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Structural Reform in Germany

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Abstract

This paper provides a quantitative evaluation of the macroeconomic, distributional, and fiscal effects of three reform proposals for Germany: i) a reduction in the social security tax in the low-wage sector, ii) a publicly financed expansion of full-day child care and full-day schooling, and iii) the further deregulation of the professional service sector. The analysis is based on a macroeconomic model with physical capital, human capital, job search, and household heterogeneity. All three reforms have positive short-run and long-run effects on employment, wages, and output. The quantitative effects of the deregulation reform are relatively small due to the small size of the professional services in Germany. Policy reforms i) and ii) have substantial macroeconomic effects and positive distributional consequences. Ten years after implementation, reforms i) and ii) taken together increase employment by 1.6 percent, potential output by 1.5 percent, real hourly pre-tax wages in the low-wage sector by 3 percent, and real hourly pre-tax wages of women with children by 2.7 percent. The two reforms create fiscal deficits in the short-run, but they also generate substantial fiscal surpluses in the long-run. They are fiscally efficient in the sense that the present value of short-term fiscal deficits and long-term fiscal surpluses is positive for any interest (discount) rate less than 9 percent.

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1. Introduction

At first sight, Germany looks like a model for economic prosperity: the unemployment rate has dropped to 4.6 percent, the government budget is in surplus, and annual per capita output growth has averaged 2.2 percent since the Great Recession.[1] However, a second look reveals two structural weaknesses. First, the dramatic ageing of the German population will act as a severe drag on future economic growth and is bound to put strain on future government finances. Second, a large number of jobs in Germany are marginal jobs (so-called mini-jobs) and part-time jobs that have low productivity and pay low hourly wages.[2] In this paper, we analyze reform proposals for Germany that can help overcome these two structural weaknesses. Specifically, we consider structural reforms that not only boost output, employment, and hourly wages, but also generate fiscal surpluses in the long-run (fiscal efficiency). In addition, we discuss the distributional consequences of the reform proposals.

We consider three reform proposals. First, we analyze a reform that reduces the social security tax in the low-wage sector. This reform increases the incentive for unemployed workers to engage in job search and it increases the incentive for marginally employed workers to search for part-time or full-time employment. Second, we consider a publicly financed expansion of full-day child care and full-day school programs. This reform helps women with children to balance work and family life, and it therefore increases their incentives to move from marginal employment to part-time or full-time employment. Third, we study the

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[1]The unemployment rate is the harmonized unemployment rate according to the OECD statistics in 2015. Note that in line with an exceptionally low unemployment rate, the employment rate in Germany is quite high (74 percent in 2014 and in Q3 2015 according to OECD statistics). The budget surplus of the German government amounted to 0.6 percent of GDP in 2015 according to the German Statistical Office (Statistisches Bundesamt). The average growth rate of per capital output is computed for the 6-year period 2010-2015 using data from the German Statistical Office.

[2]In 2014, 22 percent of employment in Germany was part-time employment and 12 percent was marginal employment (mini-jobs) according to the German Statistical Office. See Krebs and Scheffel (2015) for a detailed discussion of the data on marginal employment and part-time employment.

further deregulation of the professional services (lawyers, accountants, architects, engineers) in Germany. This reform enhances efficiency and improves productivity of firms using the professional services as an input factor. Clearly, the first two reforms increase the supply of labor, whereas the third reform increases the demand for labor.

Our analysis is based on simulations of a calibrated macroeconomic model with physical capital, human capital, and job search (frictional labor market). Households are ex-ante heterogenous differing with respect to their family type (single, couple, children) and the education level of their adult household members. Households are also ex-post heterogenous in the sense that unemployed workers engage in job search with uncertain outcome. Similarly, a fraction of the marginally employed and part-employed workers desire to extend their working hours and search for full-time work, but the success of their search effort is uncertain. Households make a consumption-saving decision and employed workers have the opportunity to invest in their human capital through on-the-job-training. In line with the empirical evidence, the model generates an endogenous wage penalty for marginal and part-time employment since full-time employed workers have the largest incentive to invest in on-the-job training. The final-goods sector is perfectly competitive and the intermediate-goods sector (professional services) is imperfectly competitive with a mark-up that depends on the level of regulation (entry barriers). The model economy is calibrated to match a number of micro-level and macro-level facts of the German economy.[3]

The first reform proposal consists of a reduction in the employee contribution to the social security tax for (most) workers with monthly earnings less than 2,000 Euro. Currently the employee contribution to the social security tax in Germany is 20 percent for monthly

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[3]The model neglects several channels that could further increase the economic benefits of the three reform proposals, and in this sense the results presented here provide a lower bound on the true benefits of reform. Specifically, the analysis neither takes into account the effect of schooling on the human capital of children nor does it allow for a labor-leisure choice along the intensive margin. Further, the macroeconomic model analyzed here does not have a Keynesian aggregate demand channel.

wages higher than 850 Euro, nothing (exemption) for monthly wages below 450 Euro (so-called mini-jobs), and linearly increasing in the range between 450 Euro and 850 Euro. We consider a reform that replaces the current social security tax system with a system in which the employee contribution increases linearly with earnings reaching its maximal value of 20 percent at monthly earnings of 2,000 Euro. The reform reduces the social security tax for full-time work in the low-wage sector and for the majority of part-time work, and it increases the tax on marginal employment since it removes the tax exception for mini-jobs. Thus, the reform gives marginally employed workers a stronger incentive to search for part-time employment and full-time employment, and induces unemployed workers to search harder for jobs since the average social security tax on employment is reduced.

The social security tax reform has positive macroeconomics effects that are quite substantial. Specifically, employment, wages, and output increase in the short-run and in the long-run. Ten years after reform implementation, employment has increased by 0.8 percent, average real hourly pre-tax wages have risen by 0.6 percent, and potential output has expanded by 0.8 percent. The reform has also positive distributional consequences since pay raises are concentrated in the low-wage sector. Ten years after the reform, real hourly pre-tax wages in the low-wage sector have gained 1.7 percent. Finally, the fiscal implications of the reform are positive. The reform generates a fiscal deficit of 0.4 percent of GDP in the first year, yields a balanced budget 9 years after implementation, and produces fiscal surpluses afterwards. For any real interest rate (discount rate) lower than 9 percent, the proposed social security reform is fiscally efficient in the sense that the present value of fiscal deficits and fiscal surpluses is positive. Put differently, from a fiscal point of view the reform yields an internal rate of return of 9 percent.

The second reform proposal is a publicly financed expansion of full-day child care and full-day school programs. Currently, only 40 percent of school children attend a full-day

3

school in Germany and less than 40 percent of the children ages 3 to 6 attend a full-day child care program. We consider a public program that expands access to full-day facilities so that after the reform 80 percent of children in Germany attend full-day child care or full-day schools. To achieve this goal, about 4 million half-day spots have to be transformed into full-day spots. According to estimates in the literature, this expansion program will create additional annual fiscal cost of about 6 Billion Euro (0.2 percent of German GDP), mainly for teacher salaries, and a one-time fiscal cost of about 20 Billion Euro (0.66 percent of German GDP), mainly for new buildings and other capital goods. This reform helps women with children to balance work and family life, and increases their incentive to search for work if unemployed or to search for work with longer work hours if already employed.

The expansion of full-day child care and full-day school programs has positive macroeconomics effects that are quite substantial. Employment, wages, and output increase in the short-run and in the long-run. Ten years after the reform implementation, employment has increased by 0.8 percent, average real hourly after-tax wages have risen by 0.4 percent, and potential output has expanded by 0.7 percent. The reform has also positive distributional consequences since pay raises are concentrated among women with children, a group that traditionally has struggled with low hourly wages. Ten years after the reform, real hourly wages for women with children have gained 0.8 percent. Finally, the fiscal implications of the reform are positive. The reform generates initial fiscal deficits due to additional public expenditures, but also generates additional tax revenues so that the government budget is balanced after 4 years and in surplus thereafter. For any real interest rate (discount rate) lower than 11.86 percent, the proposed public expansion program is fiscally efficient in the sense that the present value of fiscal deficits and fiscal surpluses is positive. In other words, this public investment program yields an internal rate of return of 11.9 percent for the government.

We also consider a reform package that combines the tax reduction program with the expansion of full-day school/child care. Though the model underlying our analysis allows for non-linear household behavior and non-linear interaction effects between labor, capital, and goods markets, we find that the macroeconomic effects of the two reforms combined are roughly the sum of the individual effects of the two reforms considered separately. In other words, the combination of individual reforms to reform packages does not generate either significant "crowding out" effects or positive spill-over effects. Specifically, 10 years after the reform package has been implemented, employment has increased by 1.8 percent, average real hourly after-tax wages have risen by 1 percent, and potential output has expanded by 1.5 percent. Further, though the reform package generates short-run fiscal deficits, it also produces substantial fiscal surpluses in the long-run. For any real interest rate (discount rate) lower than 9.4 percent, the proposed reform package is fiscally efficient in the sense that the present value of fiscal deficits and fiscal surpluses is positive. Thus, the reform package yields an internal rate of return of 9.4 percent for the government. Finally, the reform package has positive distributional consequences in the sense that workers in the low-wage sector and women with children experience substantial gains in hourly wages.

The third reform proposal is the further deregulation of the professional services (lawyers, accountants, architects, engineers) in Germany. This reform enhances efficiency and improves productivity of firms using the professional services as an input factor. We find that the macroeconomic effects of this reform are positive in the short- and long-run, but quantitatively the effects are relatively small due to the small size of the sector of professional services in Germany (around 3 percent of GDP). Specifically, 10 years after reform implementation, employment has increased by 0.02 percent, average real hourly after-tax wages have risen by 0.15 percent, and potential output has expanded by 0.14 percent.[4]

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[4]IMF (2014) considers a deregulation of the German service sector and finds positive output effects that are much larger than the 0.14 percent we find here. However, the analysis in IMF (2014) assumes that the

2. Model

This section develops the model and defines our equilibrium concept. The framework is based on Krebs and Scheffel (2013), which combines the incomplete-market model with human capital developed in Krebs (2003) with a search model along the lines of Ljungqvist and Sargent (1998).[5] For notational simplicity, we only discuss stationary equilibria (aggregate ratio variables are constant over time). The definitions and results are, mutatis mutandis, the same for non-stationary equilibria.

2.1. Goods Production

Time is discrete and open ended. We assume that there is one final good that can be consumed or used for investment purposes. Production of this final good is undertaken by one representative firm (equivalently, a large number of identical firms) that uses physical capital, human capital, and $j = 1, \ldots, J$ intermediate good to produce the final good according to the production function

$$Y_t = A K_t^{\alpha_1} H_t^{\alpha_2} \left(M_{1t} + \ldots + M_{Jt} \right)^{1-\alpha_1-\alpha_2} \tag{1}$$

where Y is aggregate output, K is the aggregate stock of physical capital, H is the aggregate level of human capital employed, and M_j is the quantity of intermediate goods j. Further, A is an efficiency parameter measuring total factor productivity and α_1 and α_2 are parameters measuring the relative importance of physical capital, respectively human capital, in production. Notice that the production function has constant-returns-to-scale, satisfies a Inada condition, and is continuous, concave, and strictly increasing in each argument. Notice further that we assume for simplicity that the J intermediate goods are perfect substitutes.

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deregulation reform can reduce markups substantially in the entire service sector, which comprises more than half of the German economy, whereas the current paper considers the deregulation of the professional service sector, which only comprises 3 percent of the German economy.

[5]An extensive literature review can be found in Krebs and Scheffel (2015).

The representative firm rents physical capital and human capital in competitive markets at rental rates r_k and r_h, respectively. Note that r_h is simply the hourly wage rate per unit of human capital and that we dropped the time index because of our stationarity assumption. In addition, the firm buys the intermediate goods at unit prices p_j. The representative firm's profit maximization problem in each period t reads

$$\max_{K_t, H_t, M_{1t}, \ldots, M_{Jt}} \left\{ A K_t^{\alpha_1} H_t^{\alpha_2} (M_{1t} + \ldots + M_{Jt})^{1-\alpha_1-\alpha_2} - r_k K_t - r_h H_t - \sum_j p_j M_{jt} \right\} \quad (2)$$

The first order conditions with respect to the intermediate good M_j delivers the inverse demand function $M_{jt} = M_j(p_1, \ldots, p_J, K_t, H_t)$ for intermediate good j.

Each intermediate good j is produced by one firm at constant marginal costs ν. There is Bertrand competition such that for given inverse demand function, each firm chooses it price level to maximize profits. Specifically, in each period t the intermediate good firm j maximizes

$$\max_{p_j} \left\{ p_j M_j(p_1, \ldots, p_J, K_t, H_t) - \nu M_j(p_1, \ldots, p_J, K_t, H_t) \right\} \quad (3)$$

For our quantitative policy analysis, we identify the intermediate-good sector with the sector of "Professional Services" consisting of tax accountants, lawyers, engineers, and architects (see Section 6).

