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Abstract

In this paper we examine the importance of imperfect competition in product and labour markets in determining the long-run welfare effects of tax reforms assuming agent heterogeneity in capital holdings. Each of these market failures, independently, results in welfare losses for at least a segment of the population, after a capital tax cut and a concurrent labour tax increase. However, when combined in a realistic calibration to the UK economy, they imply that a capital tax cut will be Pareto improving in the long run. Consistent with the theory of second-best, the two distortions in this context work to correct the negative distributional effects of a capital tax cut that each one, on its own, creates.

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1 Introduction

The seminal research of Judd (1985) and Chamley (1986) established that the optimal tax policy under commitment is to set a zero tax rate on capital in the long-run, while, concurrently, increasing labour taxes to the level required to finance public spending.[1] A striking implication of this result is that despite the higher tax burden for those agents not holding capital, optimal tax policy is Pareto improving in the long-run. The intuition is that the gains from increased labour productivity, induced by higher capital accumulation, compensate for the costs of higher labour taxes and hence labour income is increased.[2]

Another strand in the literature has focused on the distributional effects of tax reforms in models where the optimal long-run zero capital tax may or may not obtain (see e.g. Garcia-Milà *et al.* (2010) for a review of this literature). For instance, Domeij and Heathcote (2004) show that there can be distributional effects from cutting capital taxes in the presence of uninsured idiosyncratic productivity shocks. Garcia-Milà *et al.* (2010) find that there will be lifetime welfare losses for labour from a tax reform that implements the zero capital tax. This is because the benefits to labour, through the high capital and productivity channel, occur in the long-run, whereas the costs, in the form of higher labour taxes, have an immediate effect. Also Angelopoulos *et al.* (2011b) show that if capital complements skilled labour more than unskilled, capital tax cuts can be skill-biased and thus hurt unskilled labour.

With a view to contributing to the tax policy literature focussed on distributional issues, we study the importance of unionised labour markets and monopolistically competitive product markets in determining the long-run effects of tax reforms that re-allocate the tax burden from capital to labour. In this set up the government taxes capital income, including interest on savings and profits, and labour income by using two different tax rates. In the unionised labour market, the wage rate is determined, following e.g. Nickell and Andrews (1983), Farber (1986), Pissarides (1998) and Kass and von Thadden (2004), as the outcome of a Nash-bargain between unions and

[1] A significant body of literature has examined the conditions under which an optimal non-zero capital tax might be obtained in the long-run. For example Guo and Lansing (1999) and Domeij (2005) introduce product and labour market power respectively into representative agent models assuming governments have access to a commitment technology. Also see Klein *et al.* (2008) who, in contrast, use a representative agent framework without market frictions assuming time-consistent Markov policies.

[2] Note that a non-zero optimal capital tax can be obtained in models with heterogeneous agents, under skill differences (see e.g. Conesa *et al.* (2009)) or lack of commitment mechanisms on the part of the government (see e.g. Krusell (2002) and Angelopoulos *et al.* (2011a)).

firms. Also, given the importance of the unemployment benefit as the outside option in the Nash-bargaining process, we include it as a component of government spending along with non-employment related public transfers. In the monopolistically competitive product market, following e.g. Dixit and Stiglitz (1977), Benhabib and Farmer (1994) and Guo and Lansing (1999), intermediate goods producers earn non-zero economic profits. To highlight the importance of union bargaining and firm power in the product market relative to the competitive model of Judd (1985) we assume a standard neoclassical production technology without skill heterogeneity. Therefore, agents are distinguished in this setup by differences in their capital holdings.

To understand the quantitative implications of distortions in the labour and product markets when assessing the welfare effects of tax reforms, we calibrate the model so that its steady-state reproduces the main features of the current UK economy and, in particular, its tax structure and long-run unemployment rate. The UK is used to illustrate the quantitative analysis since unions play an important role in wage-bargaining at the firm-level compared to other EU economies[3] and because its tax structure stands in stark contrast with other European countries, by having a very high capital to labour income tax ratio.[4]

Since the effects of tax reforms that reduce the capital tax are monotonic in our setup, we focus on implementing a reform that is consistent with the "zero capital tax" prescription from the optimal taxation literature.[5] Tax reforms have recently received a great deal of attention by both academics and policymakers (see e.g. the discussion in Garcia-Milà et. al. (2010) for OECD countries and the Mirrlees Review, Mirrlees et. al. (2010, 2011) for the UK). However, to the best of our knowledge, the potential distributional effects of such reforms have not been examined under imperfect competition in both product and labour markets. Given the relevance of these market failures, which the fiscal authorities must largely take as given institutional features when designing tax reforms, our analysis aims to inform current policy discussions in the UK and other advanced economies.

[3]For example, see the OECD Employment Outlook 2004 which distinguishes levels of bargaining in terms of where labour contracts are negotiated for the period 1970-2000. The data show that wage bargaining in the UK mainly occurs at the firm-level since 1980. The evidence also suggests that there is little or no coordination by upper-level associations. In contrast, in many other European countries, e.g. Belgium, Germany and Spain, bargaining takes place at the industry-level.

[4]See e.g. Martinez-Mongay (2000) for effective tax rates in European countries. More details on tax and other data used for the calibration are provided later in section 3.

[5]See, however, Atkinson and Stiglitz (1980) for a discussion of Ramsey taxation in models with distortions and Hagedorn (2010) on how labour market distortions can result in non-convexities in the Ramsey problem.

