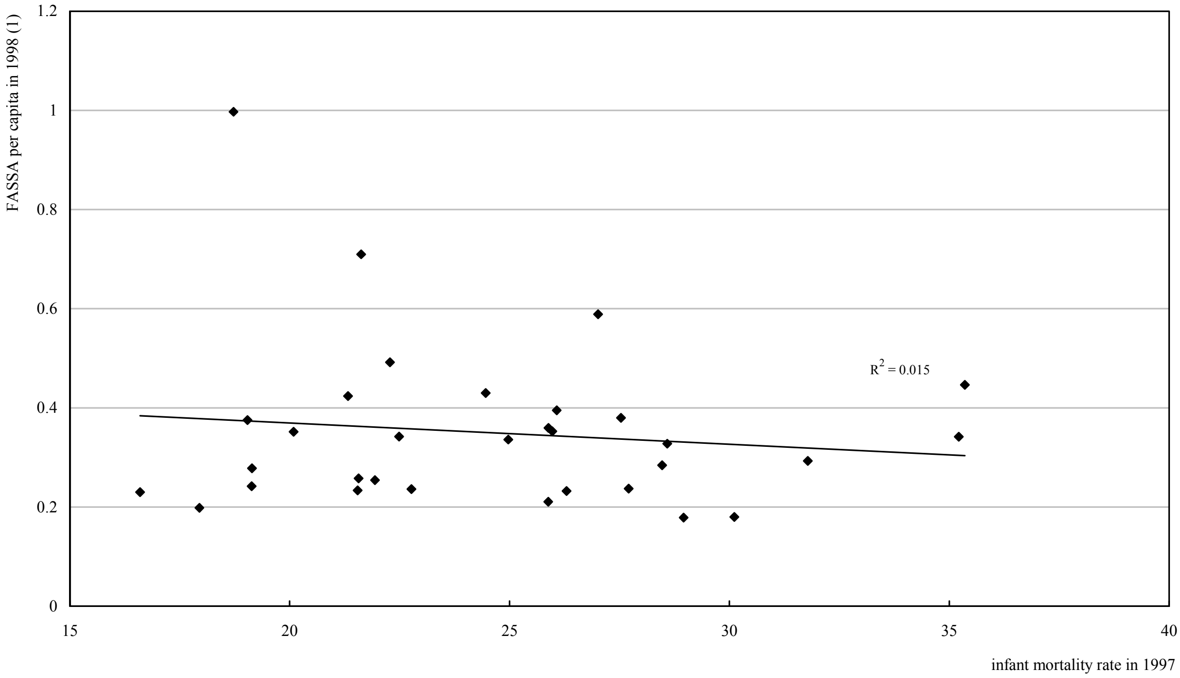
In sum, the results indicate that health outcomes (and other variables) do not determine how the resources are allocated. Our regressions suggest that the most important determinant of state non-insured expenditure is the past allocation. This finding is critical for our empirical strategy for the consequences of decentralization, as we do not have any evidence that FASSA is endogenously allocated as a result of health outcomes. So we are confident that, in particular, infant mortality rate is exogenous to how FASSA is determined (see Figure 3).

5 Does decentralization of resources for health services improve state-level health outcomes?

In this section we test, through different estimation procedures and specifications, whether the decentralization of resources for health services improve state-level health outcomes. First, we test whether state health outcomes improved in the years after the implementation of FASSA relative to how Ramo12 did in the years previous the reform. We find no significant difference

Figure 3

Infant Mortality Rate in 1997 vs. FASSA Per Capita in 1998



$$\textit{FASSA Per Capita}_{1998} = \underset{(0.158)}{0.455} - \underset{(0.006)}{0.004}\ \textit{IMR}_{1997}$$

(1) Units expressed in 2010 pesos.
Note: Standard errors are shown in parenthesis.
Source: Own elaboration with data from the Ministry of Health and UN Millennium Development Goals.

between the effectiveness of Ramo12 and FASSA. Second, we test whether states that received more FASSA resources observed better health outcomes than low FASSA states after the reform. Again, we find no significant difference. Third, we test whether there is a difference between state health outcomes of the uninsured relative to the insured population after the implementation of the reform. Since Ramo12 and FASSA focus on the non-insured population, we took the insured population as a control group. We find, as before, no significant difference between health improvements observed after the implementation of the reform among the treatment and control groups. Finally, focusing on expenditure amounts, we test whether FASSA and Ramo12, which focus on the non-insured population, between the years before the reform (1993-97) and the years after the reform was implemented (1998-2003) is more efficient than the health expenditure for the insured population.

Contrary to all previous results, we find that in fact FASSA and Ramo12 together are more effective than the IMSS, ISSSTE or PEMEX in reducing fetal deaths.

5.1 Summary statistics

Before presenting the final results, we briefly summarize the main variables used in this section. In Table 4 we show the summary statistics of these variables used by pooling the data from

Table 4

Summary Statistics 1993-2003

Variables	Mean	Std. Dev.	Min	Max
DP	266.3	1003	4.78	5920
Fetal death rate	0.262	0.121	0.026	0.783
Log(Fetal deaths)	–1.47	0.566	–3.666	–0.244
Fetal death rate for the non-insured population	0.304	0.130	0.035	0.783
Log(Fetal deaths) for the non-insured population	–1.307	0.538	–3.352	–0.244
Fetal death rate for the insured population	0.220	0.094	0.026	0.522
Log(Fetal deaths) for the insured population	–1.634	0.547	–3.666	–0.65
GSP	71.7	34.61	26.75	213.9
HBPS	0.297	0.132	0.082	0.832
HEEP	2.663	1.03	1.173	9.384
Log(infant mortality rate)	3.11	0.255	2.521	3.71
PSCR	85.52	9.185	43.42	99.16
PUP	0.49	0.148	0.148	0.798
Ramo12	0.19	0.144	0	0.725
THE	1.805	1.196	0.167	9.384
Log(*THE*)	0.355	0.736	–1.792	2.239
THE for the non-insured population	0.946	0.567	0.167	3.356
Log(*THE*) for the non-insured population	–0.218	0.577	–1.792	1.211
THE for the insured population	2.664	1.031	1.173	9.384
Log(*THE*) for the insured population	0.928	0.305	0.16	2.239

Total number of observations is 352 for all variables with exception of total health expenditure, fetal deaths and its logarithmic function which have 704 observations due the distinction between non-insured and insured population.
Note: The definition and units of the variables are in Table 2.

1993 through 2003. We follow the literature using as our preferred health status variable, infant mortality rate (deaths of babies younger than 1 year old divided by life births). According to summary statistics, the natural log of the infant mortality rate is on average 3.11, that is, approximately 22 infant deaths per thousand births among all states and years. There are various reasons we focus on IMR_{it} as our main dependent variable. Infant mortality rate is a good health outcome measure as it reflects health attention to sensitive care groups of population (children and pregnant women); it is also known that it responds rapidly to changes in the health systems (Jiménez Rubio, 2011); it is better measured than other indicators such as life expectancy; and is correlated with many other health indicators (Joumard *et al.*, 2008; and Jiménez Rubio, 2011). The other variable we use as measure of state health status is total fetal death rate. As shown in Table 4, the natural log of total fetal deaths (FDR_{it}) averages –1.470, that is, about 0.26 fetal deaths per thousand individuals. The main advantage of this variable relative to IMR_{it} is that we can obtain the fetal death rate for non-insured and insured population, respectively. According to summary statistics, for the non-insured population fetal death rate averages around 0.30 fetal deaths per thousand non-insured individuals. For insured population, there are on average 0.22 fetal deaths per thousand insured persons.

Continuing with the variables summarized in Table 4, $Ramo12_{it}$ is on average 190 pesos per capita between 1993 and 2003. The variable $FASSA_{it}$ averages 438 pesos per capita for the years after its implementation (see Table 1). Gross state product per capita (GSP_{it}) in constant pesos is on average 71,707 pesos. Population density (PD_{it}) is around 266 persons per squared kilometer on average.

The average expenditure by IMSS, ISSSTE and PEMEX is 2663 pesos per eligible person ($HEEP_{it}$). The proportion of uninsured population (PUP_{it}) over the total population per state is on average 0.49. The primary school completion rate ($PSCR_{it}$), a measure of schooling, is on average 85 per cent. We do not observe out-of-pocket expenditure on health services by the population for years before 1998. However, on average, there are 0.29 hospital beds in the private sector per 1000 inhabitants ($HBPS_{it}$).