2.2 Households

There are a large number of households who differ with respect to their family type s_1. There are six different family types, $s_1 \in \{sn, ska, skn, cn, cka, kcn\}$, corresponding to the types "single without school children (kids)", "single with school children and access to full-day school program", "single with school children and no access to full-day school program", "couple without school children", "couple with school children and access to full-day school program", and "couple with school children and no access to full-day school program". Households do not change their family type and in this sense s_1 describes ex-ante hetero-

7

geneity of households. The distribution of households over family types s_1 is exogenous and will be chosen to match the empirical distribution over family types – see the calibration section for details.

Households also differ according to their employment status, s_2. A single-household can be short-term unemployed, $s_2 = su$, long-term unemployed, $s_2 = lu$, full-time employed, $s_2 = 1e$, part-time employed, $s_2 = 0.5e$, or marginally employed, $s_2 = 0.25e$. For the couple-household the different employment states are defined as the combination of the employment states of the two adult household members. The employment state of an individual household changes over time and the associated stochastic process is a Markov process with stationary transition function that depends on search effort, l, of the household. Specifically, households can exert job search effort that determines the likelihood to transit to an employment state with higher working hours, that is, an individual worker who is short-term or long-term unemployed, $s_2 \in \{su, lu\}$, can become employed and move to one of the employment states $s_2 \in \{0.25e, 0.5e, 1e\}$, a worker who is marginally employed, $s_2 = 0.25e$, can move to one of the two employment states $s_2 \in \{0.5e, 1e\}$, and a worker who is part-time employed, $s_2 = 0.5e$, can transit to full-time employment, $s_2 = 1e$. Full-time employed workers do not search since the hourly wage per unit of human capital is common across jobs. We assume that job search is undirected across different employment types (full-time, part-time, marginal employment) in the sense that a worker/household in employment state s_2 chooses one effort level $l \in \mathbb{R}$ that determines the transition probabilities, $\pi(s_2'|s_2, l)$, to any employment state, $s_2' \geq s_2$.

The hourly wage per unit of human capital of an employed member of the household is subject to idiosyncratic risk. This risk is modeled as shocks to the individual stock of human capital, $\eta(s_3)$, that follow an i.i.d. process. See below for the details how these shocks affect the human capital of an individual household.

8

For notational ease, we define the exogenous state of an individual household in period t by $s_t = (s_{t1}, s_{t2}, s_{t3})$ and the corresponding transition probabilities by $\pi(s_{t+1}|s_t, l_t)$. Households die with constant and common probability ρ, in which case they are replaced by new born households (perpetual youth model along the lines of Blanchard, 1987).

Households can invest in financial capital (save) and human capital (on-the-job training) and we denote the level of financial capital, respectively human capital, of an individual household by a_t (asset holding), respectively h_t. Given an initial state, (h_0, a_0, s_0), a household chooses a plan, $\{c_t, l_t, h_t, a_t\}$,[6] that has to satisfy the budget constraint

$$
\begin{aligned}
(1 + \tau_c)c_t + x_{kt} + (1 - \tau_{xh})x_{ht} &= (1 - \tau_a)r_f a_t + (1 - \tau_h(s_{1t}, s_{2t}))r_h s_{2t} h_t + tr(s_{1t}, s_{2t})h_t \\
h_{t+1} &= (1 - \delta_h + \eta(s_{3t}))h_t + \phi x_{ht} \qquad (4) \\
a_{t+1} &= a_t + x_{kt} \\
h_{t+1} &\geq 0 \ , \ a_{t+1} + h_{t+1} \geq 0
\end{aligned}
$$

where the first equation in (4) is the sequential budget constraint, the second is the human capital evolution equation, and the third is the evolution equation for financial assets (capital). In (4) the variable x_{kt} denotes investment in financial capital (saving), r_f is the return to financial capital (the risk-free rate), x_{ht} is investment in human capital, ϕ a parameter describing the productivity of human capital investment, δ_h is the (average) depreciation rate of human capital, and $\eta_t = \eta(s_{3t})$ a shock to human capital that captures wage risk. The government system of taxes and transfers is defined by the labor income tax (including social security tax), τ_h, the capital income tax, τ_a, the human capital investment subsidy, τ_{hx}, the consumption tax, τ_c, and the transfer payments, $tr(s_{3t})$. Note that both labor income tax and transfer payments may depend on family type, s_1, and employment status, s_2. Note further that $r_f a_t$ is the (pre-tax) capital income in period t and that $r_h s_{2t} h_t$ is the (pre-tax)

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[6]Here c_t stands for the function mapping partial histories, s^t, into consumption levels $c_t(s^t)$, with similar notation for the other household variables.

labor income in period t. Finally, we note that the two inequality constraint in (4) impose a debt constraint.

There are financial intermediaries that have the ability to transform one unit of financial capital into one unit of physical capital at no cost. Profit maximization of these firms implies the zero-profit condition $r_f = r_k - \delta_k$, where δ_k is the depreciation rate of physical capital.

The budget constraint (4) assumes that physical capital and human capital are produced using similar technologies in the sense that one unit of physical capital can be transformed into ϕ units of human capital. Thus, we assume constant returns to scale at the household level. This assumption, also made in Krebs (2003), implies that the household decision problem displays a certain linearity with respect to physical capital investment and human capital investment in the sense that goods invested in either human capital or physical capital generate returns that are independent of household size, where size is measured by total wealth (see below).[7] In conjunction with the constant-returns-to-scale assumption for the aggregate production function F it implies that the model exhibits endogenous growth.

The assumptions we make in (4) have the advantage that they keep the model highly tractable, which, as we argued before, is essential for the quantitative analysis conducted in this paper. Tractability in the general case requires that we do not impose a restriction on the ability of households to decumulate human capital. However, in the calibrated model economy used for our quantitative analysis, the restriction that human capital investment is always non-negative, $x_h \geq 0$, is always satisfied in equilibrium; that is, it holds for all household types and all realizations of uncertainty.[8]

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[7]Note also that in (4) we focus on the resource cost of human capital investment, but we can easily introduce time cost of human capital investment without loosing tractability.

[8]Note that in (4) we have explicitly imposed a non-negativity constraint on the stock of human capital, and our general characterization of the household decision rule (proposition 1) holds with this constraint imposed. Of course, for a certain range of parameter values this constraint binds in equilibrium, but for

Households are risk-averse and have identical preferences that allow for a time-additive expected utility representation. We also assume that utility is separable in consumption and search effort, and that the current utility is given by $u(c_t, l_t, s_t) = \ln c_t - d(l_t, s_t)$, where $d(l_t, s_t)$ is the disutility from search, a strictly increasing and strictly convex function. Expected utility associated with a consumption-effort plan $\{c_t, l_t\}$ reads

$$U(\{c_t, l_t\}|s_0) = E\left[\sum_{t=0}^{\infty} \beta^t \left(\ln c_t - d(l_t, s_t)\right)\Big| s_0\right] \tag{5}$$

where $\beta = \tilde{\beta}\rho$ with $\tilde{\beta}$ the subjective discount rate and ρ the death probability. Note that the expectation in (5) depends on the effort plan $\{l_t\}$, but we will suppress this dependence for notational ease. Note also that the disutility of search effort, d, may depend on household type, s_1, and employment status, s_2.

Households choose a consumption-effort-investment plan, $\{c_t, l_t, h_t, a_t\}$, to maximize expected lifetime utility (5) subject to the budget constraint (4).

2.3 Equilibrium

The initial distribution, μ_0, of households over states, (h_0, a_0, s_0), in conjunction with the transition functions, $\pi(s_{t+1}|s_t, l_t)$, and the equilibrium effort plans, $\{l_t\}$, induce a sequence of equilibrium joint distributions, $\{\mu_t\}$, over (h_0, a_0, s_0, s^t). Assuming a law of large numbers, aggregate variables in any period t can be found by taking the expectation with respect to the joint distribution μ_t. For example, the aggregate level of financial capital of households in period t is $K_t = E[a_t]$ and the aggregate level of employed human capital is $H_t = E[s_{2t}h_t]$ In equilibrium, human capital demanded by the firm must be equal to the corresponding aggregate stock of human capital supplied by households. Similarly, the physical capital demanded by the firm must equal the aggregate net financial wealth supplied by households.

the parameter values used in our quantitative analysis this constraints never binds (does not bind for all households types and uncertainty states).

That is, in equilibrium we must have for all t

$$K_t = E[a_t] \qquad (6)$$

$$H_t = E[s_{2t}h_t]$$

To sum up, we have the following equilibrium definition:

Definition A stationary (balanced growth) equilibrium is a pair of rental rates, (r_k, r_h), a vector of intermediate good prices, $(p_1, \ldots, p_J)$, a sequence of physical and human capital stocks, $\{K_t, H_t\}$, and a family of household plans, $\{c_t, h_t, a_t, l_t\}$, such that

i) Utility maximization of households: for each initial state, (h_0, a_0, s_0), and given rental rate r_h and interest rate $r_f = r_k - \delta_k$, the household plan, $\{c_t, h_t, a_t, l_t\}$, maximizes expected lifetime utility (5) subject to the sequential budget constraint (4).

ii) Profit maximization of final-good firms: the sequence $\{K_t, H_t\}$ solves problem (2)

iii) Profit maximization of intermediate-good firms: the price p_j solves the problem (3) for all $j = 1, \ldots, J$.

iv) Market clearing: equations (6) holds for all t.

A stationary recursive equilibrium is a stationary equilibrium in which household plans are generated by policy functions. Note that in a stationary equilibrium, the extensive-form aggregate variables K_t, H_t, M_{jt}, X_{kt}, X_{kt}, and C_t all grow at a common rate and the intensive-form aggregate variables (ratio variables) are constant over time – see the equilibrium characterization below. Note further that the equilibrium growth rate of all extensive-form aggregate variables is endogenous – see Krebs (2003) for a detailed discussion of the equilibrium behavior of this class of endogenous growth models with idiosyncratic risk.

In our definition of equilibrium, we have not included the government budget constraint.

The government budget constraint reads:

$$\tau_c E[c_t] + r_h E[\tau_h(s_{1t}, s_{2t})s_{2t})h_t] + \tau_a r_f E[a_t] = \tau_{hx} E[x_{ht}] + E[tr(s_{1t}, s_{2t})h_t] \tag{7}$$

In our policy analysis below, we impose the budget constraint for the pre-reform equilibrium, but do not impose the constraint post-reform. This means that we assume that the government can borrow and lend in international financial markets and uses this ability to finance any reform-induced budget deficits and to invest any reform-induced budget surpluses. Note that a standard argument shows that in an equilibrium with (7) the goods market clearing condition (aggregate resource constraint) holds:

$$C_t + X_{kt} + X_{ht} = Y_t - \sum_j M_{jt} \tag{8}$$

2.4. Characterization of Household Problem

We next show that optimal consumption choices are linear in total wealth (human plus financial) and portfolio and effort choices are independent of wealth. This property of the optimal policy function allows us to solve the quantitative model, which has considerable household heterogeneity and three inter-temporal choice variables (h, k, l), without using approximation methods. The property also implies that the household decision problem is convex and the first-order approach can be utilized.

To state the characterization result, denote total wealth (human plus financial) of a household at the beginning of the period by $w_t = \frac{1-\tau_{hx}}{\phi}h_t + a_t$. Note that ϕ measures the productivity of goods investment in human capital and $1/\phi$ is the shadow price of one unit of human capital in terms of the consumption/capital good. Denote the portfolio share of physical capital by $\theta_t = a_t/w_t$. Note that this definition in conjunction with the definition of w imply that the portfolio share of human capital is given by $1 - \theta_t = \frac{(1-\tau_{hx})h_t}{\phi w_t}$. The sequential budget constraint (4) then reads:

$$w_{t+1} = (1 + r(\theta_t, s_t))w_t - c_t \tag{9}$$

13

$$c_t \geq 0 \ , \ w_{t+1} \geq 0 \ , \ 1 - \theta_{t+1} \geq 0$$

with

$$r(\theta_t, s_t) \doteq \theta_t r_f + (1 - \theta_t)\hat{r}_h(s_t)$$

$$\hat{r}_h(s_t) \doteq \frac{\phi}{1 - \tau_{hx}}[(1 - \tau_h(s_{1t}, s_{2t}))r_h s_{2t} + tr(s_{1t}, s_{2t})] - \delta_h + \eta(s_{3t})$$

Clearly, (9) is the budget constraint corresponding to an inter-temporal portfolio choice problem with linear investment opportunities and no exogenous source of income, where the return to physical capital investment (saving) is r_f and the risky return to human capital investment is $\hat{r}_h(s)$. Note that these returns also depend on the tax and transfer system, a dependence that we suppress for notational ease. Note also that the more time a household spend working (the larger s_{2t}), the higher is the return to human capital investment.