Our over-arching finding is that the presence of labour and product market distortions is critical in determining not only the size but also the direction of welfare effects after the capital tax cut and, in particular, whether a capital tax cut can be Pareto improving. Previous research suggests that, on their own, each of these failures should result in welfare losses for at least a segment of the population, after a capital tax cut and a concurrent labour tax increase. For instance, Ardagna (2007) employs a model with monopoly union power and documents negative welfare effects for workers after increases in labour taxes, while Guo and Lansing (1999) show that the optimal capital tax in a model with monopolistic competition in the product market can be non-zero. While these implications are confirmed in our model, we also find that when both failures characterise the economy, one distortion effectively corrects the other in a way that a capital tax cut can be Pareto improving.

Our specific results can be summarised as follows. First, in the model with only the labour market distortion, a tax reform that implements a zero capital tax will imply welfare losses for the workers in the long-run, whereas capitalist's and aggregate welfare increase. As in the model with perfectly competitive labour and product markets, when the capital tax is set to zero, the labour tax will have to increase to make up for the loss in tax revenue. However, given the non-competitive labour market, this increase in labour taxes will lead to a rise in unemployment, because it lowers the returns to work and thus makes the outside option, in the form of unemployment benefits, more attractive to the union. The unemployment channel is the critical link that modifies the results from the benchmark model with competitive labour markets.[6] In particular, although labour productivity and the wage rate increase in the long-run, thanks to the higher capital accumulation, the workers cannot capture the full benefit of this as unemployment has also increased and the return to unemployment, i.e. the unemployment benefit, is less than the wage rate.

Second, under competitive labour markets but non-competitive product markets, there are welfare gains for the capitalists, losses for the workers, and also losses at the aggregate level, by a reform that implements a zero tax on capital income. This happens because, in this case, the government foregoes revenue from a non-distortionary tax base comprised of "pure profits" so that the required increase in the labour tax is larger and thus the after-tax wage decreases after the tax reform.

[6] We confirm the quantitative importance of the unemployment channel by contrasting the above results to those obtained by performing the same experiment in the model with perfectly competitive labour markets, also calibrated to the same tax structure for the UK economy. In this case there are welfare gains for all agents.

Finally, monopolistic competition in the product market under unionised labour markets, introduces a market failure that works to correct the negative implications of imperfect labour markets. In particular, monopolistic competition tends to reduce the positive revenue effects of the increase in output after a capital tax cut and thus reduces the benefits to the firm for a successful outcome of wage bargaining. In turn, this implies that the relative attractiveness of the firm's outside option in bargaining and its power relative to the union increases. This tends to increase employment and the benefits to all agents after a tax cut.

The rest of the paper is organised as follows. Section 2 sets out the model structure and Section 3 discusses the calibration of the model to the current UK economy. The results are analysed in Section 4 and Section 5 concludes.

2 The model

We next describe a model economy that allows for imperfect competition in both labour and product markets. The economy consists of infinitely lived households, firms, trade unions, and a government. Households are comprised of capitalists and workers. Capitalists can work and save in the form of capital, own firms and receive profits. Workers, in contrast, do not save and thus consume all their disposable income in each period. Both capitalists and workers can spend part of their time endowment either employed or unemployed and receive unemployment benefits from the government when not working. All households are represented by firm-level trade unions which determine work hours and bargain with firms over the wage rate with the aim of maximising the average labour income of their members. Firms include final and intermediate goods producers. Final goods producers are competitive, but intermediate goods producers have monopoly power in the product market and seek to maximise profits employing workers from the unionised labour market and capital from the perfectly competitive asset market. Finally, exogenous public policy consists of the government taxing interest income from capital, profits and labour income to finance unemployment benefits and other non-employment related public transfers.

The timing of events in this setup is as follows. Given fiscal policy, unions and intermediate goods producers bargain over the wage rate, subject to the demand functions for labour and intermediate goods, by taking capital accumulation as given. Next, each intermediate goods producer, taking factor prices, final output and government policy as given, chooses factor quantities to maximise profits, subject to the demand function by the final goods producer for its output. Finally, final goods producers generate output and

households make their savings decisions, taking all prices and policy variables as given.

2.1 Population composition

Total population, N, is exogenous and constant over time with capitalists and workers respectively being denoted as N^k and N^w. We also define the population share of capitalists as: $N^k/N \equiv n^k$, and the workers share as $N^w/N \equiv n^w = 1 - n^k$. Finally we assume that each capitalist owns one intermediate goods-producing firm, hence the number of firms, $N^f = N^k$.

2.2 Households

Each household $i = k, w$, maximises the discounted sum of lifetime utility:

$$\sum_{t=0}^{\infty} \beta^t \frac{(C_t^i)^{1-\sigma}}{1-\sigma} \tag{1}$$

where C_t^i is household i's private consumption; $0 < \beta < 1$ is the constant rate of time preference; and $\sigma > 1$ is the coefficient of relative risk aversion.

The budget constraint of each capitalist at t is given by:

$$\begin{aligned} C_t^k + I_t^k &= r_t K_t^k - \tau_t^k \left(r_t - \delta\right) K_t^k + (1 - \tau_t^k)\pi_t^k + \\ &\quad + \left(1 - \tau_t^w\right) w_t e_t + \overline{G}_t^u \left(1 - e_t\right) + \overline{G}_t^t \end{aligned} \tag{2}$$

where I_t^k is investment; K_t^k is the capital stock held at the beginning of time t; r_t is the gross return to capital; π_t^k is profits; $e_t = 1 - u_t$ is the per capita employment rate with u_t denoting the per capita unemployment rate; w_t is the gross wage rate; $\overline{G}_t^u$ is per capita unemployment benefits; $\overline{G}_t^t$ is per capita government transfers; $0 \leq \tau_t^w < 1$ is the tax rate on labour income; $0 \leq \tau_t^k < 1$ is the tax rate on capital income; and $0 < \delta < 1$ is the constant depreciation rate of capital stock.[7]