5.2 What was the impact on state health outcomes of FASSA relative to Ramo12?

In this section we test whether state health outcomes improved in the years after the implementation of FASSA relative to how Ramo12 did in the years previous the reform. This is a way to test whether decentralizing resources from the federal to the state government improved the health of the population. Recall that before 1998 the resources for health services were channeled through Ramo12 and the federal government was responsible of their use in each state. After 1997, FASSA was created to channel those same health resources to states and now state governments are responsible of the administration of such budget. The empirical specification is the following:

$$IMR_{it} = \alpha + \beta_1 I\ (t > 1997) + \beta_2\ (Ramo12_{it}) + \beta_2\ [I(t > 1997) * (Ramo12_{it})] + \\ + \beta_4[I(t > 1997) * (FASSA_{it})] + X_{it}B_5 + c_i + u_{it} \quad (1)$$

$$I = 1, \dots 32 \qquad t = 1, \dots 11$$

In equation (1), IMR_{it} is the natural logarithm of the infant mortality rate in state i and year t; $I(t>1997)$ is an indicator function that takes value zero for the years before the reform was implemented and one after the reform; $Ramo12_{it}$ is the amount of resources per capita directly spent by the federal government for health services in state i and year t; $FASSA_{it}$ is the amount of decentralized resources per capita for health services provision in state i and year t after 1997; X_{it} refers to a vector of control variables which are described below; c_i denotes the state fixed effect which is assumed to be arbitrarily correlated with the regressors; and u_{it} denotes the idiosyncratic error for state i in year t. There are 32 states in Mexico and the analysis covers eleven years, from 1993 through 2003.

Notice that $FASSA_{it}$ enters only as an interaction with the reform-years indicator, *i.e.*, $I(t>1997)$. This is because FASSA was implemented in 1998 and thus it takes value zero for years before 1998. In contrast, $Ramo12_{it}$ operates both before and after the decentralization reform. $Ramo12_{it}$ appears by itself and as interaction with the reform-years indicator. Also, notice that β_2 is the effect of $Ramo12_{it}$ over the IMR_{it} in the years before the reform and β_4 is the effect of $FASSA_{it}$ on the IMR_{it} in the years after the reform. Thus, our interest is in β_4–β_2. We expect this difference to be negative. However, we also need this difference to be significant to be able to conclude that the decentralization improved health outcome of the population. If β_4–β_2 turns out to be not significant, even if it has the correct sign, it implies that there is no significant difference between what central government was doing with the money and what state governments do with the same resources.

Equation (1) also permits us to test whether the money spent on health services by state governments improves the IMR relative to the money spent by the federal government for the same purpose but considering both effects in the years after 1997, that is, after the decentralization reform took place. In this case our interest is in $\beta_4-(\beta_2+\beta_3)$. If this difference is negative it implies that FASSA is more efficient than Ramo12. However, regardless of the sign, if $\beta_4-(\beta_2+\beta_3)$ is not significant, we can only say that there is no difference between the two funds after the reform.

There are other variables besides $FASSA_{it}$ and $Ramo12_{it}$ that could explain the IMR_{it}. For this reason, we include different control variables in the specification equation (X_{it}). We include gross state product per capita (GSP_{it}) to control for level of income. We also try to control for the average distance between health facilities and the inhabitants by including population density (PD_{it}) as control variable. As mentioned above, there are three main public institutions in charge of providing health services to eligible population: IMSS, ISSSTE and PEMEX. The expenditures made by these institutions could also be contributing to the decrease of the IMR_{it}. We added the per insured person expenditure made by these institutions in health services provision and name the variable $HEEP_{it}$. Another control variable we include is percentage of uninsured population (PUP_{it}) in each state and in each year. This variable is a proxy of the necessities of health services for non-insured population in each state. We control for the primary school completion rate per state, $PSCR_{it}$, as a measure of schooling. Finally, we do not observe the out-of-pocket expenditure on health services by the population for years before 1998. Of course, these expenses could also be improving the health outcomes of the population. Therefore, we proxy this variable with the number of hospital beds per 1000 inhabitants in the private health sector, *i.e.*, $HBPS_{it}$.

We estimated equation (1) by fixed-effects panel estimation method, correcting standard errors for cluster effects of states.

Results from estimating equation (1) are in Table 5. The second column contains the estimates of the coefficients of specification (1) with fixed effects but without control variables.[26] Results indicate that an increase by one thousand pesos per capita in $FASSA_{it}$ decreases IMR_{it} in 39.4 per cent whereas an increase by the same amount in $Ramo12_{it}$ before 1997 decreases IMR_{it} in 33.7 per cent (and both effects are statistically significant at the 1 per cent level). Recall that average $FASSA_{it}$ is 438 pesos, thus if it increases to 1438, an increase of 228 per cent, the infant mortality decreases 39.4 per cent. For the case of $Ramo12_{it}$ an increase from its average of 278 pesos per capita between 1993 and 1998 to 1278 pesos, a 1000 pesos increase or a 359 per cent increase, the infant mortality decreases by 33.7 per cent. The difference between the two semi-elasticities is $\beta_4-\beta_2 = -0.394 - (0.337) = -0.057$, but not statistically significant. This implies that $FASSA_{it}$ and $Ramo12_{it}$ are indistinguishable.

In column (3) we estimate the same specification as before but we added control variables. Results are similar as those in column (2), that is, there is no significant difference between how $Ramo12_{it}$ did before the decentralization reform and how $FASSA_{it}$ did after its implementation. However, the difference is positive and equal to 0.0129, which implies that the semi-elasticity related to $FASSA_{it}$ is 1 percentage points higher than the corresponding for $Ramo12_{it}$. In column (4) and (5) we show the results from estimating equation (1) when we include a time trend and year indicators, respectively. In both cases, $\beta_4-\beta_2$ is negative, as expected, though not statistically different from zero. Notice that increasing $Ramo12_{it}$ and $FASSA_{it}$ by 1000 pesos decreases the IMR_{it} by 1.8 and 6.8 per cent, respectively, but neither coefficient is statistically significant (column 5).

Using the results in Table 5, we also compare $Ramo12_{it}$ and $FASSA_{it}$ with each other but in the years after the reform. In other words, we test whether $\beta_4-(\beta_2+\beta_3)$ is different from zero. In all

26 Results in column (1) were included to compare the R^2 from equation (1) without including fixed effects and when including such effects. In such case the R^2 is 0.474. We also regress *IMR* on time dummies only and on fixed effects only. The corresponding R^2's are 0.539 and 0.452, respectively.

Table 5

Fixed Effects Panel Estimated Coefficients

	Independent Variables	Log Infant Mortality Rate (1)	(2)	(3)	(4)	(5)	Log Fetal Death Rate (6)
b_1	*I(t>1997)*	–0.239***	–0.228***	–0.189***	–0.0807***	–0.074***	0.0864*
		(0.047)	*(0.025)*	*(0.022)*	*(0.013)*	*(0.012)*	*(0.0427)*
b_2	$Ramo12_{it}$	0.201	–0.337***	–0.353***	–0.061	–0.018	0.123
		(0.252)	*(0.096)*	*(0.078)*	*(0.052)*	*(0.06)*	*(0.304)*
b_3	$Ramo12_{it}$ * *I(t>1997)*	0.0387	0.006	0.088	0.093	0.014	–0.549
		(0.324)	*(0.131)*	*(0.126)*	*(0.059)*	*(0.065)*	*(0.499)*
b_4	$FASSA_{it}$ * *I(t>1997)*	–0.177	–0.394***	–0.340***	–0.097*	–0.068	–0.129
		(0.152)	*(0.055)*	*(0.08)*	*(0.05)*	*(0.056)*	*(0.203)*
	Time Trend	-	-	-	–0.047***	-	-
		-	-	-	*(0.002)*	-	-
	GSP_{it}	-	-	–0.003***	–0.0005	–0.0006	0.00119
		-	-	*(0.0007)*	*(0.0003)*	*(0.0004)*	*(0.0015)*
	DP_{it}	-	-	0.0002	0.0001	0.0003***	0.00346***
		-	-	*(0.0004)*	*(0.0001)*	*(0.0001)*	*(0.00124)*
	$HEEP_{it}$	-	-	0.073***	0.036**	0.027*	0.0802*
		-	-	*(0.01)*	*(0.013)*	*(0.013)*	*(0.0412)*
	PUP_{it}	-	-	–1.712***	–0.159	–0.318*	–0.894
		-	-	*(0.209)*	*(0.147)*	*(0.182)*	*(0.71)*
	$PSCR_{it}$	-	-	–0.005***	0.001**	0.002**	0.00515
		-	-	*(0.001)*	*(0.0009)*	*(0.0008)*	*(0.00498)*
	$HBPS_{it}$	-	-	0.061	0.069	0.055	0.0156
		-	-	*(0.075)*	*(0.042)*	*(0.04)*	*(0.116)*
	Constant	3.243***	3.393***	4.596***	3.402***	3.012***	1.021
		(0.072)	*(0.028)*	*(0.142)*	*(0.124)*	*(0.133)*	*(0.637)*
	Year Indicators	No	No	No	No	Yes	Yes
	Fixed effects	No	Yes	Yes	Yes	Yes	Yes
	$b_4 - b_2$	–0.378	–0.056	0.012	–0.036	–0.05	–0.252
	$Prob > F_1$	0.061	0.494	0.825	0.298	0.181	0.0671
	$b_4 - (b_2 + b_3)$	–0.417	–0.063	–0.076	–0.13	–0.064	0.298
	$Prob > F_2$	0.201	0.535	0.544	0.034	0.276	0.487
	Number of Groups	-	32	32	32	32	32
	Number of Observations	352	352	352	352	352	352
	R^2	0.474	0.872	0.936	0.973	0.983	0.316
	R^2 Overall	-	0.401	0.003	0.103	0.005	0.0869
	R^2 Between	-	0.0292	0.458	0.187	0.154	0.0923

Panel data estimations show state cluster robust standard errors in parentheses.
Note: The definition and units of the variables are in Table 2. Significance interpretation is as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

five columns, except for column (4), it is the case that $FASSA_{it}$ is not significantly different from $Ramo12_{it}$ after the reform was implemented. However, notice that such difference is negative in all five cases. According to results in column (5), when we added year indicators and control variables, the difference is 0.064 which implies that $FASSA_{it}$ decreases IMR_{it} relative to $Ramo12_{it}$ when comparing them after 1998.