The representation of the household budget constraint shows that (w, θ, s) can be used as individual state variable for the recursive formulation of the utility maximization problem. Specifically, the Bellman equation associated with the household utility maximization problem is

$$V(w, \theta, s) = \max_{c, w', \theta', l} \left\{ \ln c - d(l, s) + \beta \sum_{s'} V(w', \theta', s')\pi(s'|s, l) \right\} \quad (10)$$

$$subject\ to \qquad w' = (1 + r(\theta, s))w - (1 + \tau_c)c$$

where for simplicity we assume that the continuation value in the case of death is zero. We have the following characterization result for the solution to the household decision problem.

Proposition 1. The value function and the optimal policy function are given by

$$
\begin{aligned}
V(w, \theta, s) &= \tilde{V}(s) + \frac{1}{1 - \beta}\left(\ln(1 + r(\theta, s)) + \ln w\right) \\
c(w, \theta, s) &= \frac{1 - \beta}{1 + \tau_c}\left(1 + r(\theta, s)\right)w \\
\theta'(w, \theta, s) &= \theta'(s) \\
l(w, \theta, s) &= l(s)
\end{aligned}
\qquad (11)
$$

14

$$w'(w, \theta, s) = \beta (1 + r(\theta, s)) w$$

where the intensive-form value function, $\tilde{V}(s)$, the optimal portfolio choice, θ', and the optimal effort choice, l, are the solution to the intensive-form Bellman equation

$$\tilde{V}(s) = \max_{\theta', l} \left\{ - d(l, s) + \ln \frac{1 - \beta}{1 + \tau_c} + \frac{\beta}{1 - \beta} \ln \beta + \right.$$
$$\left. \frac{\beta}{1 - \beta} \sum_{s'} \ln(1 + r(\theta', s')) \pi(s'|s, l) + \beta \sum_{s'} \tilde{V}(s') \pi(s'|s, l) \right\} \quad (12)$$

Proof: The proof is an extension of the proof given in Krebs and Scheffel (2013).

The maximization problem (12) is a convex problem so that first-order conditions are sufficient. Thus, to find the optimal portfolio and effort choice we can confine attention to the first-order conditions with respect to the portfolio choice and search effort, which read

$$0 = \sum_{s'} \frac{\hat{r}_h(s') - \hat{r}_k}{(1 + r(\theta', s'))} \pi(s'|s, l) \quad (13)$$
$$\frac{\partial d(l, s)}{\partial l} = \beta \sum_{s'} \left(\frac{\ln(1 + r(\theta', s'))}{1 - \beta} + \tilde{V}(s') \right) \frac{\partial \pi(s'|s, l)}{\partial l}$$

Note that the first equation in (13) states that marginal utility weighted expected returns on the two investment opportunities (human capital and financial capital) are equalized – a standard optimality condition in portfolio theories (the marginal utility of future consumption is equal to $((1 - \beta)(1 + r')\beta(1 + r)w)^{-1}$ and therefore proportional to $(1 + r')^{-1}$). Equation (13) in conjunction with equation (12) without the max operator determine the equilibrium values of θ, l, and $\tilde{V}(.)$ for given rental rates r_k and r_h (partial equilibrium).

The first equation in (13) implies that in equilibrium part-time employed workers invest less in human capital (less on-the-job training) than full-time workers. To see this, note that the human capital return of part-time employed workers is less than the human capital return of full-time employed workers, $\hat{r}_h(s_2 = 0.5) < \hat{r}_h(s_2 = 1)$, since the additional labor income generated by the human capital investment is smaller: $0.5 \cdot r_h \cdot h < 1 \cdot r_h \cdot h$. Thus,

part-time employed workers have a smaller incentive to invest in human capital than full-time employed workers, and part-time jobs are therefore less productive, and pay lower hourly wages, than full-time jobs. Clearly, the same argument implies that marginally employed workers, $s_2 = 0.25$, have the smallest incentive to invest in human capital and end up being the least productive workers with the lowest hourly wages. These equilibrium properties are essential for some of the results to follow and can be derived formally using the first equation in (13). It is also in line with the empirical evidence – see our discussion of the empirical literature in Section 3.6.

Equation (13) is also useful to discuss the direct effects of the two reforms that increase labor supply. First, consider the effect of the reduction in the social security tax for workers with low earnings. In this case, for the affected workers the after-tax hourly wage, $(1 - \tau_h(s_1, s_2))r_h$, goes up. This has two consequences. First, unemployed workers have a stronger incentive to search for a job and workers who are marginally or part-time employed have a stronger incentive to search for a full-time job. Second, the return to human capital investment goes up and the incentive of employed workers to invest in human capital therefore increases. As a result, search effort, l, goes up and investment in human capital, $(1 - \theta)$, goes up. These two results can be formally shown using equation (13).

Consider now the second reform, the increase in public spending on schooling so that more schools in Germany will offer a full-day school program. This reform changes the distribution of households over s_1. Specifically, after the reform a larger fraction of households with kids have access to full-day school programs and members of those households who are not full-time employed have a stronger incentive to search for full-time employment.

Proposition 1 provides a convenient characterization of the solution to the household decision problem for given investment returns (partial equilibrium) and is useful for two reasons. First, it reduces the problem of solving the Bellman equation (7) to the much

16

simpler problem of solving the intensive-form Bellman equation (8). Second, it states that the consumption and saving choices are linear in wealth, and that the portfolio and effort choices are independent of wealth. This property allows us to solve for the general equilibrium without knowledge of the endogenous wealth distribution. We next turn to the general equilibrium analysis.

2.5. Equilibrium Characterization

In the previous section we characterized the solution to the household problem. Consider now the maximization problem of the final-good producer (2) and intermediate-good producers (3). For the intermediate good sector, we focus attention on symmetric equilibria, $p_j = p$ and $X_{jt} = X_t$, for all $j = 1, \ldots, J$. Using the first-order conditions associated with the maximization problems (2) and (3) and the symmetry condition, in the Appendix we show that the price for each intermediate good satisfies

$$
\begin{aligned}
p &= \frac{J}{J - \alpha_1 + \alpha_2} \nu \\
&\doteq (1 + \varphi(J))\nu
\end{aligned}
\tag{14}
$$

where $\varphi(J) = \frac{J}{J - \alpha_1 + \alpha_2} - 1$ defines the mark-up. This mark-up is decreasing in the number of firms, J, and therefore decreasing in the degree of competition in the intermediate-good sector (i.e. the professional services). In Section 6, we discuss how the deregulation of the market for professional services affects the economy by increasing the degree of competition, J, and therefore decreasing the mark-up.

Using the pricing condition (14) and the first-order condition of the final-good producer, we find the following relationship between rental rates r_k and r_h and the firm's capital-to-labor ratio $\tilde{K} = \frac{K}{H}$:

$$
\begin{aligned}
r_k &= \alpha_1 \hat{A} \tilde{K}^{1 + \frac{\alpha_1}{\alpha_2}} \\
r_h &= \alpha_2 \hat{A} \tilde{K}^{\frac{\alpha_1}{\alpha_1 + \alpha_2}}
\end{aligned}
\tag{15}
$$

17

$$\hat{A} \doteq A^{\frac{1}{\alpha_1+\alpha_2}} \left(\frac{1-\alpha_1-\alpha_2}{(1+\varphi)\nu}\right)^{(1-\alpha_1-\alpha_2)/(\alpha_1+\alpha_2)}$$

Equation (15) shows that a reduction in mark-up, φ, in the intermediate goods sector is equivalent to an increase in productivity, $\hat{A}$, in the final goods sector. Thus, a deregulation of the intermediate goods sector (professional services) that increases competition and the number of competing firms J will reduce cost and increase effective productivity, $\hat{A}$ in the final good sector, which in turn increases labor demand through (15). This is the policy experiment analyzed in Section 6 when we consider the (further) deregulation of the professional services in Germany.

To complete the equilibrium characterization, we define the share of aggregate total wealth of households in state s as

$$\Omega(s) \doteq \frac{E\left[(1+r)w|s\right]\pi(s)}{\sum_s E\left[(1+r)w|s\right]\pi(s)}$$

where π is the stationary distribution of the equilibrium transition function over s. Note that $(1+r)w$ is total wealth of an individual household after assets have paid off (after production has taken place and depreciation has been taken into account). Note also that $\sum_s \Omega(s) = 1$ by construction. Further, Ω is finite-dimensional, whereas the set of distributions over (w, s) is infinite-dimensional. Using the wealth shares Ω, we show in the Appendix that the market clearing condition (6) can be written as:

$$\tilde{K} = \frac{(1-\tau_{hx})\sum_s \theta(s)\Omega(s)}{\phi(1-\theta(s))s_2\Omega(s)} \tag{16}$$

and that stationary Ω-distribution is the solution to

$$\Omega(s') = \frac{\rho\sum_s \pi(s'|s,l(s))(1+r(\theta(s),s))\Omega(s)+(1-\rho)\psi\mu_{new}(s')}{\rho\sum_{s,s'}\pi(s'|s,l(s))(1+r(\theta(s),s))\Omega(s)+(1-\rho)\psi\mu_{new}(s')} \tag{17}$$

where μ_{new} determines how the wealth of dying households is distributed among new-born households and $\psi < 1$ is a parameter that measures the fraction of wealth that is passed on to the new generation.

18

Summing up, we have the following equilibrium characterization result:

Proposition 2. Suppose that $(\theta, l, \tilde{V}, \tilde{K}, \Omega)$ solve (12),(15), (16), and (17). Then the sequence $\{K_t, H_t\}$ and the family of household plans, $\{c_t, h_t, k_t, l_t\}$, induced by $(\theta, l, \tilde{V}, \tilde{K}, \Omega)$ together with the corresponding rental rates, (r_k, r_h) and inter-mediate goods prices $(p_1, \ldots, p_J)$ given by (14) define a stationary (balanced growth) equilibrium.

Proof. The proof is an extension of the proof given in Krebs and Scheffel (2013).

Proposition 2 shows that the stationary equilibrium can be found without knowledge of the infinite-dimensional wealth distribution; only the finite dimensional distribution of wealth across family types Ω matters. The is because the linearity of the policy functions in wealth make the infinite dimensional distribution of wealth across households of a given type irrelevant. Proposition 2 facilitates our quantitative analysis significantly since it implies that there is no need to approximate an infinite dimensional distribution over financial wealth and human wealth when computing equilibria.

3. Calibrating the Model

The calibration is based on macro- and microeconomic evidence from various sources. Specifically, the cross-sectional distribution of households over family types and employment states are taken from the 2010 Micro-census provided by the Federal Office of Statistics (Statistisches Bundesamt). Data on labor market dynamics are generally taken from the Federal Employment Agency (Bundesagentur fuer Arbeit) and policy variables, including benefits, labor taxes and social security contributions are taken from the OECD Tax Benefit Model. See Krebs and Scheffel for a detailed description of the data sources and a discussion of the various empirical distributions.

3.1 Search Technology and Transition Rates Across Employment States

We set the period length to one quarter. We use a standard convention and define long-term unemployment as any unemployment spell that lasts longer than 12 months. Thus, we choose $\pi(su|lu) = 0.25$.

We assume an exponential specification for the probability of an unemployed worker finding a job as a function of effort:

$$\pi(s_2 \in \{1e, 0.5e, 0.25e\}|su, l) = 1 - e^{-\lambda(su)l} \tag{18}$$
$$\pi(s_2 \in \{1.0e, 0.5e, 0.25e\}|lu, l) = 1 - e^{-\lambda(lu)l}$$

In search models with only one employment state, the exponential formulation is often used in the literature (Hopenhayn and Nicolini, 1997, Lentz, 2009, and Shimer and Werning, 2008). Specification (12) is the generalization of this approach to the case of multiple employment states if there is undirected search for different employment opportunities (full time, part time, marginal employment). We choose the values $\lambda(su)$ and $\lambda(lu)$ so that the job finding probabilities (12) match the corresponding quarterly job finding rates in 2010 provided by the Federal Employment Agency (Bundesagentur fuer Arbeit). In 2010, these quarterly job finding rates were 0.36 for the short-term unemployed and 0.09 for the long-term unemployed.