The capital stock evolves according to:

$$K_{t+1}^k = \left(1 - \delta\right) K_t^k + I_t^k \tag{3}$$

[7]Note that we assume capital taxes net of depreciation as in e.g. Lansing (1998). Also, we assume, as in e.g. Guo and Lansing (1999), that the fiscal authority cannot impose a separate tax rate on profits and on interest income from savings, since it is difficult, in practice, to distinguish these two sources of capital income. If a separate profit tax was available, welfare could be improved by using this tax instrument, relative to the others, given that taxing profits does not distort incentives.

and each worker's within period budget constraint is:

$$C_t^w = (1 - \tau_t^w)\, w_t e_t + \overline{G}_t^u\, (1 - e_t) + \overline{G}_t^t. \tag{4}$$

Each household is randomly allocated to a union which bargains with a firm to determine employment, e_t, and the wage rate, w_t. Given that we will work with a symmetric equilibrium, employment and the wage rate will be the same for all households, so that the allocation of households to unions does not matter. In other words, we do not examine hetererogeneity in the labour market. Instead, all heterogeneity in our model is driven by differences in asset ownership.[8]

Therefore, the capitalist's problem is to choose $\left\{C_t^k, K_{t+1}^k\right\}_{t=0}^{\infty}$ to maximize (1) subject to (2) and (3) taking market prices $\{r_t, w_t\}_{t=0}^{\infty}$, the employment rate $\{e_t\}_{t=0}^{\infty}$, policy variables $\left\{\tau_t^k, \tau_t^w, \overline{G}_t^u, \overline{G}_t^t\right\}_{t=0}^{\infty}$, and K_0^k as given. The work hours for capitalists and the wage rate are determined by the bargain between the union and firm. Since the worker does not save and given that his work hours also depend on the outcome of the Nash bargain, optimal consumption simply follows residually from his budget constraint in (4).

2.3 Firms

We follow e.g. Guo and Lansing (1999) in allowing for monopolistic power in the intermediate goods market. A unique final good Y_t is produced according to the following constant returns to scale technology:

$$Y_t = \left[\sum_{f=1}^{N^f} \lambda^f \left(Y_t^f\right)^{\theta}\right]^{1/\theta} \tag{5}$$

where $\sum_{f=1}^{N^f} \lambda^f = 1$ are weights attached to intermediate goods producers; and $0 < \theta \leq 1$ implies the degree of monopoly power of intermediate goods producers. Final goods producers behave competitively and choose intermediate inputs, Y_t^f , to maximize profits, Π_t, taking the price of these inputs, P_t^f, as given:

$$\Pi_t = Y_t - \sum_{f=1}^{N^f} \lambda^f P_t^f Y_t^f. \tag{6}$$

[8] To simplify notation, we do not use household subscripts for e_t and w_t, since these quantities will be the same for capitalists and workers in equilibrium. Thus, e_t and w_t, like $\overline{G}_t^u$ and $\overline{G}_t^t$, denote average, or per capita outcomes.

Each intermediate firm produces its output, Y_t^f, with a constant-returns-to-scale technology in two productive inputs: capital, K_t^f, and workers, L_t^f:

$$Y_t^f = A\left(K_t^f\right)^{\alpha}\left(L_t^f\right)^{1-\alpha} \tag{7}$$

where A is neutral technical progress and $0 < \alpha < 1$ denotes capital's share of output. Hence, the profits earned by the intermediate goods producer at time t are:

$$\pi_t^f = P_t^f Y_t^f - r_t K_t^f - w_t^f L_t^f. \tag{8}$$

Taking factor prices, r_t and w_t^f, and final output, Y_t, as given, the intermediate firm chooses K_t^f and L_t^f to maximize profits (8) subject to its production function (7) and the demand function for its output, $P_t^f = \left(Y_t/Y_t^f\right)^{1-\theta}$, given by the optimality condition of the final goods producer, $\partial\Pi_t/\partial Y_t^f = 0$. When $\theta = 1$, intermediate goods are perfect substitutes in the production of the final good implying that intermediate goods producers have no power in the product market. In this case, prices are given for these producers and thus there is perfect competition. However, when $\theta < 1$, the demand function is downward slopping and they can exploit their monopoly power to maximise non-zero profits.

2.4 Unions

Following the literature cited in the introduction, we employ the right-to-manage setup where unions and firms (intermediate goods producer) bargain over the wage rate. For simplicity, we assume that each union bargains with one firm to determine the wage rate (see e.g. Pissarides (1998)). Given that we will work with a symmetric equilibrium, this assumption is not important. Moreover, for tractability, and following e.g. Domeij (2005) and Koskela and von Thadden (2008), we make two simplifying assumptions regarding this bargaining process.[9] First, we assume that unions are small enough so that they do not internalise the effects of the wage rate on capital accumulation and thus on future prices. Second, we assume that firms are also small enough so that they do not internalise the effects of the outcome of wage bargaining on capital accumulation.

The above assumptions imply that unions and firms take capital as given when bargaining over the wage rate. This form of myopia allows for a technical simplification in that it effectively reduces the wage-bargaining problem

[9] See e.g. Domeij (2005), Koskela and von Thadden (2008) and the references therein for the empirical relevance of these assumptions.

to a series of static problems, as in e.g. Pissarides (1998). The union and the intermediate goods producer bargain over the wage rate to maximise a weighted average of labour income and profits:

$$U_t^N = \left[\left(1-\tau_t^w\right) w_t n^k L_t^f + \overline{G}_t^u \left(1 - n^k L_t^f\right) - \overline{G}_t^u\right]^{\phi} \left[\pi_t^f + r_t K_t^f\right]^{1-\phi} \tag{9}$$

subject to the labour demand function given by the firm's first-order condition for labour, $\partial \pi_t^f / \partial L_t^f = 0$, and the firm's product demand function, $P_t^f = \left(Y_t / Y_t^f\right)^{1-\theta}$, taking the capital stock, K_t^f, final output, Y_t, and the fiscal policy variables, $\left\{\tau_t^k, \tau_t^w, \overline{G}_t^u, \overline{G}_t^t\right\}$, as given.