From Table 5 it is also possible to compare $Ramo12_{it}$ performance in the years after the reform with the years before the reform, coefficient β_2 captures this difference. This coefficient is positive in all four columns, but fails to be statistically significant. This implies that there is no difference between $Ramo12_{it}$ nowadays compared to before the reform. In accordance to column (5), the coefficient is 0.014. This means that one thousand pesos increase in $Ramo12_{it}$ after the reform took place decreases in 1.42 per cent the IMR_{it} compared to the effect of $Ramo12_{it}$ in the years before the reform took place.

Finally, another coefficient of interest from Table 5, is the one associated to the decentralization reform, $I(t>1997)$. Notice that in all five columns this coefficient is negative and statistically significant at 1 per cent level. This coefficient is capturing the fact that over time the IMR_{it} is decreasing between 1993-97 and 1998-2003. The magnitude of the coefficient decreases when we include either a time trend or year fixed effects.

Results presented in Table 5 are robust to different measures of health well-being, specifically, infant mortality rate for children less than 5 years old, child deaths by respiratory diseases per 1000 births, child deaths by intestinal diseases per 1000 inhabitants, and fetal death rate per 1000 inhabitants. Results from estimating equation (1) using as the dependent variable the fetal death rate are shown in column 6 of Table 5. Notice results are the same as before, $\beta_4 – \beta_2$ is negative, although significant at 10 per cent level.

5.3 What was the impact of decentralization on health outcomes in states that received more resources from FASSA?

The lack of significance of the previous results is evidence that, in general, decentralization of responsibilities and funds from federal to state authorities regarding state health services provision did not significantly improve the well-being of the population. Although the sign of the coefficients of interest are negative, their magnitudes are rather small. However, perhaps states that received more resources from FASSA did a better job than states that received fewer resources.

In this section we follow a difference in difference approach which will enable us to address the following question: Did states that receive more FASSA get better health outcomes than states that received less FASSA after the reform? Ideally, we would like to have an experiment with one group of states that were treated with health decentralization and other set of control states that were not submitted to the institutional change, and compare the performance of both groups after the reform was implemented. However, as previously discussed, all states received FASSA funds. Thus, we perform a pseudo experiment. We divide the states into two groups according to FASSA transfers per capita received in the first year of the reform (1998).[27] We called the first group high FASSA states[28] (or treated group) and are those that are above the median of the 32 states. The low

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27 The range of the distribution of FASSA per capita is large as the descriptive statistics point out. The median of FASSA per capita in 1998 was 332 pesos of 2010 and the mean was 350 pesos, with the maximum value being 997 pesos and the minimum 179 pesos. The coefficient of variation (standard deviation/mean) is 0.48. The average FASSA per capita for the high group is 458 pesos and for the low group is 242 pesos.

28 Baja California Sur, Colima, Campeche, Quintana Roo, Guerrero, Nayarit, Aguascalientes, Durango, Tabasco, Sonora, Tlaxcala, Tamaulipas, Yucatán, Morelos, Chiapas, and Querétaro.

FASSA states group (or control group) are the remaining states. We estimate a set of difference in difference regressions with the following simple framework:

$$IMR_{it} = \alpha + \beta_1(H_i) + \beta_2 I\,(t > 1997) + \beta_3\,[I(t > 1997) * (H_i)] + X_{it}B_4 + c_i + u_{it} \qquad (2)$$

$$i = 1, \dots 32 \qquad\qquad t = 1, \dots 11$$

In this specification the dependent variable refers to the natural log of the infant mortality rate; H_{it} is an indicator function that takes the value of one if the state i belongs to the high FASSA group and zero if it belongs to the low FASSA group; $I(t>1997)$ is also an indicator function defined as before; and the variable multiplied by β_3 is an interaction term between the previous variables. This is the coefficient of interest because it is the difference in difference effect on health of the reform on the treated states (high FASSA) relative to the control group (low FASSA). X_{it} refers to the same vector of control variables as before; c_i denotes the state fixed effect which is assumed to be arbitrarily correlated with the regressors; and u_{it} denotes the idiosyncratic error for state i in year t. Also, in some specifications we also include state fixed effects, a time trend common to all states, and year fixed effects, just as before.

The interpretation of the coefficients of interest is as follows: α refers to the health indicator average of low FASSA group before the intervention; β_1 is the difference in the average of the dependent variable of the high and low FASSA groups before 1998; and β_2 is the change in the average for the control group (low FASSA) after the reform relative to the pre reform period. Finally, β_3 captures the difference of health indicator average between high and low FASSA states after the decentralization relative to the difference between high and low FASSA states in the years prior to decentralization. We expect this last coefficient to be negative, but also significant. If it turns out to be not significant, then we cannot conclude that there is a difference between the control and treatment group due to the decentralization.

Before presenting our results, it is worth pointing out that our identification strategy requires that per capita FASSA assignment in 1998, and thus our classification of states according to FASSA, to be exogenous and not correlated to the error term conditioned on the variables included in the right hand side of equation (2). For instance, if FASSA is assigned to states according to their health indicators, that is, states with worse health indicators receive more FASSA, our classification of states according to FASSA would not be exogenous. Table 6 shows the average of both groups for a variety of health indicators and other controls in 1997, the previous year to the reform. Last column indicates the *p*-value for the *t*-test of differences in means between both groups. With the exception of two of our shown variables, it is not possible to reject the hypothesis that the difference in means is statistically different from zero. Given the classification of the groups and the persistency of FASSA per capita as a function of the allocation of Ramo12 per capita in 1997, it is not a surprise that such variables are the only ones that are significantly different from zero at 1 per cent level. This result suggests that the initial allocation of FASSA and its classification were not determined by health indicators, as one would expect.

Table 7 shows the results of the estimating equation (2) between 1993 and 2003. The difference-in-difference coefficient (β_3) is negative but not significant in any of the regressions. Although the direction of the coefficient indicates that states receiving more FASSA had lower infant mortality rate after the reform than low FASSA states, this coefficient is statistically not different from zero. Thus, the results suggest that there is no significant difference in health indicators between the treated and control states after the reform relative to the years previous to the introduction of FASSA. The very small magnitude of the coefficient provides further assurance that decentralizing resources did not have an impact on health indicators for states which received more resources relative to those states who received fewer resources from FASSA. According to the results in column (4), which include control variables and a time trend, the coefficient associated to the high FASSA (β_1) states is negative and statistically significant. This implies that

Table 6

Mean Comparison Between Low and High FASSA States
(null hypothesis: high FASSA mean – low FASSA mean = 0)

	Year	High FASSA per capita mean	Low FASSA per capita mean	p-value
FASSA	1998	457.66	242.18	0
*Ramo*12	1997	392.51	229.4	0
HBPS	1998	0.21	0.29	0.04
DP(1)	1997	77.46	451.1	0.3
Log (infant mortality rate)	1997	3.2	3.17	0.71
Infant mortality rate	1997	24.88	24.28	0.73
GSP	1997	65993	68259	0.85
PSCR	1997	86.96	87.4	0.89
PUP	1997	0.49	0.49	0.9
HEEP	1997	2343	2330	0.97
Number of observations		16	16	

(1) Population density of the Low FASSA group in 1997 (451.10) seems to be quite bigger than the High FASSA counterpart; this difference is mainly explained because Distrito Federal belongs to the Low FASSA group. Alone in 1997 Distrito Federal had a population density of 5786.15 habitants per square kilometer. By excluding Distrito Federal from the Low FASSA group the new population density mean would be 95.43 and the new p-value would be 0.6531.

previous to the reform, high FASSA states had a mortality rate 34 per cent lower than low FASSA states. This suggests that FASSA was not assigned accordingly to health necessities by states. Finally, β_2 is significantly negative (–0.080) reflecting the downward trend of infant mortality in control states.

Results presented in Table 7 are robust to different measures of health well-being, as the ones used for robustness in Table 5; results are also robust to excluding states around the median. For example, we pick only the 10 states with the highest and the 10 with the lowest FASSA and the results do not change (column 6). We also run the same specification with the top and bottom six FASSA states and results remain.