Specification (18) determines the average job finding probability, but does not pin down what type of job is found in case job search was successful (full time, part time, marginal employment). We assume that the arrival rate of the different employment states is the same:

$$\pi(s_2 = 1e|su, l) = \pi(s_2 = 0.5e|su, l) = \pi(s_2 = 0.25e|su, l) \tag{19}$$
$$\pi(s_2 = 1e|lu, l) = \pi(s_2 = 0.5e|lu, l) = \pi(s_2 = 0.25e|lu, l)$$

This assumption can be easily relaxed from a modelling point of view, but we are not aware

of any micro-level evidence that would allow us to calibrate the additional parameters of the richer model structure. For this reason, we confine attention to specification (19).

There is little empirical evidence regarding the transition rates from marginal employment, $s_2 = 0.25e$, to either part-time employment, $s_2 = 0.5e$, or full-time employment, $s_2 = 1e$, and regarding the transition rate from part-time employment, $s_2 = 0.5e$, to full-time employment, $s_2 = 1e$. Caliendo, Kuenn, and Uhlendorff (2012) show that the probability of a marginally employed worker to move to a higher employment state (i.e. part-time or full-time employment) is not different from the job finding rate of an unemployed worker. Motivated by this evidence, we set the probability of moving from $s_2 = 0.25e$ to either $s_2 = 0.5e$ or $s_2 = 1e$ equal to the job finding rate of a short-term unemployed worker. In addition, we also set the probability of moving from $s_2 = 0.5e$ to $s_2 = 1e$ equal to the job finding rate of short-term unemployed workers.

We choose the job destruction rates, i.e. the flow rates from the employment states $s_2 = 1e, 0.5e, 0.25e$ to unemployment $s_2 = su$, so that we match the empirical distribution of households over employment states s_2. In addition, we calibrate the transition rate from long-term to short-term unemployment to match the composition of the unemployment pool in the data. Specifically, conditional on the family and skill type, we target a value of 50 percent for the fraction of long-term unemployed workers in the pool of all unemployed workers. The only exception are single parents, a group for which the large majority of unemployed are long-term unemployed. In line with the data, for single parents we use a share of 86 percent long-term unemployment as our target.

We also allow for one-step transitions from higher to lower employment levels, that is, we allow for transitions from full-time employment to part-time employment ($1.0e \rightarrow 0.5e$) and from part-time employment to marginal employment ($0.5e \rightarrow 0.25e$). For lack of evidence, we assume that for each family type these transitions rates are equal to the corresponding

21

job destruction rates (i.e. the transition rate from the employment state to unemployment).

3.2 Search Preferences

We assume that disutility of search effort is

$$d(l, s_1) = d_0 l^\gamma - d_1(s_1)$$

It is well-known that with the above specification the parameters $\lambda(su)$ and $\lambda(lu)$ and d_0 are not separately identified. We choose a numerically convenient normalization of $d_0 = 1$. We choose the curvature parameter γ to match a given value of the elasticity of the job finding rate with respect to benefit payments for the short-term unemployed, where we choose as target the micro elasticity holding constant the labor market state. This target elasticity is chosen as follows.

For the US, there are a number of empirical micro studies estimating the search elasticity directly. The best known studies are Moffitt (1985) and Meyer (1990) who estimate an elasticity of around -0.9. Meyer and Krueger (2002) survey the literature and suggest an elasticity of -1, whereas Chetty (2008) suggests a value of -0.5. Card et al. (2015) provide new evidence using administrative data from the state of Missouri covering the period 2003-2013. Based on identification coming from a regression kink design, they find an elasticity of around -0.35 before the recession and an elasticity between -0.65 and -0.9 after the recession. Krueger and Mueller (2010) analyze time use data and find that the level of unemployment benefits has a large negative effect on the time unemployed workers spent searching for a job, a finding that broadly supports the basic channel we emphasize in this paper.

There is much less work on this issue for Germany. Hunt (1995) finds estimates for Germany that are in line with the US estimates of Moffitt (1985) and Meyer (1990). Addison, Centeno, and Portugal (2008), who use a structural search model and the European Com-

munity Household Panel (ECHP), find values of the search elasticity ranging from -1.14 to -1.66 for Germany. Consistent with this finding are the results reported in Hofmann (2012) and Mueller and Steiner (2008) who find that imposing benefit sanctions/reduction long-term unemployed for non-compliance has significant effects on the unemployment-to-employment transition in Germany. With the exception of these last two studies, the empirical literature has focused on unemployed workers who are short-term unemployed according to our definition (less than one year of unemployment). Guided by the evidence, for our baseline calibration we choose a conservative value for the target elasticity of -0.7 for the short-term unemployed.

For the disutility-term $d_1(s)$ we choose the specification $d_1(s) = d_{11}(s_1) + \bar{d}_{12}s_2$, where s_1 denotes the family type and s_2 the employment status. We choose the value of $\bar{d}_{12}$ consistent with the disutility of work used in the RBC literature, e.g. Cooley and Prescott (1995). We choose the values of $d_{11}(s_1)$ to match the empirical ratio of full-time employment to the sum of part-time and marginal employment for each family type s_2. Note that this approach ensures that the model matches the significant empirical difference in employment type between women with kids who have access to full-day school and women with kids who do not have access to full-day school. See Krebs and Scheffel (2015) for a detailed discussion of the empirical evidence on this issue.

3.3 Wage Risk

One can show (Krebs 2003) that the assumption of i.i.d human capital shocks, η, implies that the log of labor wages of individual households follows approximately a random walk with innovation term $\epsilon = (1 - \theta)\eta$. For the US, the random walk component of individual labor income has been estimated by a number of empirical studies using data drawn from the PSID, and estimates of σ_ϵ for the US are in the range of .15 for annual wage changes, which amounts to quarterly standard deviation of $0.15/2 = 0.075$. For Germany, Krebs and

Yao (2016) and Fuchs-Schuendeln, Krueger, and Sommer (2009) find similar values, and we therefore choose this value as a target for σ_ϵ.

3.4 Government Policy Parameters

We set the capital income tax at $\tau_k = 0.20$, which is at the upper end of the range of capital income taxes reported by the OECD. We set the schedule of labor income taxes and social security contributions, $\tau_h(s_1, s_2)$, consistent with numbers computed from the OECD tax calculator and the social security tax schedule. We choose the unemployment benefit parameters that are a part of the transfer system, $tr(s_1, s_2)$, to match the net replacement rate for the short-term and long-term unemployed taken from Krebs and Scheffel (2013). The remaining parameters of the transfer system are set so that the model's implications for labor income after taxes and transfers are consistent with the data drawn from the German "Mikrozensus". Finally, we choose the value of the consumption tax, τ_c, to ensure that the government budget constraint is satisfied.

3.5 Production Technology

We set $\frac{\alpha_1}{\alpha_1 + \alpha_2}$ to match the share of labor income in the data and $1 - \alpha_1 - \alpha_2$ to match the share of the sector professional services in the German economy, which is 3 percent. We choose the remaining technology parameters to match capital-to-output ratio of 2.5, an annual physical capital return of 4 percent and an annual average human capital return of 8 percent (human capital risk premium of 4 percent).

3.6 Implied Wage Differentials

As discussed in Section 2, the model implies that marginally employed workers have the smallest incentive to invest in human capital (on-the-job training) and full-time employed workers the largest incentive. As a result, marginally employed workers are the least productive workers and are paid the lowest hourly wage and full-time employed workers have the

24

highest productivity and are paid the highest hourly wage. Thus, the model generates an endogenous wage penalty for marginal employment and part-time employment. According to the calibrated model economy, this wage penalty is 15 percent for marginal employment and 48 percent for part-time employment. This implication of the calibrated model is consistent with the available empirical evidence in the following sense.

Data provided by the German Statistical Agency show that in 2014 the average hourly wage of full-time employed workers was 23 percent higher than the average hourly wage for part-time workers (Statistisches Bundesamt, 2014). Data drawn from the SOEP for the year 2010 show an average part-time wage penalty of 22 percent (Brenke, 2012). For marginally employed workers the wage penalty is even larger: the average hourly wage of full-time employed workers is 93 percent higher than the average hourly wage of workers whose only job is a so-called mini-job (Eichhorst et al. 2012), which is the relevant group for calibrating the model. Thus, the data indicate a substantial wage penalty for part-time work and a very large wage penalty for marginally employed workers.

The above numbers are simple averages and do not take into account that observed wage differentials between full-time work and part-time work or mini-jobs might be due to differences in worker characteristics (education, experience) or firm characteristics (firm size) or labor market characteristics (sector, occupation). There is a substantial amount of empirical work on the part-time wage penalty for US workers (Hirsch, 2005, Moffitt, 1984) and also British workers (Ermisch and Wright, 1993, and Manning and Petrongolo, 2008). The results of this literature can be summarized as follows. First, there is a large unadjusted wage penalty for part-time workers (20-30 percent) that is larger for men than for women. Second, controlling for worker, firm and labor-market characteristics roughly halves the part-time wage penalty. For Germany, the study by Wolf (2002, 2010) finds that, in line with the international evidence, after controlling for worker and firm characteristics the part-time

wage penalty is 11 percent for women and 25 men. Unfortunately, there is no empirical work on the wage penalty for marginally employed workers, but extrapolation from the results on part-time work would suggest that the adjusted wage penalty is about half of the unadjusted wage penalty (i.e. half of 93 percent).

4. Reform of Social Security Taxes for Low-Wage Jobs

4.1 Current Situation

In Germany, the social security system covers public pension, health insurance, unemployment insurance, accident/disability insurance, and elderly nursing care insurance. The total social security contributions from employers and employees add up to roughly 40 percent of earnings for monthly earnings exceeding 850 Euro, where the employee contribution is slightly less than 20 percent and the employer contribution is somewhat higher than 20 percent. For all monthly earnings below 450 Euro (marginal employment also called mini-jobs), there is no employee contribution to social security. For monthly earnings between 450 Euro and 850 Euro, the employee contribution increases linearly with earnings. See Figure 1 for a graphical representation of the employee contribution to the social security tax in Germany. The limit of the amount of earnings subject to social security taxation, the so-called contribution and benefit base, is 72,600 Euro for West Germany and 62,400 for East Germany.

Labor income taxes (excluding the social security tax) are relatively low for workers with monthly wages less than 2,000 Euro. For example, for a single person without children (highest tax burden) monthly earnings of up to 700 Euro are exempt from income tax, and the average income tax rate is 11 percent for monthly earnings of 1,500 Euro and 15 percent for monthly earnings of 2,000 Euro. Thus, for low-wage jobs, the social security tax dominates the labor income tax, and any tax reduction program that wants to target the

low-wage sector has to focus on the social security tax. Such a reform of the social security tax will be discussed next.

4.2 Reform Description

We consider a reform that replaces the current social security tax system with a system in which the employee contribution increases linearly with earnings reaching its maximal value of 20 percent at monthly earnings of $2,000$ Euro. See Figure 1 for a graphical representation of the effect of the reform on the employee contribution to the social security tax. To implement the reform, we use micro-level earnings data and first compute for every family type s_1 and employment state s_2 the reform-induced average change in the social security tax for workers of a given family type and employment status. We then feed these changes into the calibrated model and compute the equilibrium effects.

To gain a better understanding of the reform effects discussed below, Table 1 shows the average change in the social security tax for marginally employed workers (mini jobs), part-time employed workers, and full-time employed workers (averaged over all workers of all family types). The reform substantially lowers the social security tax for many part-time and full-time employed workers, and increases the social security tax for marginally employed workers since it removes the tax exemption for mini-jobs. Thus, the reform will give marginally employed workers a stronger incentive to search for part-time employment and full-time employment. Further, unemployed workers will on average search harder for jobs since the average social security tax on employment is reduced (the population weighted average in Table 1 is negative).

4.3 Results

The macroeconomic, distributional, and fiscal effects of the reform are shown in Table 2 and Figures 2 - 6. Figure 2 shows that the reform leads to a substantial reduction in the

unemployment rate: the unemployment rate falls by 0.08 percentage points in the short-run (in the first year), by 0.25 percent in the medium run (after 5 years), and by 0.30 percent in the long-run (after 10 years). The intuition underlying the decline in the unemployment rate is simple. The reduction in the social security tax increases the attractiveness of work relative to unemployment, which improves search incentives and therefore induces unemployed workers to increase their search effort. An improvement in search effort, in turn, increases job finding rates and reduces unemployment.

Figure 3 shows the time path of employment after the reform. Employment increases by 0.22 percent in the first year, 0.72 percent after 5 years, and 0.87 percent after 10 years. Less than half of the increase in employment is caused by the reduction in unemployment depicted in figure 2. The rest is explained by an increase in full-time employment relative to marginal employment (part-time employment remains roughly constant – see figure 3). There is a simple reason behind the increase in full-time employment relative to marginal employment: the reform reduces the social security tax for most full-time employed workers in the low-wage sector, but increases the social security tax for the marginally employed – see table 1. Thus, the reform increases the incentive for marginally employed workers to look for full-time employment, and the transition rate from marginal employment to full-time employment (and part-time employment) goes up.