In the above setup, $n^k L_t^f \equiv e_t$ is the average employment rate, so that $\left(1 - n^k L_t^f\right)$ is the unemployment rate and $0 \leq \phi \leq 1$ describes the relative bargaining power of the union with $\phi = 1$ representing the monopoly union case. Note that the union targets average labour income, $\left(1-\tau_t^w\right) w_t n^k L_t^f + + \overline{G}_t^u \left(1 - n^k L_t^f\right)$, while the firm targets average profits, π_t^f. The outside option for the union is the unemployment benefit, $\overline{G}_t^u$, while for the firm it is the sunk cost of capital, $-r_t K_t^f$, which is a consequence of the assumption that the representative firm takes the average capital accumulation as given. It is important to note that while the agents involved in Nash-bargaining over the wage rate do not internalise the effects of the wage rate on capital accumulation, consistent with e.g. Domeij (2005) and Koskela and von Thadden (2008), they do internalise the effects of the wage rate on profits, via the monopolistic demand schedule.

2.5 Government and market clearing conditions

The per-capita government budget constraint equating public spending and revenues is given by:

$$\overline{G}_t^t + \overline{G}_t^u \left(1 - e_t\right) = n^k \tau_t^k \left(r_t - \delta\right) K_t^k + n^k \tau_t^k \pi_t^k + \tau_t^w w_t e_t. \tag{10}$$

To ensure that the government budget is balanced at each time t, we allow the wage income tax τ_t^w to be residually determined. In what follows, we will assume that the government spending instruments are fixed to their steady-state values $\overline{G}^t$ and $\overline{G}^u$, respectively, so that any changes in the capital tax rate, τ_t^k, will be met by changes in τ_t^w, ensuring that the budget constraint of the government is satisfied.

The capital market clears when the supply is equal to the demand for capital per capita:

$$K_t^k = K_t^f. \tag{11}$$

The market clearing condition for per capita dividends is:

$$\pi_t^k = \pi_t^f. \tag{12}$$

In the labour market the equality of per capita labour supply and demand is given by:

$$e_t = n^k L_t^f. \tag{13}$$

Finally, in the goods market, the economy's per capita resource constraint is:

$$n^k Y_t^f = n^k C_t^k + n^w C_t^w + n^k \left[K_{t+1}^k - (1-\delta) K_t^k\right]. \tag{14}$$

2.6 Decentralized equilibrium

We summarize the decentralized equilibrium conditions in real terms and as a symmetric equilibrium implying that $Y_t^f = Y_t$, $w_t^f = w_t$ and $P_t^f = 1$ for all f. Given the paths of prices $\{w_t, r_t\}_{t=0}^{\infty}$ the policy instruments $\left\{\tau_t^k, \overline{G}_t^u, \overline{G}_t^t\right\}_{t=0}^{\infty}$ and an initial condition for K_0^k, a decentralized equilibrium (DE) is defined to be an allocation $\left\{C_t^k, K_{t+1}^k, C_t^w, e_t\right\}_{t=0}^{\infty}$ and one residually determined policy instrument, τ_t^w, such that (i) households, firms and unions undertake their respective optimization problems outlined above; (ii) all budget constraints are satisfied; and (iii) all markets clear.

To summarize, the DE consists of the capitalist's optimality conditions for C_t^k and K_{t+1}^k; the firm's first-order conditions for K_t^f and L_t^f; the budget constraints of workers and government, i.e. BC^w and BC^g; the aggregate resource constraint, RC; the market clearing conditions in the capital, dividend and labour markets, i.e. MC_K, MC_π and MC_L; the union's optimality condition for the wage rate, w_t, and constraint for the employment rate, e_t:[10]

$$\begin{aligned}
C_t^k: &\quad \lambda_t^k = -\tfrac{1}{C_t^k} \\
K_{t+1}^k: &\quad \lambda_t^k = \beta\lambda_{t+1}^k \left[r_{t+1} - \delta + \tau_{t+1}^k (\delta - r_{t+1}) + 1\right] \\
K_t^f: &\quad r_t = \theta\alpha \tfrac{Y_t^f}{K_t^f} \\
L_t^f: &\quad w_t = \theta (1-\alpha) \tfrac{Y_t^f}{L_t^f} \\
BC^w: &\quad C_t^w = (1-\tau_t^w) w_t e_t + \overline{G}_t^u (1-e_t) + \overline{G}_t^t \\
BC^g: &\quad \overline{G}_t^t + \overline{G}_t^u (1-e_t) = n^k \tau_t^k (r_t - \delta) K_t^k + n^k \tau_t^k \pi_t^k + \tau_t^w w_t e_t \\
\\
RC: &\quad n^k Y_t^f = n^k C_t^k + n^w C_t^w + n^k \left[K_{t+1}^k - (1-\delta) K_t^k\right]
\end{aligned} \tag{15}$$

[10] Note that relying on Walras's law, we drop the budget constraint of the capitalist from the DE.