5.4 *What was the impact of decentralization on the health outcomes of the non-insured population relative to the insured population?*

So far we have not found evidence that health decentralization significantly improved the infant mortality rate, used as a proxy of the health conditions of the population. In this section we present two more empirical exercises. As mentioned before, all the states received FASSA funds, so in that sense, all states were treated, that is, all states were affected by the reform. However, recall that FASSA and Ramo12 have a target population: those who have no insurance. Thus there

Table 7

Difference in Difference Estimated Coefficients (Pseudo Experiment)

Independent Variables	Log Infant Mortality Rate						Log Fetal Death Rate
	(1)	(2)	(3)	(4)	(5)	(6) [1]	(7)
I(High FASSA group)	0.021	–0.264***	–0.573***	–0.348***	–0.407***	–0.393***	–0.275
	(0.057)	*(0.007)*	*(0.106)*	*(0.047)*	*(0.054)*	*(0.065)*	*(0.274)*
*I(t>*1997*)*	–0.341***	–0.341***	–0.255***	–0.080***	-	–0.066***	-
	(0.007)	*(0.008)*	*(0.024)*	*(0.012)*	-	*(0.017)*	-
*I(High FASSA group) * I(t>*1997*)*	–0.007	–0.007	–0.022	–0.003	–0.002	0.007	–0.147
	(0.013)	*(0.013)*	*(0.018)*	*(0.012)*	*(0.011)*	*(0.016)*	*(0.097)*
GSP_{it}	-	-	–3.875***	–0.548	–0.587	–0.864*	0.213
	-	-	*(0.765)*	*(0.396)*	*(0.431)*	*(0.446)*	*(1.474)*
$HEEP_{it}$	-	-	0.036**	0.028**	0.023*	0.026*	0.038
	-	-	*(0.018)*	*(0.011)*	*(0.012)*	*(0.013)*	*(0.044)*
$Ramo12_{it}$	-	-	–0.152**	0.045	0.036	0.101**	–0.332
	-	-	*(0.069)*	*(0.039)*	*(0.033)*	*(0.04)*	*(0.34)*
$PSCR_{it}$	-	-	–0.005***	0.002***	0.002***	0.003**	0.007
	-	-	*(0.001)*	*(0.001)*	*(0.001)*	*(0.001)*	*(0.006)*
DP_{it}	-	-	0.001	0.000**	0.000***	0	0.003***
	-	-	*(0.001)*	*(0)*	*(0)*	*(0)*	*(0.001)*
PUP_{it}	-	-	–2.107***	–0.166	–0.367*	–0.316	–0.894
	-	-	*(0.241)*	*(0.162)*	*(0.205)*	*(0.205)*	*(0.663)*
$HBPS_{it}$	-	-	0.019	0.076	0.048	0.153**	–0.016
	-	-	*(0.088)*	*(0.046)*	*(0.046)*	*(0.059)*	*(0.121)*
Time Trend	-	-	-	–0.049***	-	–0.049***	-
	-	-	-	*(0.002)*	-	*(0.003)*	-
Constant	3.288***	3.448***	5.114***	3.585***	2.962***	3.621***	–4.986***
	(0.044)	*(0.004)*	*(0.123)*	*(0.12)*	*(0.155)*	*(0.136)*	*(0.52)*
Year Indicators	No	No	No	No	Yes	No	Yes
Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	352	352	352	352	352	220	352
Number of Groups	32	32	32	32	32	20	32
R^2	0.457	0.904	0.958	0.985	0.991	0.983	0.948

[1] Only for Top 10 and Bottom 10 FASSA states.
Note: The definition and units of the variables are in Table 2. Significance interpretation is as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.10$.
Panel data estimations show state cluster robust standard errors in parentheses.

is a fraction of the population in each state that was not affected by the reform, namely, those who had already health coverage. Taking advantage of this fact, we perform two exercises in which we consider the non-insured population as the treatment group and the insured population as the control group. Under this assumption, we are able to compare the performance of both groups for the years before (1993-97) and after (1998-2003) the reform was implemented.

To compare these groups we need to observe the infant mortality rate for each group. However, official statistics do not include IMR by insurance status, nor is there available data that permit us to construct the IMR for the insured and the uninsured population, respectively. Therefore, we rely on another health outcome: fetal deaths. This variable is part of *Estadísticas Vitales* published by INEGI. It is based on the information contained in Fetal Death Certificates. The main advantage of this variable is that it permits us to classify fetal deaths into our two groups of interest, according to whether the mother has insurance or not.

On the one hand, women who reported being beneficiary of either IMSS, ISSSTE, PEMEX, SEDENA,[29] SEMAR[30] or other institution are considered as insured. On the other hand, women who reported not having insurance are considered as non-insured.[31]

Using this data we construct the fetal deaths rate (FDR_{ijt}) defined as the number of fetal deaths occurred in state i, for group j, in year t as a fraction of the total population in state i which belongs to group j, in year t. In this case, j is equal to 1 for the non-insured population and equal to 2 for the insured population. Another advantage of this health outcome is that, similar to IMR, it responds relatively quickly to improvements in health provision. Moreover, this measure continues to be closely related to maternal health, one of the responsibilities transferred to states in the reform.

Nonetheless, FDR_{ijt} has one important problem. It tends to be biased because not all fetal deaths are reported to the corresponding authorities. Therefore not all fetal deaths have their corresponding certificate. This problem is more evident in poor, less educated and more disperse states, as well as states with a high proportion of uninsured population and less administrative capacity to register deaths. By controlling for some of these variables we take care for part of this bias. However, we do not observe other drivers of the bias. We have available two different series for the IMR, one that is biased (IMR_{Biased}) and one not (which corresponds to our IMR measure used along this study). We use the difference between these two series to approximate the bias in our FDR measure. By including this difference as a regressor, we try to control for the FDR bias we observe.

In a first exercise, we analyze whether the non-insured population had greater improvements in health outcomes after decentralization relative to the insured population. The identification strategy behind this specification is that the health provision decentralization was implemented for the benefit of non-insured people, leaving insured people unaffected. We expect that non-insured population observed improvements in fetal death rate relative to the insured population after the reform.

Our identification strategy requires that the distribution of people between the uninsured and insured cohorts is exogenous, *i.e.*, that insured population is almost the same as non-insured population but the treatment itself. There are many reasons we can think of that these two groups are not similar. However, Figure 4 graphs the national version of FDR_{ijt} per insurance eligibility group. As we would expect, insured population has a lower FDR than the one for non-insured

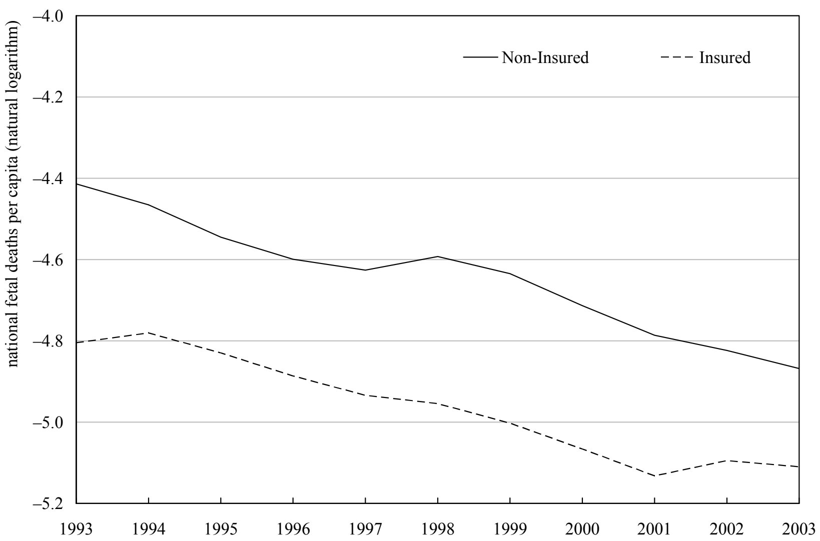
29 SEDENA stands for Secretaría de la Defensa Nacional, that is, Ministry of National Defense.

30 SEMAR stands for Secretaría de Marina, that is, Mexican Navy.

31 Those who reported insurance institution as unknown or not specified were excluded from the estimation. Nevertheless, as we will see in the results, classifying this group as insured or non-insured makes no significant difference in the results.

Figure 4

National Fetal Deaths Per Capita (Natural Logarithm) By Insurance Elegibility Group



Note: The insured fetal deaths per capita accounts for the fetal deaths of mothers who reported having some kind of medical insurance (*i.e.*, IMSS, ISSSTE, PEMEX, SEDENA, SEMAR or other institutions). Whereas the non-insured fetal deaths per capita accounts for the Fetal Deaths of mothers who reported not having any kind of medical insurance.
Source: Own elaboration with data from INEGI.

population. Second, from the graph it is also clear that both groups had very similar trends, particularly in the years before the reform took place. This is perhaps enough for our difference in difference approach to be credible. After 1997, the insured population continued with no particular changes whereas the non-insured population observed a small increase in 1998 to later show a steady decrease along the following years.