We next turn to a discussion of the wage effect of the reform. There are three forces that act upon hourly pre-tax wages. First, the increase in labor supply tends to reduce wages because the marginal product of labor is diminishing in employment. Second, the reform-induced increase in employment increases the marginal product of capital, which induces firms to increase their labor demand – this force tends to push up wages. In a standard neoclassical model with frictionless labor markets and fixed human capital, the negative wage effect dominates in the short-run and the two effects cancel each other out

in the long-run. However, the current model assumes a frictional labor market with search unemployment and the employment adjustment therefore takes time (see figures 1 and 2). In addition, there is a third effect on wages because workers invest in their human capital (on-the-job training) and the incentive to invest in human capital is stronger for full-time employed workers than for marginally employed workers – see also our discussion in Section 2.4. Thus, this third effect tends to push up hourly wages since the reform increases the share of full-time employed workers relative to marginally employed workers (see figure 3).

Figure 4 depicts the development of hourly pre-tax wages after the reform (relative to trend wage growth). The graph shows that the net effect on wages is positive in the short-run and in the long-run. In other words, the two positive effects on hourly wages discussed in the preceding paragraph dominate the negative effect on wages. Specifically, hourly pre-tax wages increase by 0.15 percent in the short-run, by 0.42 percent in the medium run, and by 0.63 percent in the long-run. Figure 4 also shows that the reform has desirable distributional consequences in the sense that the rise in wages is concentrated in the low-wage sector. Specifically, hourly pre-tax wages in the low-wage sector increase by 0.40 in the first year, by 1.13 percent after five years, and by 1.71 percent after 10 years.[9]

Figure 5 shows the time path of output after the reform (relative to trend output growth). There are three reasons why the reduction in the social security tax considered here will raise output. First, the employment increase discussed above increases output. Second, the physical capital stock increases, which increases labor productivity and therefore output. Third, the human capital stock increases because marginal employment is replaced by full employment, which increases labor productivity and therefore output. Figure 5 shows that the output effects are substantial: output increases by 0.26 percent in the short-run, by 0.63

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[9]We follow the standard approach and define low-wage sector as all workers whose monthly (pre-tax) earnings is below 2/3 of the monthly median earnings. We compute these numbers based on the model distribution.

percent in the medium run, and by 0.82 percent in the long-run.

Finally, in Figure 6 we turn to the fiscal effects of the reform. Without adjustment of labor or capital, the tax reduction program generates a fiscal deficit due to forgone tax revenues. However, the reform-induced increase in employment and hourly wages discussed above raises tax revenues. Figure 6 shows that in the first year the negative fiscal effect dominates and the reform generates a fiscal deficit of 0.39 percent of output. However, the increase in tax revenues generated by the expansion in employment and hourly wages increases over time, and this increase is strong enough so that after 9 years the fiscal budget is balanced and generates surpluses thereafter. In other words, after 9 years the economy is on the upward-sloping part of the Laffer-curve. For any real interest rate less than 9.02 percent, the reform is fiscally efficient in the sense that the present value of fiscal deficits and fiscal surpluses is positive. Put differently, this reform yields an internal rate of return of 9.02 percent for the government.

5. Public Expansion of Full-Day School Programs

5.1 Current Situation

In Germany, only one third of schools offer some version of full-day school program, and two thirds of schools are half-day schools – dismissal of school children is at 1 pm or earlier. If we add other types of after-school programs not offered by the school itself, then at best 40 of the school children in Germany can take advantage of a full-day (i.e. until 4 pm) school program. In contrast, around 80 percent of women with children in Germany would like their children to attend a full-day school (Klemm, 2014). This indicates that there is a large demand for public full-day schools in Germany that is not satisfied. The situation is similar for child care programs for children ages $3-6$: less than 40 percent have access to a full-day program, but a large majority of women with children would like to use a full-day child care

program. See Krebs and Scheffel (2015) for a detailed discussion of the evidence on this issue.

5.2 Reform Description

We consider a publicly financed expansion of full-day schools from the current status quo, in which 40 percent of children have a full-day spot, to a situation in which 80 percent of children have a full-day spot. We also assume that for children ages $3 - 6$ a similar expansion in full-day spots takes place in child care centers. To achieve this goal, about 4 million half-day spots in schools and child care centers have to be transformed into full-day spots (Klemm, 2014). The annual running cost of this expansion program is about 6 Billion Euro per year (0.2 percent of German GDP), where the largest part of this cost is wages for teachers/educators.[10] In addition, there is a one-time (sunk) cost for initial investment in school buildings and other capital goods, which we assume to be 20 Billion Euro (0.66 percent of GDP). See Krebs and Scheffel (2015) for a detailed discussion of the costs of transforming half-day spots into full-day spots. This program will increase (female) labor supply in the sense that unemployed or marginally employed women with children will have a stronger incentive to search for part-time or full-time employment. See our discussion of this effect in Section 2.4.

5.3 Results

The macroeconomic, distributional, and fiscal effects of the public expansion program are shown in Table 3 and Figures 7 to 11. Figure 7 shows that the reform leads to a substantial reduction in the unemployment rate: the unemployment rate falls by 0.11 percentage points in the short-run (in the first year), by 0.33 percent in the medium run (after 5 years), and by 0.38 percent in the long-run (after 10 years). The intuition underlying the decline in the

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[10]We assume that this cost is 0.2 percent of GDP in all future years, which means that we assume that it rises in step with the growth of GDP.

unemployment rate is simple. The expansion of full-day school programs by the government improves the family situation for many unemployed women with children. These women will increase their search effort, which increases job finding rates and reduces unemployment.

Figure 8 shows the time path of employment after the reform. Employment increases by 0.23 percent in the first year, 0.79 percent after 5 years, and 0.95 percent after 10 years. About one half of the increase in employment is caused by the reduction in unemployment pictured in figure 7. The other half is explained by an increase in full-time employment relative to marginal employment (and part-time employment – see Figure 8). There is a simple reason behind the increase in full-time employment relative to marginal employment. For many marginally employed women with children, the reform improves their ability to combine family with work and a significant fraction of these women begin to search for part-time work or full-time work. This, in turn, leads to an increase in the transition rate from marginal employment to part-time and full-time employment, and an increase in the transitions from part-time employment to full-time employment.

We next discuss the wage effect of the reform. As in the case of the tax reduction analyzed in the previous section, there are three forces that act upon hourly pre-tax wages. First, the increase in labor supply tends to reduce wages because the marginal product of labor is diminishing in employment. Second, the reform-induced increase in employment increases the marginal product of capital, which induces firms to increase their labor demand – this force tends to push up wages. In a standard neoclassical model with frictionless labor markets and fixed human capital, the negative wage effect dominates in the short-run and the two effects cancel each other out in the long-run. However, in the current model the labor market has search frictions and the employment adjustment therefore takes time (see Figures 7 and 8). In addition, there is a third effect on wages because workers invest in their human capital (on-the-job training) and the incentive to invest in human capital is stronger for full-time

employed workers than for marginally employed workers – see also our discussion in Section 2.4. Thus, this third effect tends to push up hourly wages since the reform increases the share of full-time employed workers relative to marginally employed workers (see Figure 8).

Figure 9 depicts the development of hourly pre-tax wages after the expansion of public full-day school programs (relative to trend growth). The graph shows that the net effect on wages is positive in the short-run and in the long-run. In other words, the two positive effects on hourly wages discussed in the preceding paragraph dominate the negative effect on wages. Specifically, hourly wages increase by 0.12 percent in the short-run, by 0.38 percent in the medium run, and by 0.40 percent in the long-run. Figure 9 also shows that the reform has desirable distributional consequences in the sense that the rise in wages is concentrated among women with children, whose hourly wage is significantly lower than the average wage of all workers. Specifically, hourly wages for women with children increase by 0.25 in the first year, by 0.59 percent after five years, and by 0.84 percent after 10 years.

Figure 10 shows the time path of output after the reform (relative to trend growth). There are three reasons why the reform considered here will raise output. First, the employment increase discussed above increases output. Second, the physical capital stock increases, which increases labor productivity. Third, the human capital stock increases because marginal employment is replaced by full employment, which increase labor productivity and therefore output. Figure 10 shows that the output effects are substantial: output increases by 0.22 percent in the short-run, by 0.52 percent in the medium run, and by 0.67 percent in the long-run.

Finally, in Figure 11 we turn to the fiscal effects of the expansion of full-day child care and full-day schools. Without adjustment of labor or capital, the reform generates a fiscal deficit due the public expenditure associated with the expansion of full-day programs, which has two components: an annual running cost of 0.2 percent GDP (salaries of teachers/educators)

33

and a one-time (sunk) cost for initial investment in school buildings and other capital goods of 0.66 percent of GDP. However, the reform-induced increase in employment and hourly wages discussed above raises tax revenues. Figure 11 shows fiscal cost and benefits. In the first few years, the negative fiscal effect dominates, but the increase in tax revenues generated by the expansion in employment and hourly wages is strong enough so that after 4 years the fiscal budget is balanced. In other words, after 4 years the economy is on the upward-sloping part of the Laffer-curve. For any real interest rate less than 11.86 percent, the reform is fiscally efficient in the sense that the present value of fiscal deficits and fiscal surpluses is positive. Put differently, this public investment program yields an internal rate of return of 11.86 percent for the government.

6. Deregulation of the Professional Services

6.1 Current Situation

In Germany, the professional services (lawyers, accountants, architects, engineers) produce about 3 percent of GDP. Further, more than 90 of these services are produced for upstream firms, that is, these services are mainly intermediate goods. Until the 1990s the professional services in Germany were heavily regulated, but a number of deregulation reforms led to substantial improvements. However, even though there have been improvements, the current level of regulation in Germany is only in line with the EU average and is still much heavier than the regulation levels in the UK or Netherlands – see Krebs and Scheffel (2015) for a detailed description of the German professional service and a survey of the literature. Further, the average profit margin for the professional services in Germany is 24 percent, which is roughly in line with EU-average, but significantly larger than the profit margin for professional services in Netherlands (8 percent) and also significantly larger than the profit margin in other knowledge-intensive service sectors in Germany (16 percent). Overall,

the available evidence indicates that current profit levels in the professional service sector in Germany still contain a substantial mark-up component (i.e. rent), and that further deregulation of this sector would lead to a reduction in mark-ups and a corresponding increase in production efficiency.

6.2 Reform Description

We consider a de-regulation of the professional services in Germany that reduces the OECD-regulation index from its current value of 2.65 to a value of 1.65, which corresponds to a reform that reduces the distance between regulation in Germany and regulation in the two best-performers UK and Netherlands by half (Krebs and Scheffel, 2015). Based on empirical evidence between the relationship between the OECD regulation index and mark-ups, such an improvement in the regulatory framework is expected to reduce the by 4 percentage points – see Krebs and Scheffel for a detailed discussion. As discussed in Section 2.5, the reduction in mark-ups is formally equivalent to an increase in total factor productivity in the final goods sector, which in turn increases labor demand. We next analyze the economic impact of this deregulation reform.

6.3 Results

The results are shown in Table 4 and Figures 12 to 16. Figure 12 shows that the reform leads to a modest reduction in the unemployment rate: the unemployment rate falls by 0.01 percentage points in the short-run (in the first year), by 0.02 percent in the medium run (after 5 years), and by 0.02 percent in the long-run (after 10 years). The intuition underlying the decline in the unemployment rate is simple. The deregulation of the professional services reduces the input cost for the producers of final goods, which is equivalent to an increase in total factor productivity in the final goods sector – see Section 2.5 for the formal argument. The productivity increase in turn leads to an increase in labor demand and a

corresponding increase in hourly wages (see below), which improves search incentives and reduces unemployment.

Figure 13 shows the time path of employment after the reform. Employment increases by 0.01 percent in the first year, 0.02 percent after 5 years, and 0.02 percent after 10 years. About one half of the increase in employment is caused by the reduction in unemployment pictured in Figure 12. The other half is explained by an increase in full-time employment relative to marginal employment (part-time employment remains roughly constant – see Figure 12). There is a simple reason behind the increase in full-time employment relative to marginal employment. The reform increases hourly wages by a constant amount for all types of employment, which implies that the gain for full-time employed workers is on average four times larger than for marginally employed workers. Thus, the attractiveness of full-time employment relative to marginal employment increases, and this to higher search effort among the marginally employed and a corresponding increase in the transition rate from marginal employment to full-time employment (and part-time employment).