$$
\begin{aligned}
MC_K: &\quad K_t^k = K_t^f \\
MC_\pi: &\quad \pi_t^k = \pi_t^f \\
MC_L: &\quad e_t = n^k L_t^f \\
w_t: &\quad \lambda_t^u = \frac{e_t(\phi-1)[-e_t\Omega_t]^\phi}{n^k\left[\left(n^k\right)^{1-\theta} Y_t^f - w_t L_t^f\right]^\phi} - e_t\phi[\Psi\left(\tau_t^w - 1\right)[-e_t\Omega_t]^{(\phi-1)} \\
e_t: &\quad \lambda_t^u \left[\frac{\alpha(\alpha-1)A\left(K_t^k\right)^\alpha}{n^k\left(L_t^f\right)^{\alpha+1}}\right] + \frac{(2\alpha-2)(\alpha-1)(\theta-1)A\left(K_t^k\right)^\alpha\left(L_t^f\right)^{-\alpha-1}}{n^k} = \\
&= \frac{(\alpha-2)(\alpha-1)(\theta-1)A\left(K_t^k\right)^\alpha\left(L_t^f\right)^{-\alpha-1}}{n^k} + \phi\Psi^{(1-\phi)}\Omega_t\left[-e_t\Omega_t\right]^{(\phi-1)} - \\
&- (\phi-1)\left[\frac{w_t}{n^k} + \frac{(\alpha-1)\left(n^k\right)^{-\theta}A\left(K_t^k\right)^\alpha}{\left(L_t^f\right)^\alpha} + \frac{(\alpha-1)(\theta-1)A\left(K_t^k\right)^\alpha\left(L_t^f\right)^{-\alpha}}{\left(n^k\right)^\theta}\right]\frac{[-e_t\Omega_t]^\phi}{\Psi^\phi}
\end{aligned}
$$

where λ_t^k and λ_t^u refer to the Lagrangian multipliers from the capitalist's and union's problems respectively; $Y_t^f = A\left(K_t^f\right)^\alpha\left(L_t^f\right)^{1-\alpha}$; $\pi_t^k = (1-\theta)Y_t^f$; $\Psi \equiv \left(n^k\right)^{1-\theta} Y_t^f - w_t L_t^f$; and $\Omega_t \equiv \overline{G}_t^u + w_t\left(\tau_t^w - 1\right)$.

3 Calibration to the UK economy

We next calibrate the structural parameters of the model with product and labour market distortions so that its steady-state solution reflects the main empirical characteristics of the UK economy, with particular emphasis on the tax rates and the unemployment rate. The structural parameters for the full model, including both labour and product market distortions, are reported in Table 1 with the implied steady-state solution in Table 2 column (1).

According to the Family Resources Survey in 2008-2009, about 30% of households have savings and investments above £10,000.[11] Assuming, for the households with savings below this threshold, that capital income does not constitute a significant portion of their budget, we set the share of capitalists, n^k, to 0.3. We normalise the productivity parameter, A, to 1. We also use common values from the literature for the: (i) intertemporal elasticity of substitution, $1/\sigma = 0.5$ or $\sigma = 2$; (ii) depreciation rate, $\delta = 0.1$; and (iii) annual rate of time preference, $\beta = 0.97$, (see, e.g. Angelopoulos *et al.* (2011b) and references therein). Together with a standard value for the capital productivity parameter, $\alpha = 0.35$, these parameters imply that in the steady-state the capital-to-output ratio is about 2.

We choose a value for union power, $\phi = 0.5$, which is in the middle of the range (i.e. 0.4 to 0.6) of values typically used in the literature (see e.g.

[11] The survey is sponsored by the Department for Work and Pensions (see their Table 4.9 in Chapter 4: Savings and Investments of the 2008-2009 Annual Report for the information reported here).

Domeij (2005) for a discussion of the relevant studies and empirical evidence). We show later that the results which follow in the remainder of the paper remain qualitatively robust to lower and higher values of ϕ encompassing this range.

The base calibration also allows for market power in the product market by setting $\theta = 0.9$, implying that profits, in equilibrium, amount to 10% of GDP. This value approximates the magnitude typically employed in New Keynesian models to capture the price mark-up over marginal costs (see, e.g. Leith and Malley (2005)). As with union power, we show below that the results which follow, generally, do not change qualitatively when different values of θ are considered.

Effective average tax rates for capital and labour income from 1970-2005 are constructed by following the approach in Conesa *et al.* (2007) using data from the National Accounts and the Public Sector, Taxation and Market Regulation databases (available from OECD.Stat database). The average capital tax rate over the time period is $\tau^k = 0.442$. This dataset also implies that the average labour income rate is 0.27.[12] We thus calibrate the spending instruments, $\overline{G}^t$ and $\overline{G}^u$, so that the implied model solution for τ^w is 0.27 and the unemployment rate is 7%. The unemployment rate corresponds to the average from 1970 to 2010 from the UK Office for National Statistics.

Table 1: Calibration (labour and product market distortions)

Parameter	Definition	Value
$0 \leq \beta \leq 1$	rate of time preference	0.970
$0 \leq \alpha \leq 1$	capital's share	0.350
$0 \leq \delta \leq 1$	depreciation rate on capital	0.100
$0 \leq n^k \leq 1$	population share of capitalists	0.300
$\sigma \geq 1$	relative risk aversion coefficient	2.000
A	TFP level	1.000
$0 \leq \phi \leq 1$	union power	0.500
$0 \leq \theta \leq 1$	product market power	0.900
$\overline{G}^t \geq 0$	per capita public transfers	0.309
$\overline{G}^u \geq 0$	per capita unemployment benefit	0.475
$0 \leq \tau^k \leq 1$	tax rate on capital income	0.442

[12] According to the ECFIN tax rates (see Martinez-Mongay, 2000) the UK implicit tax rate on labour is 26.5% compared to 37.5% in the EU-11. In contrast, the implicit tax rate on capital of 47% in the UK is well above the rate of 30% in the EU-11 and indeed is one of the highest in the EU. Following the approach in Conesa *et al.* (2007) gives similar qualitative tax rates for the UK and has the advantage that we can use data for a longer period.