Another important assumption behind our identification strategy is that the composition of groups does not change over time, particularly as the result of decentralization. However, the insurance status depends on whether the person works in the formal or informal sector. Therefore, most people do not choose whether to have insurance or not, but in which sector of the labor market to work. Moreover, health services for non-insured people tend to be worse than health services for insured people.

We perform a difference in difference approach with fixed effects. The equation to regress is as follows:

$$FDR_{ijt} = \alpha + \beta_1 T_{ij} + \beta_2 I(t>1997) + \beta_3[I(t>1997) * (T_j)] + X_{ijt}B_4 + c_i + u_{ijt} \quad (3)$$

$i = 1, \dots 32$ j = Non-insured population, Insured population $t = 1, \dots 11$

In this case, FDR_{ijt} is the natural log of the fetal death rate for state i, group j, in year t. T_{ij} is equal to one for the non-insured population in state i, and zero otherwise. Finally, $I(t>1997)$ is defined as before. Our interest focuses on the coefficient that accompanies the interaction the latter two variables: β_3. This coefficient is the difference in difference effect of the reform on FDR_{ijt} for the non-insured population relative to the control group, that is, the insured population. We expect this coefficient to be negative and significant. If it is only negative but not significant, we cannot conclude that the reform had an impact on the treatment group relative to the control group. As before, c_i denotes the state fixed effect which is assumed to be arbitrarily correlated with the regressors; and u_{it} denotes the idiosyncratic error for state i in year t.

The vector of control variables, X_{it}, is the same as in previous exercises, except for two differences. First, total health from public institutions per capita, THE_{ijt}, is equal to FASSA and Ramo12 expenditures for non-insured population, that is when j=1, and equal to the sum of the health expenses by IMSS, ISSSTE and PEMEX for insured population (j=2).[32] Second, since our dependent variable is most probably biased, we add $log(IMR)–log(IMR_{Biased})$ as an additional variable to control for the possible bias contained in the data.[33] As already mentioned, the assumption behind this inclusion is that the bias observed in *FDR* is the same as the bias observed in IMR. Our IMR measure does not have this problem because corresponding authorities already corrected the statistics from this bias. However, such bias can be observed at the national level, if we compare our measure of IMR, available at the Millennium Development Goals Statistics published by United Nations, and what we denote IMR_{Biased}, published by the Bureau of Health Statistics of Mexico, SINAIS.

Results of the difference in difference regressions are shown in Table 8. Columns from (1) to (4) were included to keep the table comparable with previous exercises. According to the results in column (5), which include year indicators and control variables, the coefficient β_3 is negative (–0.0269) but it is not significant. This result suggests that average FDR_{ijt} after the decentralization reform took place relative to previous years, is 0.026 lower for the treatment group relative to the control group, however, it is not statistically different from zero. According to the same set of results, β_1 suggests that fetal deaths rate for the non-insured is significantly higher (0.621) than the insured population in the years before the reform and the coefficient is statistically significant at 1 per cent level. Moreover, β_2 suggests that the fetal deaths rate for the insured population decreased (–0.162) after the reform relative to previous years, and the coefficient is statistically significant at 5 per cent level. In column (6) and (7) we run the same specification as in column (5); however, in column (6) we included those fetal deaths in which the insurance status was not specified as if they were part of the insured population group, and in column (7) those fetal deaths were instead included in the non-insured population group. In both cases, β_3 is negative and not significant. These columns are included to check whether omitting the unknown or unspecified insurance status fetal deaths makes a difference for our results. Concluding, we found no significant difference between the non-insured and the insured population when comparing the mean FDR_{ijt} after the reform relative to previous years.

In a second exercise we continue exploiting our identification strategy and study whether there are differences in expenditure efficiency for insured and non-insured population, respectively, after the reform was implemented relative to previous years.

Fortunately, we are able to measure the efficiency of the expenditure for each of the two groups, because we also have detailed data on health expenditures made by various public health institutions. This information is summarized in the variable THE_{ijt} explained above. In equation notation this variable is:

$$THEijt = \begin{cases} Ramo\ 12 + FASSA_{it} & if\ \ j = Non-insured\ \ population \\ IMSS + ISSSTE + PEMEX_{it} & if\ \ j = Insured\ \ population \end{cases}$$

Therefore, we study whether the change in the elasticity of FDR_{ijt} with respect to total health expenditure for the non-insured population between 1998-2003 and 1993-97 is different from the change in the same elasticity for the insured population. The equation to estimate is the following:

[32] We do not have data about health expenditure realized by other health institutions, for example, private institutions. Nevertheless, IMSS, ISSSTE and PEMEX provide health coverage to more than 95 per cent of the insured population.

[33] Results are not significantly different if we do not include this difference as control variable. Results are available upon request.

Table 8

Difference in Difference Estimated Coefficients

Independent Variables	Log Fetal Death Rate						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I(Non-insured)	0.478***	0.478***	0.534***	0.587***	0.621***	0.512***	0.743***
	(0.0423)	*(0.0433)*	*(0.0952)*	*(0.0907)*	*(0.1)*	*(0.125)*	*(0.0902)*
I(t>1997)	–0.340***	–0.227***	–0.150**	–0.0196	–0.162**	–0.213***	–0.174**
	(0.045)	*(0.0492)*	*(0.0602)*	*(0.0517)*	*(0.0709)*	*(0.0632)*	*(0.0647)*
*I(Non-insured)*I(t>1997)*	0.0175	0.0175	0.000165	–0.0169	–0.0269	–0.0294	–0.0581
	(0.0311)	*(0.0318)*	*(0.0452)*	*(0.0454)*	*(0.0469)*	*(0.0499)*	*(0.0439)*
$HEEP_{it}$	-	-	0.0405	0.0795	0.104	0.148	0.104
	-	-	*(0.0692)*	*(0.0684)*	*(0.0798)*	*(0.0971)*	*(0.0725)*
$PSCR_{it}$	-	-	–0.00494*	0.0039	0.00305	0.00331	0.00285
	-	-	*(0.00269)*	*(0.00337)*	*(0.00361)*	*(0.00331)*	*(0.00332)*
DP_{it}	-	-	0.00250***	0.00251***	0.00258**	0.00253**	0.00280***
	-	-	*(0.00072)*	*(0.000896)*	*(0.000976)*	*(0.000927)*	*(0.000948)*
$HBPS_{it}$	-	-	–0.0606	0.00357	–0.0354	–0.0805	–0.0847
	-	-	*(0.0841)*	*(0.102)*	*(0.13)*	*(0.116)*	*(0.123)*
GSP_{it}	-	-	–3.72e–05**	–1.77E–06	1.59E–05	1.09E–05	1.20E–05
	-	-	*(1.62E–05)*	*(1.43E–05)*	*(1.60E–05)*	*(1.66E–05)*	*(1.54E–05)*
PUP_{it}	-	-	–2.471***	–0.637	–1.281*	–1.103	–1.498**
	-	-	*(0.577)*	*(0.652)*	*(0.751)*	*(0.716)*	*(0.691)*
$IMR_{Ratio,\ it}$	–0.823***	0.0189	–0.115	–0.157	–0.155	–0.187*	–0.157
	(0.141)	*(0.105)*	*(0.111)*	*(0.107)*	*(0.115)*	*(0.101)*	*(0.111)*
Trend	-	-	-	–0.0252***	-	-	-
	-	-	-	*(0.00437)*	-	-	-
Constant	–1.172***	–1.225***	–0.00731	–1.611***	–1.588***	–1.493***	–1.491***
	(0.0811)	*(0.0565)*	*(0.23)*	*(0.397)*	*(0.389)*	*(0.351)*	*(0.356)*
Year Indicators	No	No	No	No	Yes	Yes	Yes
Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	704	704	704	704	704	704	704
R^2	0.638	0.886	0.896	0.901	0.904	0.894	0.916

Panel data estimations show state cluster robust standard errors in parentheses.
Note: The definition and units of the variables are in Table 2. Significance interpretation is as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

$$FDR_{ijt} = \alpha + \beta_1 T_{ij} + \beta_2 I\,(t > 1997) + \beta_3\,[I(t > 1997) * T_{ij}] + \beta_4 \log(THE_{ijt}) + \beta_5[\log(THE_{ijt}) * \\ * I(t > 1997)] + \beta_6[\log(THE_{ijt}) * T_{ij}] + \beta_7[\log(THE_{ijt}) * I(t > 1997) * T_{ij}] + X_{it}B_8 + c_i + u_{ijt} \quad (4)$$

$i = 1, \ldots 32$ j = Non-insured population, Insured population $t = 1, \ldots 11$

Equation (4) is just an extension of equation (3) where we interact $log(THE_{ijt})$ with the decentralization reform indicator, the treatment indicator and with both indicators together. As in previous exercise, FDR_{ijt} is the natural log of the fetal death rate for state i, group j, in year t; T_{ij} is equal to one for the non-insured population in state i, and zero otherwise; $I(t>1997)$ is decentralization reform indicator; c_i denotes the state fixed effect which is assumed to be arbitrarily correlated with the regressors; and u_{it} denotes the idiosyncratic error for state i in year t. The vector of control variables, X_{it}, is the same as in the previous exercise, that is, includes all controls discussed before plus THE_{ijt} and $log(IMR)–log(IMR_{Biased})$.