We next turn to a discussion of the wage effect of the reform. As already mentioned, the reform increases total factor productivity and therefore hourly wages. This is a short-run effect. In addition, there are two long-run effects that push up hourly wages. First, the increase in employment shown above increases the marginal product of capital, which induces firms to increase their labor demand. Second, workers invest in their human capital (on-the-job training) and the incentive to invest in human capital is stronger for full-time employed workers than for marginally employed workers – see also our discussion in Section 2.4. Thus, this effect also pushes up hourly wages since the reform increases the share of full-time employed workers relative to marginally employed workers (see Figure 13). Figure 14 depicts the development of hourly wages after the reform (relative to trend growth). Hourly wages increase by 0.13 percent in the short-run, by 0.14 percent in the medium run, and by

0.15 percent in the long-run.

Figure 15 shows the time path of output after the reform (relative to trend output growth). There are four reasons why the reform considered here will raise output. First, the increase in total factor productivity increases output. Second, the employment increase discussed above increases output. Third, the physical capital stock increases, which increases labor productivity. Finally, the human capital stock increases because marginal employment is replaced by full employment, which increase labor productivity and therefore output. Figure 15 shows that the cumulative output effect of the reform is relatively modest, but somewhat larger than the increase in employment: output increases by 0.13 percent in the short-run, by 0.14 percent in the medium run, and by 0.14 percent in the long-run.

Finally, in Figure 16 we turn to the fiscal effects of the reform. The reform increase tax revenues in the short-run and in the long-run. Specifically, the fiscal surplus generated by the reform is 0.00 percent of GDP in the short-run, 0.01 percent in the medium run, and 0.01 percent in the long-run.

7. A Reform Package

In this section, we consider a reform package that combines the tax reduction program with the expansion of full-day school/child care. Table 5 summarizes the results. Though the model underlying our analysis allows for non-linear household behavior and non-linear interaction effects between labor, capital, and goods markets, we find that the macroeconomic effects of the two reforms combined are roughly the sum of the individual effects of the two reforms considered separately. In other words, the combination of individual reforms to reform packages does not generate either significant "crowding out" effects or positive spill-over effects. Specifically, 10 years after the reform package has been implemented, employment has increased by 1.78 percent, average real hourly after-tax wages have risen by 1.01 percent,

and potential output has expanded by 1.46 percent. Further, the reform package generates a balanced budget after 7 years and produces a fiscal surplus of 0.11 percent of GDP after 10 years. For any real interest rate (discount rate) lower than 9.37 percent, the proposed reform package is fiscally efficient in the sense that the present value of fiscal deficits and fiscal surpluses is positive. Thus, from a fiscal point of view the reform package yields an internal rate of return of 9.37 percent. Finally, the reform package has positive distributional consequences in the sense that the low-wage sector and women with children experience the largest gains wages: hourly pre-tax wages increase by 3.08 percent in the low-wage sector and by 2.68 percent for women with children.

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Table 1: Reform of Social Security Taxes for Low-Wage Jobs

	change in average social security tax
full-time employment	-0.92%
part-time employment	-1.73%
marginal employment	$+1.90\%$

Table 2: Social Security Taxe Reform

	after ...		
	...1 year	...5 years	...10 years

CHANGE OF FULL-TIME EQUIVALENT JOBS[1]

full-time employment	0.221	0.723	0.869
part-time employment	0.016	0.077	0.109
marginal employment	−0.031	−0.123	−0.157
net effect	0.206	0.677	0.821

CHANGE OF UNEMPLOYMENT[2]

| unemployment | −0.075 | −0.245 | −0.297 |

CHANGE OF HOURLY PRE-TAX WAGES[1]

| average hourly pre-tax wages | 0.149 | 0.420 | 0.634 |
| hourly pre-tax wages in low-wage sector | 0.401 | 1.134 | 1.712 |

CHANGE OF GDP[3]

| gdp | 0.264 | 0.632 | 0.824 |

CHANGE OF GOVERNMENT OUTLAYS[3]

tax revenues	−0.396	−0.157	−0.001
unemployment benefits	−0.009	−0.020	−0.022
net effect	−0.388	−0.137	0.021

FISCAL EFFICIENCY

internal rate of return: 9.020 percent

[1] in percent

[2] in percentage points

[3] in percent of gdp

Table 3: Public Full-Day School Program

	after ...		
	...1 year	...5 years	...10 years
CHANGE OF FULL-TIME EQUIVALENT JOBS[1]			
full-time employment	0.234	0.793	0.954
part-time employment	−0.024	−0.061	−0.062
marginal employment	−0.012	−0.058	−0.078
net effect	0.198	0.675	0.813
CHANGE OF UNEMPLOYMENT[2]			
unemployment	−0.108	−0.329	−0.381
CHANGE OF HOURLY PRE-TAX WAGES[1]			
average hourly pre-tax wages	0.121	0.280	0.400
hourly pre-tax wages for women with kids	0.253	0.588	0.839
CHANGE OF GDP[3]			
gdp	0.217	0.523	0.673
CHANGE OF GOVERNMENT OUTLAYS[3]			
tax revenues	0.091	0.218	0.271
unemployment benefits	−0.015	−0.031	−0.033
cost	−0.660	−0.200	−0.200
net effect	−0.554	0.049	0.104
FISCAL EFFICIENCY			
internal rate of return: 11.858 percent			

[1] in percent

[2] in percentage points

[3] in percent of gdp

Table 4: Deregulation of Professional Services

	after ...		
	...1 year	...5 years	...10 years
CHANGE OF FULL-TIME EQUIVALENT JOBS[1]			
full-time employment	0.005	0.019	0.023
part-time employment	0.000	0.001	0.001
marginal employment	0.000	0.000	−0.000
net effect	0.006	0.020	0.024
CHANGE OF UNEMPLOYMENT[2]			
unemployment	−0.007	−0.020	−0.023
CHANGE OF HOURLY PRE-TAX WAGES[1]			
average hourly pre-tax wages	0.129	0.140	0.145
CHANGE OF GDP[3]			
gdp	0.127	0.137	0.142
CHANGE OF GOVERNMENT OUTLAYS[3]			
tax revenues	0.003	0.007	0.009
unemployment benefits	−0.001	−0.002	−0.002
net effect	0.004	0.009	0.011
FISCAL EFFICIENCY			
internal rate of return: N/A			

[1] in percent

[2] in percentage points

[3] in percent of gdp

Table 5: Reform Package (Social Security Tax and Public Full-Day School Program)

	after ...		
	... 1 year	... 5 years	... 10 years
CHANGE OF FULL-TIME EQUIVALENT JOBS[1]			
full-time employment	0.457	1.499	1.786
part-time employment	−0.008	0.012	0.036
marginal employment	−0.044	−0.181	−0.231
net effect	0.404	1.330	1.591
CHANGE OF UNEMPLOYMENT[2]			
unemployment	−0.182	−0.556	−0.647
CHANGE OF HOURLY PRE-TAX WAGES[1]			
average hourly pre-tax wages	0.268	0.685	1.005
hourly pre-tax wages in low-wage sector	0.821	2.100	3.082
hourly pre-tax wages for women with kids	0.713	1.825	2.679
CHANGE OF GDP[3]			
gdp	0.479	1.133	1.455
CHANGE OF GOVERNMENT OUTLAYS[3]			
tax revenues	−0.308	0.050	0.253
unemployment benefits	−0.024	−0.049	−0.052
cost	−0.660	−0.200	−0.200
net effect	−0.485	−0.101	0.105
FISCAL EFFICIENCY			
internal rate of return: 9.369 percent			