The steady-state solution for the above parameterisation, as shown in Table 2 column (1), implies the following shares of public spending in GDP: $\frac{G^t}{Y} = 0.227$ and $\frac{G^u}{Y} = 0.024$, which further implies that government spending in transfers is about 25% of GDP, consistent with UK data from the OECD.Stat database. In addition, it suggests a replacement ratio, $\frac{\overline{G}^u}{w}$, of about 50% in the long-run. This rate is comparable with data for industrialised countries (see e.g. Nickell and Nunziata (2001)) and values used in previous studies, ranging from 45% (Shi and Wen (1999)) to 60% (Pissarides (1998)). We also report, in Table 2, the net returns to labour and capital, $\widetilde{w} = w(1-\tau^w)$ and $\widetilde{r} = (r-\delta)\left(1-\tau^k\right)$, respectively, which will be useful for the analysis which follows. Finally aggregate or social welfare, U, is defined in the Benthamite fashion as the average welfare of all agents in the economy.

Table 2: Pre-reform steady-states

	Full Model (1)	Comp. Model (2)	Union Model (3)	Profits Model (4)
$\frac{C}{Y}$	0.797	0.775	0.775	0.797
$\frac{I^k}{Y}$	0.203	0.225	0.225	0.203
$\frac{K^k}{Y}$	2.027	2.252	2.252	2.027
$\frac{G^t}{Y}$	0.227	0.231	0.203	0.252
$\frac{G^u}{Y}$	0.024	0.000	0.028	0.000
$\frac{\pi}{Y}$	0.100	0.000	0.000	0.100
$\frac{\overline{G}^u}{w}$	0.499	0.000	0.575	0.000
τ^w	0.270	0.270	0.270	0.270
$(1-e)$	0.070	0.000	0.070	0.000
w	0.951	1.006	1.006	0.856
$\widetilde{w}$	0.694	0.735	0.735	0.625
r	0.173	0.155	0.155	0.155
$\widetilde{r}$	0.041	0.031	0.031	0.031
C^k	1.461	1.451	1.350	1.571
C^w	0.924	1.092	1.015	0.993
U^k	-22.82	-22.97	-24.70	-21.22
U^w	-36.09	-30.53	-32.83	-33.57
U	-32.11	-28.26	-30.39	-29.86

To obtain benchmarks that will help contextualise the importance of the two distortions in the labour and product markets, in addition to the full model shown in column (1) of Table 2, we also present the relevant special cases. For example column (2) reports the steady-state results for the

competitive model.[13] This model effectively belongs to the set of models discussed in Judd (1985) and assumes an inelastic labour supply implying that $e^k = e^w = e = 1$, or that unemployment is zero.[14] Column (3) covers the case when product markets are competitive but labour markets are unionised.[15] Following the setup in Guo and Lansing (1999), albeit with inelastic labour supply, column (4) shows the results for the model when product markets are monopolistic but labour markets are competitive.[16]

To understand the effects of introducing union power to the competitive model and to the profits model, compare respectively the results in columns (2) with (3) and (4) with (1). It is clear that the labour market distortion worsens relative outcomes for both agents through higher unemployment, lower labour income and lower consumption. Hence welfare for both agents and thus aggregate welfare is lower in the models incorporating unions.

Similarly the effects of allowing for market power in the competitive model and in the union model can be seen by comparing, respectively, the results in columns (2) with (4) and (3) with (1). In both cases we can see that the capitalist's welfare has increased but worker's and aggregate welfare has decreased. This finding is driven by higher relative consumption for the capitalist arising from non-zero economic profits.

4 Distributional effects of tax reforms

We are now in a position to examine the distributional effects of tax reforms that reduce the tax burden on capital under market distortions in labour and product markets. In all cases, we find that the effects of capital tax reductions are monotonic and increase with the magnitude of the capital tax cut. Hence, we focus on a policy reform that imposes a zero capital tax given, as pointed out in the introduction, its prominence in the tax reform

[13] The results reported in column (2) have been obtained using the parameters in Table 1 except that ϕ and $\overline{G}^u$ are not relevant since unemployment is zero, θ is equal to unity and $\overline{G}^t$ is re-calibrated so that the steady-state value of $\tau^w = 0.27$ can be achieved.

[14] The case of inelastic labour supply was also considered by Judd (1985) and is employed here so that exogenous leisure is treated consistently across the models we employ. However, note that the results reported below do not change qualitatively when we allow for endogenous leisure in the perfectly competitive model.

[15] To obtain the results reported in column (3), we use the parameters from Table 1, except that θ is equal to unity and we re-calibrate $\overline{G}^t$ and $\overline{G}^u$, so that the implied model solutions for τ^w and $(1-e)$ are 0.27 and 0.07 respectively.

[16] The results reported in column (4) have been obtained using the parameters in Table 1, except that, ϕ and are not relevant since unemployment is zero and G^t is re-calibrated so that the steady-state value of $\tau^w = 0.27$ can be achieved.

literature.

We evaluate the effects of the tax reform by comparing the post- with the pre-reform steady states since we are interested in distributional effects of capital tax cuts in the long-run.[17] In the Tables 3-6 which follow, for ease of comparison, we repeat the relevant pre-reform results alongside the post-reform ones. To contextualise the importance of market imperfections, we first discuss the results for the benchmark case of competitive markets. We next analyse the role of unionised labour markets and imperfect product markets in isolation and then add product market power to the labour market distortion. Finally, as a robustness exercise, in Tables 7 and 8 respectively, we examine the quantitative importance of firm and union power.