In this case, the coefficient of interest is β_7. This coefficient compares the elasticity of the fetal death rate with respect to total health expenditure after the reform relative to years previous the reform for the non-insured population relative to the insured population. We expect this coefficient to be negative and significant. In other words, we expect health expenditure for non-insured population to have a greater impact in reducing fetal death rate after the reform relative to the control group.

Results for the difference in difference regressions are shown in Table 9. We again include columns (1) through (4) just to keep all tables comparable. Results in column (5) are the more general since they include control variables and year indicators. According to such results, which include control variables and year indicators, the coefficient β_7 is negative (–0.192) and significant at the 10 per cent level. It implies that the difference in elasticities from 1998-2003 and 1993-97 is 0.192 lower for the non-insured population relative to insured population. In other words, if health expenditure increases 1 per cent for both groups and both periods, the FDR exhibits a larger fall by 0.19 per cent for the non-insured population relative to the insured population. Contrary to our previous results, the health expenditure for the non-insured population, through Ramo12 and FASSA, is significantly more effective after the reform took place than the health expenditure for the insured population. This is perhaps an indication that the health production function in general is convex. Thus, further reductions of the FDR are more costly in the insured sector, for which the FDR is already low, compared to the non-insured sector. Another possible explanation is that when analyzing the performance of Ramo12 and FASSA expenditure together, they do much better than each by their own. Understanding what is explaining the obtained result certainly is an interesting line of future research.

This result can be explained by the fact that the elasticity of FDR with respect to THE did not improve for the insured group from 1993-97 to 1998-2003, that is, coefficient β_5 is 0.0322 and it is not statistically significant. This is in accordance with the implicit assumption that the insured population group was not affected by the decentralization reform. Moreover, for the non-insured group that same elasticity improved after the reform, *i.e.*, $\beta_5+\beta_7$, is –0.16 and it is statistically significant at 5 per cent level. This is because the elasticity of FDR with respect to THE for the period 1998-2003 is 0.02 and not significant, whereas the same elasticity for the period 1998-2003 is 0.184 and statistically significant at 1 per cent level (therefore, 0.18–0.02=–0.16). Although this implies that the reform did improve the health well-being of the population, notice that these elasticities are positive. In other words, increasing Ramo12 before the reform by 1 per cent increased the FDR by 0.18 per cent and increasing Ramo12+FASSA by 1 per cent for the years after the reform increased the FDR by 0.02 per cent although we cannot distinguish this effect from zero. This is thus in accordance to our results from previous sections.

Table 9

Health Expenditure Efficiency Comparison: Estimated Coefficients

Independent Variables		Log Fetal Deaths Rate						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
b_1	*I(Non-insured)*	0.510***	0.484***	0.452***	0.516***	0.538***	0.351**	0.642***
		(0.167)	*(0.133)*	*(0.125)*	*(0.125)*	*(0.144)*	*(0.163)*	*(0.118)*
b_2	*I(t>1997)*	–0.215	–0.189	–0.195**	–0.0414	–0.194*	–0.220**	–0.228**
		(0.177)	*(0.127)*	*(0.0926)*	*(0.0923)*	*(0.102)*	*(0.0924)*	*(0.0995)*
b_3	*I(J=Non-insured) * I(t>1997)*	–0.127	–0.114	–0.018	–0.0623	–0.063	–0.109	–0.0764
		(0.168)	*(0.128)*	*(0.0822)*	*(0.084)*	*(0.0885)*	*(0.0724)*	*(0.0877)*
b_4	THE_{ijt}	–0.0022	–0.104	–0.13	–0.0694	–0.0511	–0.105	–0.078
		(0.156)	*(0.137)*	*(0.122)*	*(0.125)*	*(0.147)*	*(0.169)*	*(0.115)*
b_5	THE_{ijt} * *I(t>1997)*	–0.123	–0.0254	0.0668	0.0287	0.0322	0.0126	0.0587
		(0.163)	*(0.132)*	*(0.0711)*	*(0.0737)*	*(0.0788)*	*(0.0685)*	*(0.0764)*
b_6	THE_{ijt} * *I(J=Non-insured)*	0.0637	0.269*	0.277**	0.241*	0.235*	0.339**	0.270**
		(0.155)	*(0.137)*	*(0.121)*	*(0.123)*	*(0.134)*	*(0.151)*	*(0.11)*
b_7	THE_{ijt} * *I(Non-insured) * I(t>1997)*	–0.187	–0.231	–0.260**	–0.199*	–0.192*	–0.161	–0.235**
		(0.177)	*(0.156)*	*(0.0987)*	*(0.102)*	*(0.102)*	*(0.1)*	*(0.098)*
	$PSCR_{it}$	-	-	–0.00615**	0.00214	0.00195	0.00237	0.0016
		-	-	*(0.00245)*	*(0.00299)*	*(0.00332)*	*(0.00295)*	*(0.00299)*
	DP_{it}	-	-	0.0019***	0.002**	0.00215**	0.0021**	0.00231**
		-	-	*(0.000584)*	*(0.000823)*	*(0.0009)*	*(0.000842)*	*(0.00088)*
	$HBPS_{it}$	-	-	0.00316	0.0562	–0.00393	–0.042	–0.0484
		-	-	*(0.0925)*	*(0.114)*	*(0.141)*	*(0.127)*	*(0.132)*
	GSP_{it}	-	-	–2.64e–05*	6.32E–06	1.82E–05	1.33E–05	1.36E–05
		-	-	*(1.51E–05)*	*(1.42E–05)*	*(1.54E–05)*	*(1.62E–05)*	*(1.47E–05)*
	PUP_{it}	-	-	–1.957***	–0.273	–0.83	–0.559	–1.039
		-	-	*(0.505)*	*(0.548)*	*(0.672)*	*(0.619)*	*(0.633)*
	$IMR_{Ratio,it}$	–0.826***	–0.0343	–0.127	–0.167	–0.17	–0.202*	–0.172
		(0.142)	*(0.108)*	*(0.113)*	*(0.109)*	*(0.114)*	*(0.0996)*	*(0.11)*
	Time Trend	-	-	-	–0.0234***	-	-	-
		-	-	-	*(0.00403)*	-	-	-
	Constant	–1.168***	–1.124***	0.056	–1.466***	–1.467***	–1.339***	–1.324***
		(0.169)	*(0.119)*	*(0.279)*	*(0.394)*	*(0.396)*	*(0.361)*	*(0.349)*
	Year Indicators	No	No	No	No	Yes	Yes	Yes
	Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
	$b_4 + b_5 + b_6 + b_7$	–0.248	–0.0906	–0.0462	0.00152	0.0242	0.0862	0.0156
	$Prob > F_1$	0.000732	0.199	0.554	0.984	0.766	0.282	0.837
	$b_4 + b_6$	0.0615	0.165	0.147	0.172	0.184	0.235	0.192
	$Prob > F_2$	0.373	0.00267	0.00761	1.83E–03	2.89E–03	0.0000985	0.000778
	$b_5 + b_7$	–0.31	–0.256	–0.193	–0.17	–0.16	–0.148	–0.176
	$Prob > F_3$	0.0000336	2.47E–03	8.70E–03	0.0165	0.0228	0.0348	0.00915
	$b_4 + b_5$	–0.126	–0.129	–0.0631	–0.0406	–0.0189	–0.0922	–0.0193
	$Prob > F_4$	0.605	0.0506	0.432	0.648	0.861	0.445	0.821
	Number of Observations	704	704	704	704	704	704	704
	R^2	0.649	0.893	0.9	0.905	0.907	0.9	0.92

Panel data estimations show state cluster robust standard errors in parentheses.

Note: The definition and units of the variables are in Table 2. Significance interpretation is as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

Just as in the previous exercise, column (6) and (7) are the same specification with the only difference being related to the dependent variable: in column (6) fetal death certificates with insurance status not specified were classified as in the insured population group; and in column (7) those same fetal deaths were classified in the non-insured population group. In both cases, β_7 is negative, however, it is not significantly different from zero in column (6). This is accordance to the hypothesis that those fetal deaths with unspecified insurance status are in fact non-insured because the magnitude of the coefficient β_7 in column (6) decreases sufficiently to become insignificant; and the magnitude of the same coefficient but in column (7) increases and becomes significant at 5 per cent level. As before, these columns are included to check that omitting the unknown or unspecified insurance status fetal deaths makes no significant difference for our results.