[1] in percent

[2] in percentage points

[3] in percent of gdp

Figure 1: Social Security Tax Reform
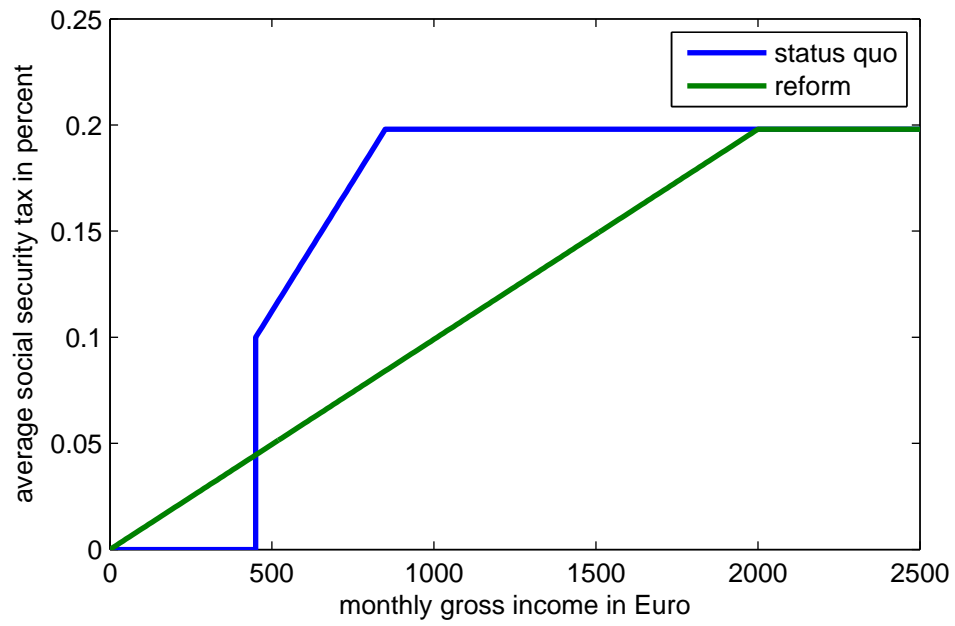
Figure 2: Unemployment Rate (Social Security Tax Reform)
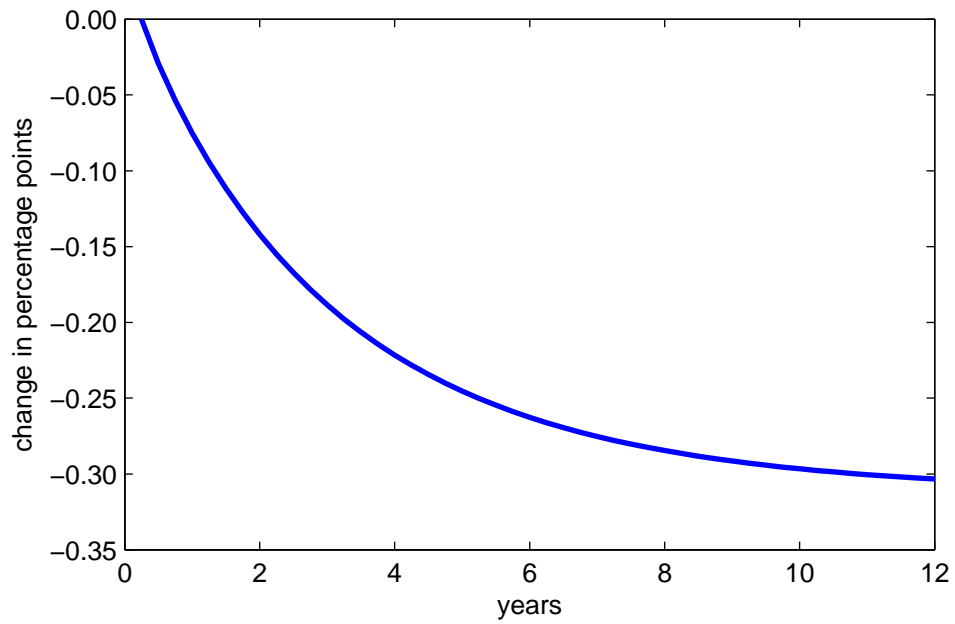
Figure 3: Employment: Full-Time Equivalent Jobs (Social Security Tax Reform)
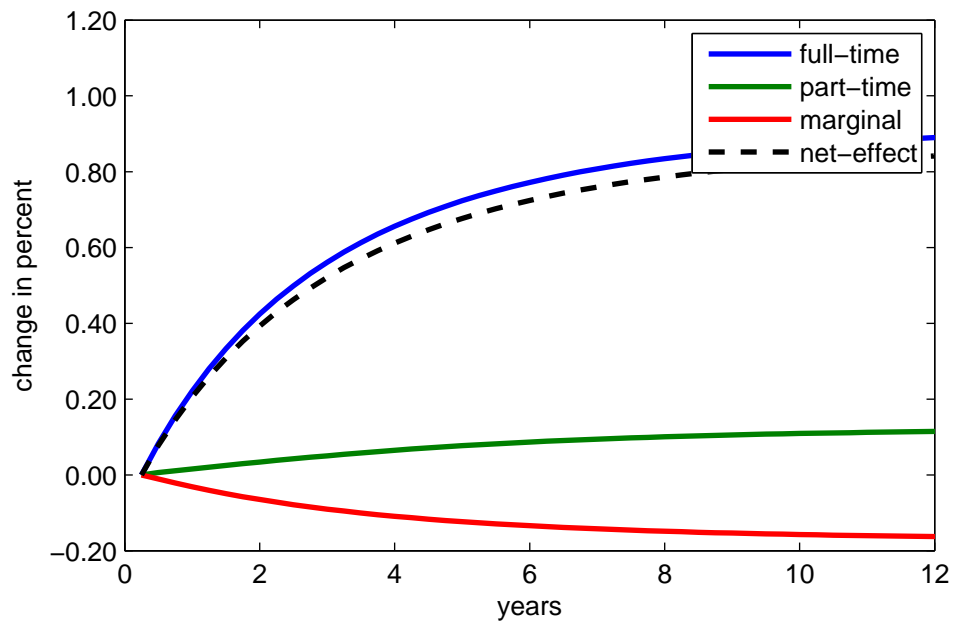
Figure 4: Hourly Pre-Tax Wage (Social Security Tax Reform)
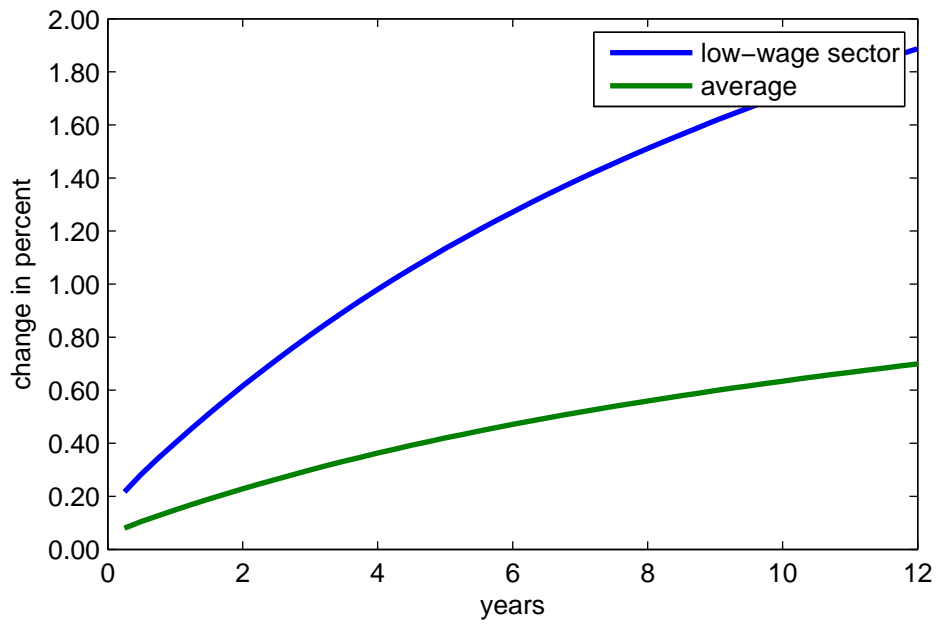
Figure 5: Output (Social Security Tax Reform)
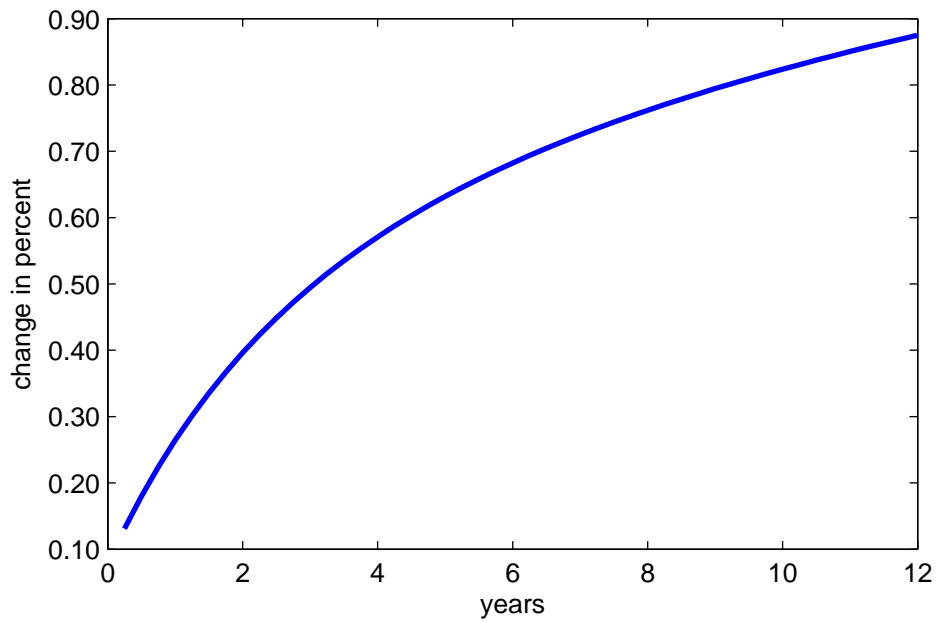
Figure 6: Fiscal Effects (Social Security Tax Reform)
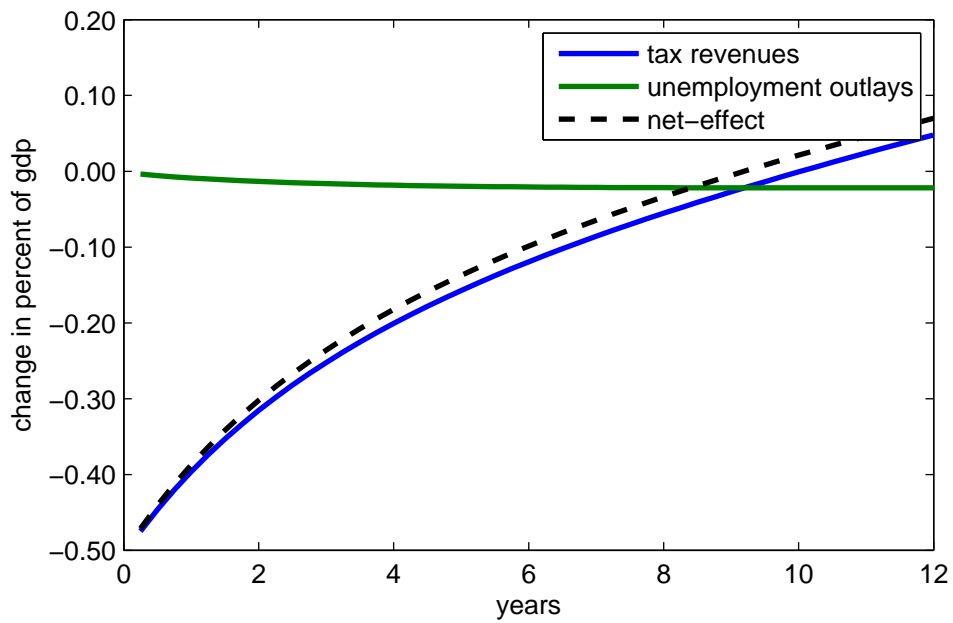
Figure 7: Unemployment Rate (Public Full-Day School Program)
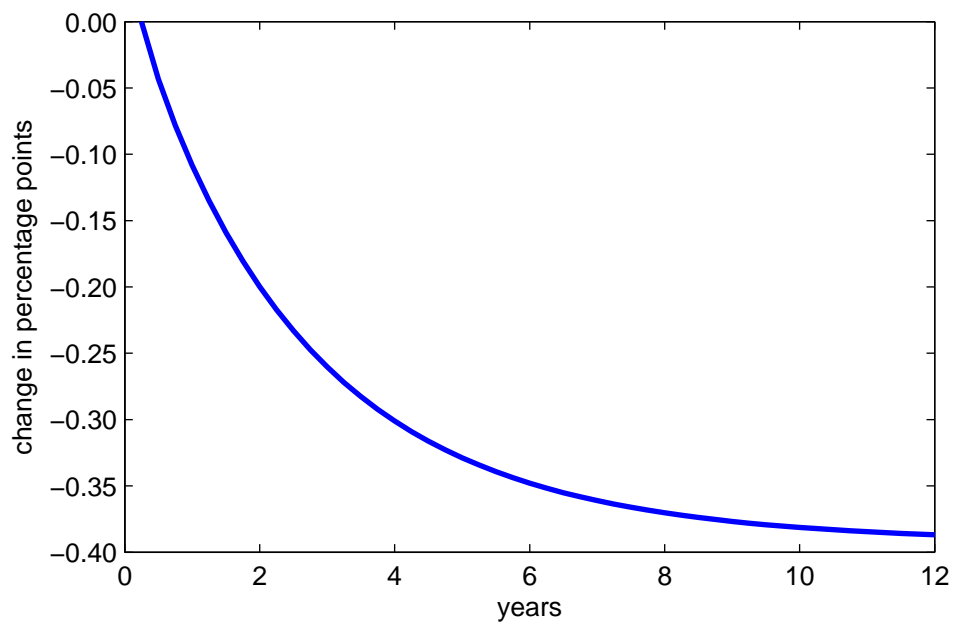
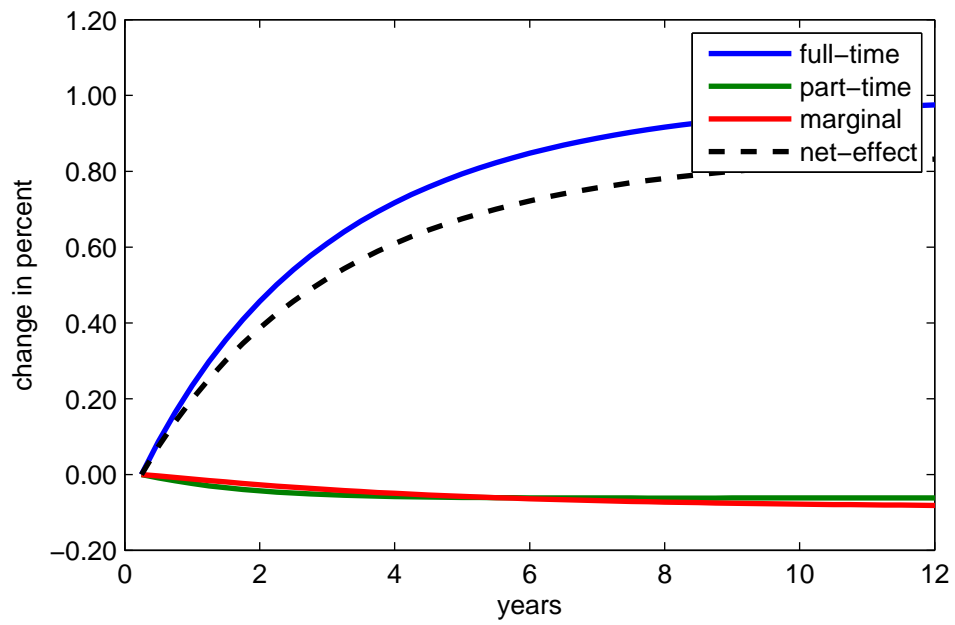Figure 8: Employment: Full-Time Equivalent Jobs (Public Full-Day School Program)