4.1 The competitive model

The steady-state allocations together with welfare in the competitive model are shown in Table 3. We also report the welfare gains and losses for capitalists and workers, ζ^k and ζ^k, respectively, together with the welfare gains at the aggregate level, ζ. These have been calculated as the consumption supplement required to make the agent as well off in both regimes.[18] As can be seen, in the competitive model, implementation of the tax reform will be Pareto improving in the long-run, even if it increases inequality. In other words, there are welfare gains for both type of agents, although the gains for the capitalists compared to the workers are much higher (i.e. 8.3% versus 1.1%) and thus their relative welfare position improves. This is consistent with Judd's (1985) results that it is optimal for both types of agents to choose a zero capital tax.

The trade-off for the worker after implementing the zero capital tax can be seen by noting that, although the labour tax, τ^w, increases (i.e. from 0.27 to 0.324) to make up for the loss in the tax revenue, due to the elimination of the capital tax, the wage rate, w, rises as well (i.e. from 1.006 to 1.104). This implies that the net return to labour, $\widetilde{w}$, also increases (i.e. 0.735 to 0.747) and thus income, consumption and welfare rise. The reason the wage rate increases by more than the tax rate is that the elimination of the capital tax boosts investment and capital, which in turn increases labour productivity

[17] Note that it is already known that including the transition period will affect the Pareto superiority of capital tax cuts, even in models where a reduction in the capital tax is Pareto improving in the long-run (see e.g. Garcia-Milà *et al.* (2010) and Angelopoulos *et al.* (2011b)).

[18] In particular, they have been obtained using the formula $\left(\frac{W_A}{W_B}\right)^{\frac{1}{1-\sigma_1}} - 1$, where W_A and W_B is welfare post- and pre-reform, respectively.

and this is translated into higher wages. Therefore, everyone benefits in the long-run by a reform that implements the zero capital tax.

Table 3: Effects of tax-reform in the competitive model

	post-reform (1)	pre-reform (2)
$\frac{C}{Y}$	0.733	0.775
$\frac{I^k}{Y}$	0.267	0.225
$\frac{K^k}{Y}$	2.673	2.252
$\frac{G^t}{Y}$	0.210	0.231
$\frac{G^{tu}}{Y}$	0.000	0.000
$\frac{\pi}{Y}$	0.000	0.000
$\frac{G^u}{w}$	0.000	0.000
τ^w	0.324	0.270
$(1-e)$	0.000	0.000
w	1.104	1.006
$\widetilde{w}$	0.747	0.735
r	0.131	0.155
$\widetilde{r}$	0.031	0.031
C^k	1.572	1.451
C^w	1.104	1.092
U^k	-21.21	-22.97
U^w	-30.20	-30.53
U	-27.50	-28.26
ζ^k	0.083	–
ζ^w	0.011	–
ζ	0.028	–

4.2 Unionised labour markets

The results for the model with distortions in the labour market are shown in Table 4. Under unionised labour markets, the welfare gains for all agents are generally lower, compared to those obtained in the competitive model (see Table 3), and, more importantly, there are now welfare losses for the workers in the long-run. This occurs since imperfect competition in the labour market negatively affects the trade-off for the worker that arises with the implementation of the zero capital tax.

For example, Table 4 shows that the rise in the wage rate (i.e. from 1.006 to 1.104), due to higher productivity, just makes up for the rise in the labour

Table 4: Effects of tax reform in the union model

	post-reform (1)	pre-reform (2)
$\frac{C}{Y}$	0.733	0.775
$\frac{I^k}{Y}$	0.267	0.225
$\frac{K^k}{Y}$	2.673	2.252
$\frac{G^t}{Y}$	0.187	0.203
$\frac{G^u}{Y}$	0.030	0.028
$\frac{\pi}{Y}$	0.000	0.000
$\frac{G^u}{w}$	0.524	0.575
τ^w	0.334	0.270
$(1-e)$	0.082	0.070
w	1.104	1.006
$\widetilde{w}$	0.735	0.735
r	0.131	0.155
$\widetilde{r}$	0.031	0.031
C^k	1.443	1.350
C^w	1.014	1.015
U^k	-23.10	-24.70
U^w	-32.89	-32.83
U	-29.95	-30.39
ζ^k	0.069	–
ζ^w	-0.002	–
ζ	0.015	–

tax rate (i.e. from 0.27 to 0.334), so that the net wage for workers is the same before and after the zero capital tax reform (i.e. $\widetilde{w} = 0.735$).

Given the existence of unemployment, the labour tax rate has to increase by more under imperfect competition to raise the necessary tax revenue after the loss in capital tax revenue. However, this rise in the labour tax has an additional side effect which ultimately hurts worker's labour income. In particular, a higher labour tax increases the unemployment rate, $(1-e)$, (i.e. from 7% to 8.2%), given that, *ceteris paribus* at the union-firm bargaining level, it decreases the returns to work and thus makes the outside option more attractive to the union. At the same time, again at the union-firm bargaining level, the rise in firm's capital stock increases output and this tends to increase the desire of the firm for a successful outcome of the wage bargain and thus further enhances the power of the union.[19]

[19]Note, given that there is perfect competition in the product market, prices are given

Since both effects tend to increase union's power, unemployment increases. This in turn implies that the labour income of the worker falls since the wage rate is higher than the unemployment benefit. Therefore, the distortion in the labour market implies that workers cannot fully benefit from the positive effects created from capital accumulation and overall they are worse off by a tax reform that eliminates capital and increases labour taxes.

Our results for aggregate welfare are consistent with the long-run welfare gains to the representative agent in a unionised labour market generated by a tax reform that cuts capital taxes and increases labour taxes, see e.g. Daveri and Maffezzoli (2001). The quantitative magnitudes we find suggest that such a reform would generate enough gains to compensate the losers. Our findings regarding the distributional effects of the tax reform are also consistent with those in Ardagna (2007) who uses a model with monopoly union power following Maffezzoli (2001). Under perfectly competitive product markets, Ardagna (2007) includes a rich fiscal policy menu and government sector employment to examine exogenous changes in fiscal instruments accommodated by changes in government debt and finds that workers' utility decreases after increases in labour taxes.