6 Conclusions

The results presented in this paper suggest that health decentralization in Mexico did not have the desired effects on state-level health outcomes. We did not find strong evidence that expenditure after the reform can explain improvements in health indicators, such as the child mortality or the fetal death rates. In particular, we did not find that the effectiveness of FASSA expenditure was higher than the impact of Ramo12 previous to the reform. Nevertheless, our exercises also suggest that the non-insured population had better outcomes derived from the reform than insured population. These results contrasts to what the policy makers that implemented the reform intended as well as what the classical theory of federalism would predict.

We believe that the results observed in Mexico may have obeyed to different factors that are worth exploring in future extensions of this paper. First, the reform was implemented from one year to the next and it is possible that states lacked the capacity to meet their new responsibilities immediately and neither were they able to administer the economic resources associated to health provision (Merino, 2003). The reforms may take some time in order to be effectively implemented as governments learn to operate and spend efficiently. A second hypothesis is that the institutional framework in which health was decentralized did not provide states with the incentives to provide better services to people. As we discussed in the text, the allocation of FASSA among states is rather unclear and it does not depend on the own state effort or health results. A merit-based system, in which future FASSA allocations depend on state's own contributions and the efficiency with which each state used its resources in previous years, could have helped to boost the impact of health expenditure. In this sense, a study of the effects of the Seguro Popular (which is partially financed by FASSA) would contribute to the discussion since the rules and uses of decentralized resources for that program are better defined. A third explanation is related to checks and balances that states have when spending public resources, the capacity of the taxpayers to know how efficiently their money is being spent and the availability of mechanisms for accountability. We think that these three potential explanations are not exclusive and certainly complement the results of the paper.

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COMMENTS ON SESSION 3
TAXATION, REGULATIONS AND PUBLIC SERVICES

*Stefan Bach**

Comments on "How Costly Are the Public Sector Inefficiencies? An Integrated Framework for Its Assessment" by Jorge Onrubia-Fernández and A. Jesús Sánchez-Fuentes

Summary

The paper provides a theoretical framework to analyse public sector performance. Two equivalent measures of social welfare changes are proposed, obtained from the cost function, and directly from the production function. Applications to empirical analysis are discussed.

Comments

The efficiency issues of public spending are increasingly on the political agenda against the outstanding budgetary imbalances in many countries. It is helpful to provide and enlarge theoretical models to assess public sector inefficiencies in terms of social welfare. The latter implies not only budgetary savings but also indirect monetary gains, e.g., from better education and health. The authors discuss goods and services that are *excludable*, unlike pure public goods. It would be helpful to extend the analysis on the character of pure public goods such as defense, social security, etc. Financing issues could also be discussed. Excludable goods and services would allow for user fees covering the "private" character, whereas distortionary taxes are required to finance the mere public good impact such as redistribution or positive externalities. A further critical topic is the assumption of the exogenous degree of efficiency. Actually, organizational issues or rent-seeking behavior of politicians and public administration play an important role in public sector reform.

Transaction costs of implementing public sector reforms could be substantial with respect to the devaluation of existing capital and protection of trust/grandfathering, which provokes compensation requirements to the losers and thus reduces the welfare benefits from the reform. In a more dynamic setting, collective decision-making as well as the lack of competition and "creative destruction" in public sector performance and reform might be considered. Thus, one could distinguish between technical efficiency and economic efficiency in a narrower sense, which is largely addressed in the study, and a wider scope of dynamic and political efficiency.

Measurement and application issues regard the availability of information on production and cost functions, including organizational slacks. This would require raising internal information from public authorities. An alternative would be benchmark comparisons between different jurisdictions or countries, which have their own shortcomings. Demand functions on public goods could be derived from specific surveys, or by estimates from existing surveys and from political decision making and voting. Social welfare functions could be used to operationalize political programs.

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Comments on "The Quality of Government and Living Standards" by Francesco Grigoli and Eduardo Ley

Summary

The study analyses the potential impact of public waste on national income and living standards in international comparison. Illustrative calculations based on scores from different studies are used to demonstrate the significant impact, which could imply a re-ordering of cross-country rankings on living standards.

Comments

The illustrative calculations reveal the economic importance of public waste in macroeconomic terms. However, the reliability of the efficiency scores is contentious. This would require scrutinizing public sector efficiency more detailed. Moreover, an implementation within national accounting is intricate. This would introduce a normative element of output valuation that goes beyond simple accounting. Similar corrections could also be applied to externalities of the private sector, such as environmental pollution, market failure, or inequality.

Anyway, it is meritorious to point out that public waste reduces real income and living standards. Larger disparities between countries or regions should be considered within the pertinent comparisons. Finally, this is another topic of criticism to GDP as an indicator of economic performance or even welfare, which should be part of the discussion following the Stiglitz-Sen-Fitoussi report. Therefore, items of public waste could be included into complementary satellite information attached to GDP compilations and rankings. This would, however, require measurable and reliable indicators of public waste in international comparison, and thus call for more detailed data from the public administration as well as output indicators on public goods such as health, education levels, etc.

Comments on "An Evaluation of the 1997 Fiscal Decentralization Reform in Mexico: The Case of the Health Sector" by André Martínez Fritscher and Carolina Rodríguez Zamora

Summary

The paper provides an ex-post evaluation of the decentralization reform of health funds and responsibilities in Mexico in 1997. It aims to identify the impact of decentralization on health indicators, as there were no changes in the regional distribution of funds after reform. The authors found no significant effects on infant mortality rate at the state level by a comparison of outcomes before and after reform, further differentiated by state groups with different endowments. Moreover, as a natural experiment, the insured population is used as a control group, which indicates some increased efficiency of the program. The authors discuss reasons of the reform's meager results. In particular, they argue that it took some time to become effectively, and that there were no incentives for state governments to provide better services.

Comments

This paper is a fine impact assessment study, which aims to identify the impact of decentralization on public sector outcome at the example of public health care in Mexico. With respect to the empirical specification one might question whether the outcome measures are too rough. Child mortality of fetal death rate seems to be a rather specific indicator, although important especially for low developed regions. Actually, the long-term impact, e.g. from medical prevention and rehabilitation would be interesting if measurable. Moreover it would be challenging to exploit the heterogeneity within the states, e.g., by measuring rural vs. urban areas, or the share of indigenous population. Finally, further reasons for ineffectiveness could be analyzed, such as organizational issues, or incentives for service provision before and after the reform. This would, however, require case studies or expert interviews on the implementation of the reform in single states.

COMMENTS ON SESSION 3
TAXATION, REGULATIONS AND PUBLIC SERVICES

Sergio Clavijo[*]

Comments on "Service Regulation and Growth: Evidence from OECD Countries" by Guglielmo Barone and Federico Cingano

Barone and Cingano argue that anti-competitive regulations go against growth in provision of services like energy, telecom and transportation in OECD countries. The authors also argue that such anti-competitive regulations impair price reductions in those services that would, otherwise, benefit consumers at large.

This lack of growth in service provision and the slow transmission of price reduction is due to three main factors, according to the authors. In the first place, setting regulation of prices and tariffs is a very complex issue, where even knowledgeable regulators tend to err. In the second place, by forcing "unbundling" of investments between generators and distributors, most economies loose opportunities to exploit economies of scale and scope in such services. Finally, the authors also argue that such excessive regulations hamper productivity gains at the inter-industry level, which is the main focus of their analysis.

This is very well crafted paper, where macro- and micro-analysis are carefully entangled and explained. In my opinion, the main conclusions against over-regulation in the service sectors could as well be extended to the health sector, where regulators have also requested "unbundling" of investments between the insurance component and the hospitals components, losing "economies of scale-scope", as explained before.

However, such conclusions seem to me a bit "counter-intuitive" when applied to the financial sector, where the recent financial global crises tells us that the lack of proper regulation prompted a severe and long-lasting mortgage and derivative crises. For instance, the Dodd-Frank Act in the United States and the Basle III regulations seem to be on the right track of strengthening regulations in order to avoid future "systemic risks".

Regarding their econometric work, their "working-horse" regressions focuses on the Real Value-Added Growth for the 1996-2002 period for OECD countries, as in equation (1):

$$VA_{j,c} = B_0 + B_1\ SERVREG + B_2\ SHARE + U_c + U_j + Error_{j,c} \quad (1)$$

where one of the main hypotheses has to do with finding $B_1<0$; in this case the argument is that higher regulation would imply lower growth in the provision of such services. Interestingly, the authors find statistical support, in a cross-country panel of a fixed-effect model, to argue that the rule of law (strong institutions) would permit that firms operate better in a deregulated framework, where markets conditions would benefit consumers.

Although the paper does not focus on emerging markets, let me suggest the authors to extend their analysis to those countries, since there seems to be a historical cycle regarding the regulation of services. In my experience as civil servant in Colombia, I have noticed that in many less developed economies the State moves late in regulating the provision of services. Hence, in order to catch up historically, then they move to the point of setting an over-regulatory framework which, indeed, might end up causing a lot of the problems stated here by Barone and Cingano.