Figure 9: Hourly Pre-Tax Wage (Public Full-Day School Program)
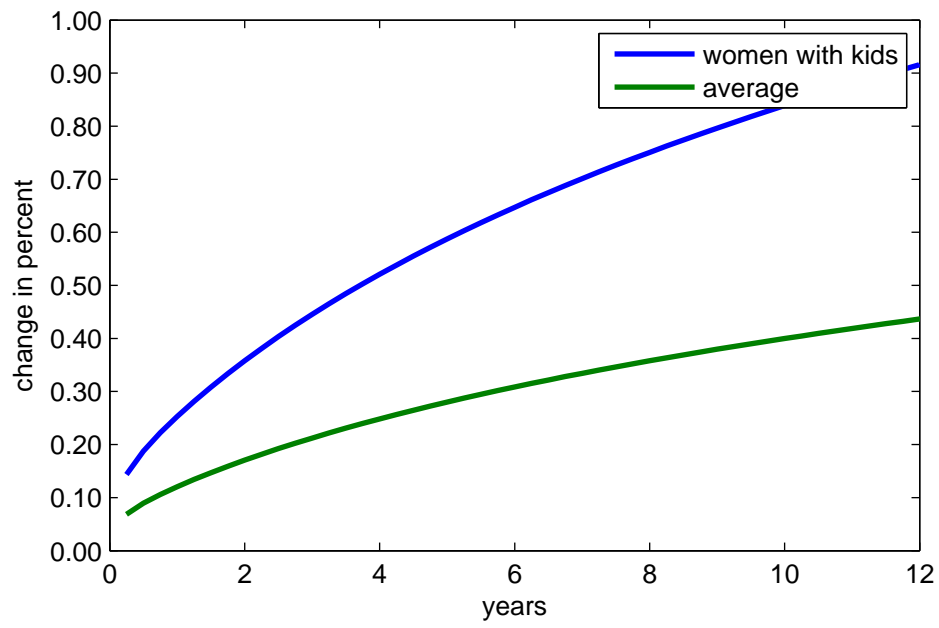
Figure 10: Output (Public Full-Day School Program)
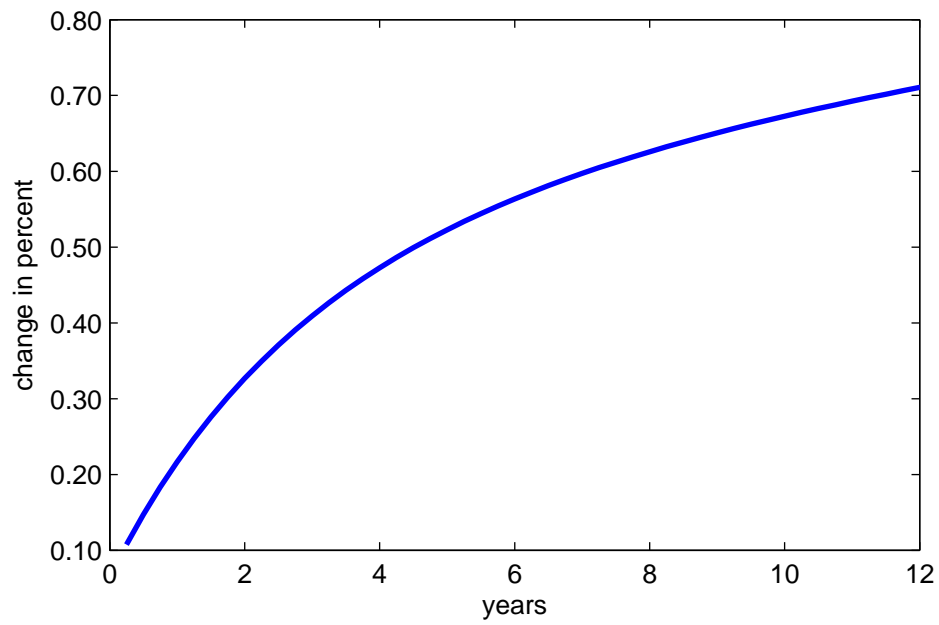
Figure 11: Fiscal Effects (Public Full-Day School Program)
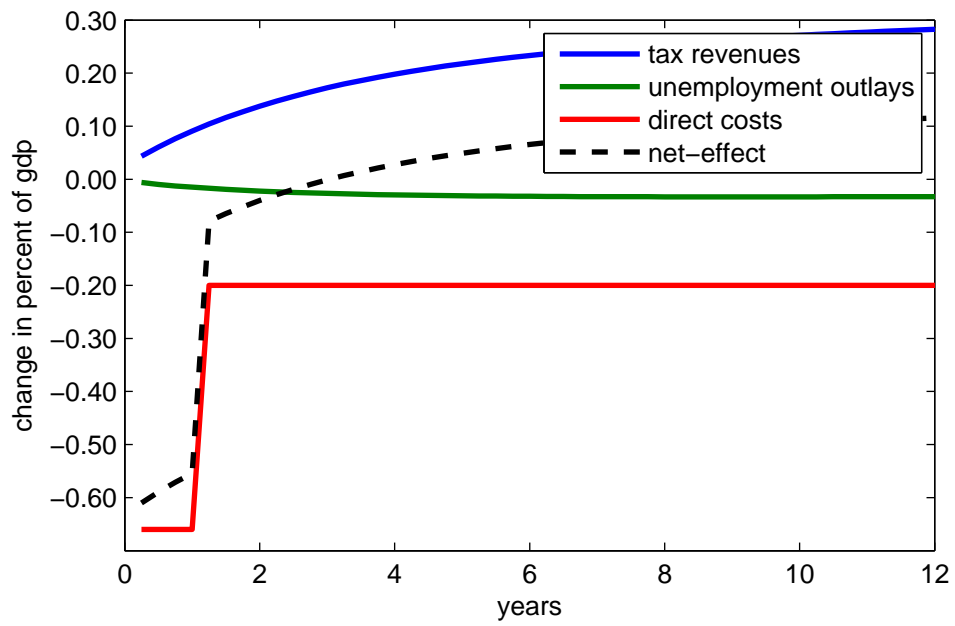
Figure 12: Unemployment Rate (Deregulation of Professional Services)
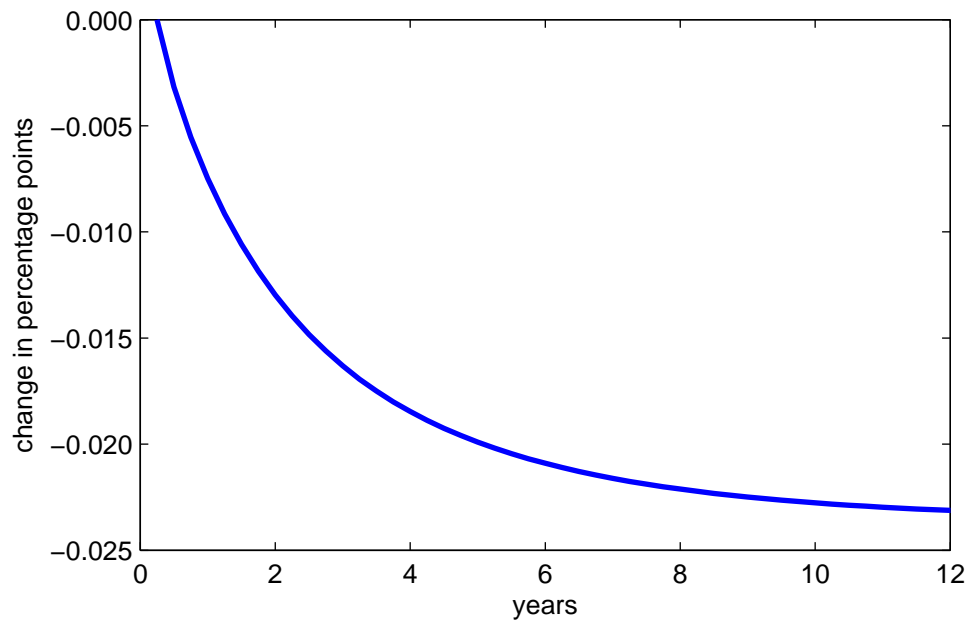
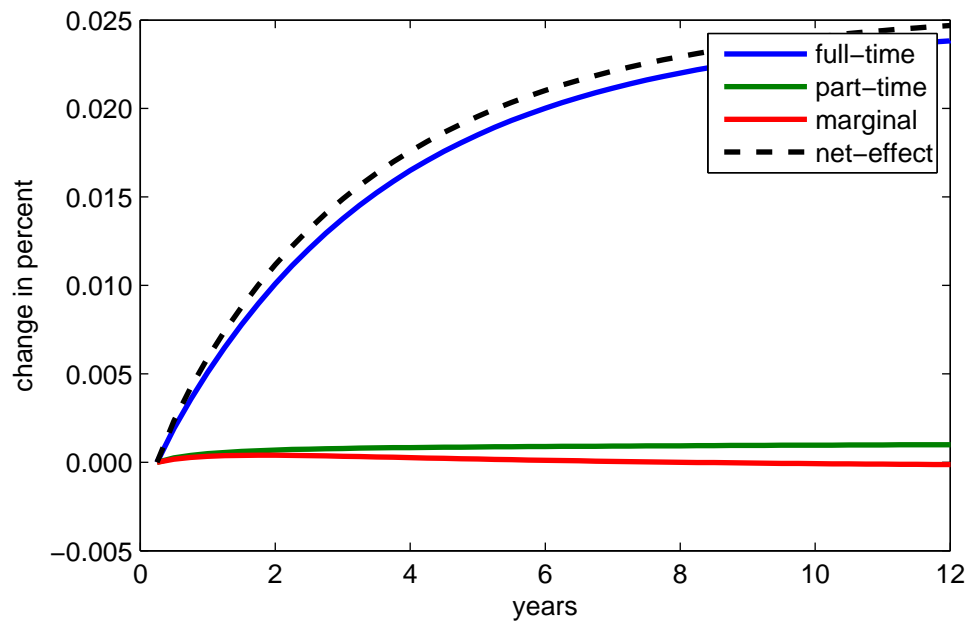Figure 13: Employment: Full-Time Equivalent Jobs (Deregulation of Professional Services)

Figure 14: Hourly Pre-Tax Wage (Deregulation of Professional Services)
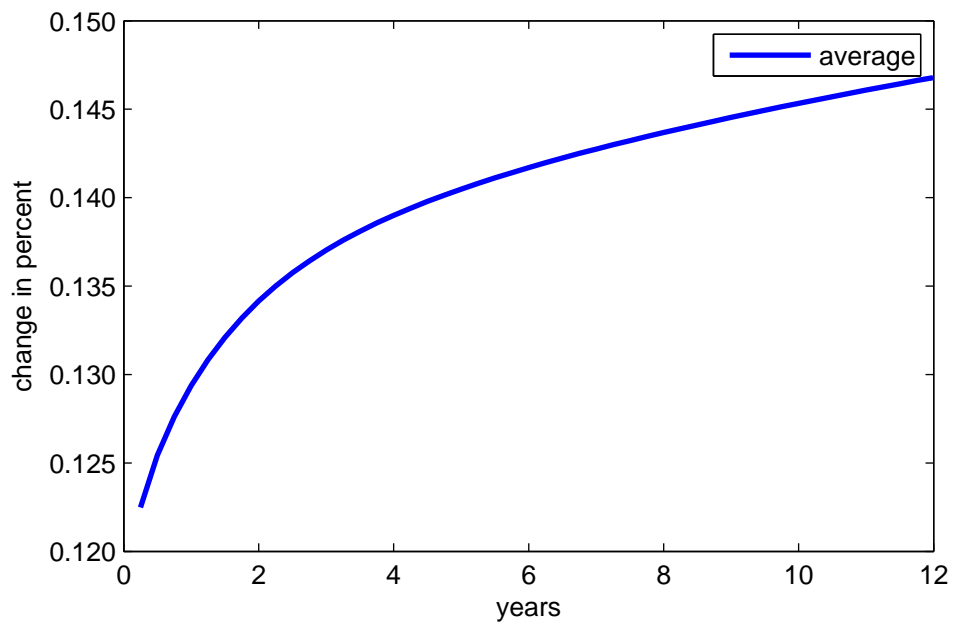
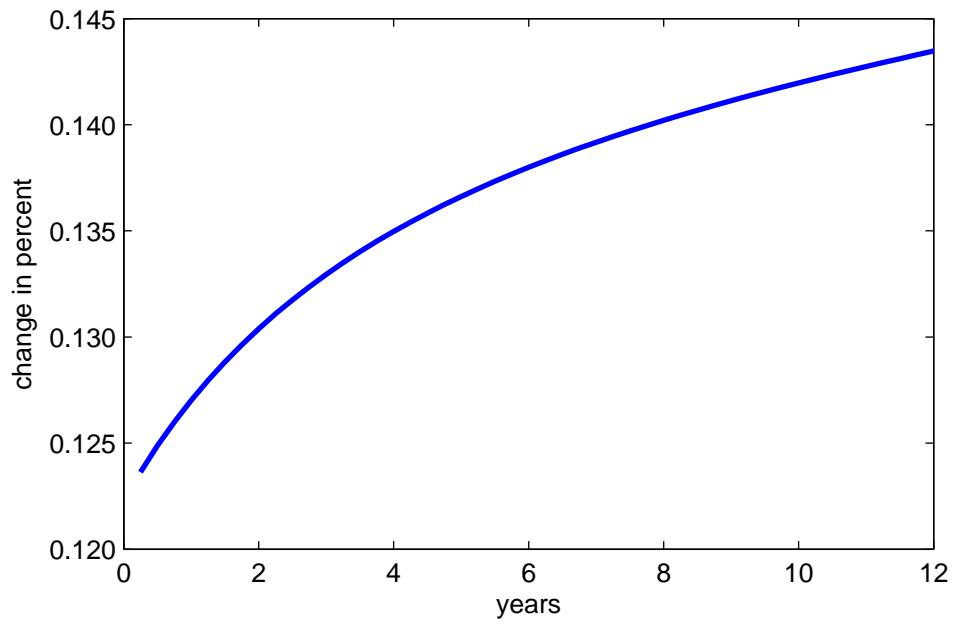Figure 15: Output (Deregulation of Professional Services)

Figure 16: Fiscal Effects (Deregulation of Professional Services)