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Comments on “Growth Implications of Structure and Size of Public Sectors” by Hans Pitlik and Margit Schratzenstaller

The main message of Pitlik and Schratzenstaller, in their interesting paper about structure of public sectors, is that there is not such a thing as “one-size-fits-all” both regarding public sector structure in promoting growth and concerning the topics of taxes and expenditure.

The authors analyze the “friendliness” indicators of growth for EU-12-15 and OECD countries and find, in the spirit of “endogenous growth models”, that tax/expenditure composition is much more important that the size of revenue collections of outlays.

The authors take dispersion in the growth “friendliness” index as evidence of lack of policy coherence. Consequently, Pitlik and Schratzenstaller call for pursuing complementary policies to gain coherence, finding that over-regulation seems to play a role in growth stagnation (as in the case of Greece), while deregulation apparently promotes growth (as in the case of New Zealand).

On the issue of productive vs. unproductive expenditure, the authors explain that this continues to be an open debate matter. On the operative side, you could always argue about increasing expenditures in the “meritory ones” (education and health), while in the case of the “golden fiscal rules” you could as well argue that fixed capital formation is good to propel sustainable growth in the near future.

Let me suggest to the authors the adoption of an explicit theoretical framework in order to better organize this kind of discussion. For instance, the adoption of a model would allow the authors to better cast their hypothesis about growth promotion/retardyness, especially since productive/unproductive definitions are rather arbitrary. The second suggestion I offer is to include in their analysis cases of *ex ante*/*ex post* responses to the current European crisis, which I reckon could easily be introduced, given the complete research they have already conducted regarding both tax and expenditure structures.

Finally, let me pose two questions. How is it that well positioned countries such as Spain and USA (“friendliness index”) have experienced so much macroeconomic pain recently (2010-12), lagging behind in the growth field and facing high fiscal tension? This is an example of how useful an analysis of *ex ante*/*ex post* experiences could be. My last query has to do with deepening their analysis with regard to the “effective tax burden”, because clearly nominal or marginal rates do not tell the whole story regarding tax collections. On the expenditure side, it would be vital to include the impact of the so-called “contingent liabilities”, which will significantly alter current expenditure structures, as discussed in previous fiscal workshops of the Banca d’Italia.

COMMENTS ON SESSION 3
TAXATION, REGULATIONS AND PUBLIC SERVICES

Yngve Lindh[*]

The papers presented in this session provide interesting insights in the current debate on taxation. The two papers I will comment on are related to each other as they both analyses aspects of how of tax systems affect employment and economic growth. While the paper by Peter Benczur, Gabor Katay, Aron Kiss and Oliver Racs concentrates on the tax system and its interaction with transfers in one country, in this case Hungary, the paper by Bert Saveyn, Jonathan Pycroft and Salvador Barrios highlights the importance to take into account cross-country spillovers when analysing effects of tax changes in single countries.

1 Income taxation, transfers and labour supply at the extensive margin

The paper by Benczur, Katay, Kiss and Racs delves into a very relevant issue: The effects of reforms in taxes and transfers on labour market participation. This issue is highly topical in many countries. Related to the economic and fiscal crises in the Euro Area, structural reforms that have significant positive impact on employment and growth are search for high and low. Reforms that improve labour supply are obvious examples of growth-friendly policies, at least in the longer term. And more generally, reshuffling tax systems to make them more economically efficient is a good example of reforms that could be used in the current situation to boost growth.[1]

This issue is not least relevant for Hungary, a country with one of the lowest labour market participation rates in the European Union. As the authors point out this has been an obstacle for convergence to higher income-levels after Hungary joined the EU in 2004. Some types of individuals have particularly low rates: women in child bearing ages, elderly and low skilled.

In my own country, Sweden, there has in recent years been a strong focus on the joint effects on participation in the labour market from a substantially increased Earned Income Tax Credit (EITC), together with reforms of the unemployment and sick leave insurances. An assessment is that these reforms will have a significant positive long-run effect on employment even if there are uncertainties around how large they will be in a longer perspective.[2]

In the Hungarian paper, effects on labour market participation of changes in taxes and transfers are estimated for different types of households and individuals. Related to this, it would be informative to get a bit more details about the Hungarian reforms in this area under the relevant time period and also how these reforms affect the calculated disposable income variable. The introduction of the flat tax in Hungary is mention, but not much more. For instance, reforms in unemployment benefit systems have been important in some countries. Is this also the case in Hungary? And, if this is the case, are these reforms included in the dataset?

Generally, the results in the paper for the different types and households and individuals seem reasonable. Weak groups in the labour market are more sensitive to changes in taxes and transfers for their decision to participate in the labour market. The only results that are a bit surprising are those related to the education level. Elementary, secondary and tertiary school backgrounds are related to weak effects of tax and transfer changes, while a vocational training background is related to stronger effects. Is there a rational for this difference?

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[1] See, for instance, Å. Johansson, C. Heady, J. Arnold, B. Brys and L. Varia (2009), *Taxation and Economic Growth*, OECD.

[2] Swedish Fiscal Policy Council (2011), *Swedish Fiscal Policy*, pp. 222-23, Stockholm.

The features of the disposable income variable I mentioned earlier have also implications for the estimation of elasticities. In a recent Swedish study[3] the authors look into the effects on labour supply of the recent Earned Income Tax Benefit (EITB) reform in Sweden. From this study it is concluded that the effects are significantly positive. However, the results are found uncertain because there is too little variation in treatment between different individuals and that there are underlying trends in participation/employment that co-varies with the tax credit in ways that are hard to control. A question is if such estimation problems also could be relevant in the Hungarian study?

A last issue is that reforms in tax, transfer and benefit systems could have effects on the equilibrium wage level and consequently on labour demand. It seems that the effects of these types of reforms on participation and employment could go through both supply and demand channels.

In the end of the paper the elasticities found at the micro level are used to calculate the aggregated effect of recent Hungarian reforms. The result is unfortunately not encouraging. In its latest Economic Survey of Hungary by the OECD,[4] the Organisation also warns that the recent reforms in Hungary potentially can have negative effects on the participation rate, especially for low-income earners. This really shows how highly policy-relevant the work by Benczur, Katay, Kiss and Razc is.

2 The cost of tax increases in the EU

Not least in the wake of the global economic and financial crises governments need to implement tax systems that are growth-friendly. This is a complex issue in the European Union where economies are deeply interdependent. Bert Saveyn, Jonathan Pycroft and Salvador Barrios have in their paper chosen to gauge the size of potential cross-country spillover effects from tax changes by calculating the marginal cost of increases in labour taxes and energy taxes. The authors also analyses the role of labour market rigidities for the sizes of tax distortions.

The first question put by the authors is which types of tax reforms will promote growth in European countries. A second question is which types of taxes should or should not be coordinated at the European level.

The authors main contribution is that they take into account "spillover" effects when analyzing tax distortions, which they also claim has been ignored in earlier literature. Labour and energy taxes are in the focus of the analyses and this choice is well motivated in the paper. However, in the tax literature property taxes and broad based taxes on consumption are often seen as taxes which are least distortive, *i.e.*, most growth-friendly.[5]

A few questions on the analytical framework:

- is there empirical evidence that R&D expenditure is a good proxy for technological progress? There has been some criticism that this "input measure" is a rather blunt approximation;
- cross-border shopping is not included in the analysis. Could that potentially be of importance? What do we know empirically?
- the possibility to vary labour market imperfections are built into the model used by the authors through a parameter, e.g., in equation 2.8 in Appendix 2. A question is if this parameter has an economic interpretation. Would it be possible to, as an alternative, use an index reflecting degrees of imperfections in the labour market in different countries?

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3 K. Edman, C.Y. Liang, E. Mörk and H. Selin (2012). "Evaluation of the Swedish Earned Income Tax Credit", IFAU, Uppsala.

4 OECD (2012), *Economic Survey – Hungary*, March.

5 See, for instance, Å. Johansson, C. Heady, J. Arnold, B. Brys and L. Varia (2009), *Taxation and Economic Growth*, OECD.

I also believe it would be fine, as a reader, to get more explicit descriptions about channels and mechanisms in the model leading to the spillover effects.

Most empirical results in the study seem plausible. First, distortions of income tax increases are higher in high tax countries compared in low tax countries. Second, "spillover" effects of income taxes are small, but larger in small open economies; third, it is really plausible that large countries have important roles in inducing "spillover" effects. Fourth, energy taxes has small direct effects, but relatively large "spillover" effects and last, distortions increases with labour market rigidities.

However, a less intuitive result is described by the statement: "A low degree of flexibility would result in lower welfare losses as wages adjust less to lower labour demand". This result is probably true in the short term, but in the longer run there would be negative effects on employment (hysteresis effects) and on production resulting over time in lower welfare. This puts a question mark on the time horizon of the used model.

My concluding remarks are, first, that analyses of effects of tax changes in a coordinated European perspective, taking into account spillover effects, really is interesting and a promising strand of research. Second, a more detailed description of spillover channels and mechanisms given by the used model would be welcomed. And last, it would be interesting to see analyses of a broader set of taxes and their effects by the use of the presented analytical framework.