4.3 Monopolistic product markets

The results for the model with distortions in the product markets are shown in Table 5. These suggest that there are welfare losses for the workers and at the aggregate level, but big welfare gains for the capitalists. This occurs since imperfect competition in the product market negatively affects the trade-off for the worker that arises with the implementation of the zero capital tax.

More specifically, although the wage rate increases after the elimination of the capital tax (i.e. from 0.856 to 0.939), due to the usual channel of increased capital stock and labour productivity, the net wage decreases (i.e. from 0.625 to 0.57), as the rise in the labour tax (i.e. from 0.27 to 0.393) is higher than the increase in the wage rate. This implies that labour income is reduced and the worker is worse-off after the tax reform. This results is driven by the fact that the loss in tax revenue from capital is bigger under monopolistic profits, since profits represent an inelastic tax base. In turn, consistent with the findings in Guo and Lansing (1999), this implies that the tax rate on labour has to increase by more to make up for the loss in revenue, so that the net wage is reduced.

for the firm and thus the increase in output implies a similar increase in revenue. The importance of this will become clearer when we consider the case of monopolistic competition in product markets below.

Table 5: Effects of tax reform in the profits model

	post-reform (1)	pre-reform (2)
$\frac{C}{Y}$	0.759	0.797
$\frac{I^k}{Y}$	0.241	0.203
$\frac{K^k}{Y}$	2.406	2.027
$\frac{G^t}{Y}$	0.230	0.252
$\frac{G^u}{Y}$	0.000	0.000
$\frac{\pi}{Y}$	0.100	0.100
$\frac{G^u}{w}$	0.000	0.000
τ^w	0.393	0.270
$(1-e)$	0.000	0.000
w	0.939	0.856
$\widetilde{w}$	0.570	0.625
r	0.131	0.155
$\widetilde{r}$	0.031	0.031
C^k	1.871	1.571
C^w	0.939	0.993
U^k	-17.81	-21.22
U^w	-35.52	-33.57
U	-30.20	-29.86
ζ^k	0.192	–
ζ^w	-0.055	–
ζ	-0.011	–

4.4 Labour and product market distortions

The post-reform findings in the model with distortions in both product and labour market are shown in Table 6. These reveal that the zero capital tax is Pareto superior to the current tax regime. This transpires since distortions in the product market work to offset the effects of imperfect competition in the labour market, resulting in a trade-off for the worker implying welfare gains in the long-run after the capital tax cut.

Table 6: Effects of tax reform in the full model

	post-reform (1)	pre-reform (2)
$\frac{C}{Y}$	0.759	0.797
$\frac{I^k}{Y}$	0.241	0.203
$\frac{K^k}{Y}$	2.406	2.027
$\frac{G^t}{Y}$	0.194	0.227
$\frac{G^{tu}}{Y}$	0.002	0.024
$\frac{\pi}{Y}$	0.100	0.100
$\frac{\widetilde{G}^u}{w}$	0.455	0.499
τ^w	0.334	0.270
$(1-e)$	0.006	0.070
w	1.043	0.951
$\widetilde{w}$	0.694	0.694
r	0.146	0.173
$\widetilde{r}$	0.046	0.041
C^k	1.861	1.461
C^w	0.933	0.924
U^k	-17.92	-22.82
U^w	-35.72	-36.09
U	-30.38	-32.11
ζ^k	0.273	–
ζ^w	0.010	–
ζ	0.057	–

Although again, after the tax reform, the net return to labour has remained the same as in the pre-reform economy, unemployment falls from 7% to 0.6% and, given that the wage rate is higher than the unemployment benefit, income, consumption and welfare for the worker increase as well. The two distortions create two opposing effects on unemployment after the tax reform. On one hand, the unionisation of the labour market implies that, as previously, the rise in the labour tax (i.e. from 0.27 to 0.334) decreases the return to work and thus makes the outside option more attractive to the union. However, the fall in the capital tax increases capital accumulation, which increases each individual firm's output, i.e. Y^f goes up. Given that final, per capita output, Y, is taken as given, this increase in individual firm's supply in the monopolistic market implies a fall in its individual price, P^f and tends to decrease the expected revenue of the representative firm. Monopolistic competition, therefore, tends to reduce the positive revenue effects

of the increase in output and overall reduces the desire of the firm for a successful outcome of the wage bargain. In turn, this implies that the relative attractiveness of the firm's outside option in bargaining has increased, or else that the firm's power relative to the union has increased. The result of these opposing effects is a rise in employment which is beneficial to the worker. Finally, note that the welfare gains to the capitalist are bigger relative to the worker, so that, although the elimination of the tax cut is Pareto superior, welfare inequality has increased.

In general, our findings for this case are consistent with results from policy analyses in second-best environments, which suggest that adding more frictions may lead to improved outcomes, given that one distortion might, effectively, correct another. Independently, each market failure implies that capital tax cuts will result in welfare losses for at least one segment of the population. Together, however, decreases in the capital tax under monopolistic competition in the product markets and unionisation in labour markets are welfare improving for all agents.

4.5 Changes in firm power

Using the full model, we next examine the importance of firm power in the product market on the welfare gains/losses of a tax reform that eliminates the capital tax, given a unionised labour market (i.e. $\phi = 0.5$). We summarise the results for θ between 0.9 and 1. For each case considered, we report changes for consumption and the unemployment rate from a tax reform that eliminates the capital tax relative to the current tax policy as well as the compensating consumption supplement for each agent and the aggregate economy.[20]

Under unionised labour markets, the positive welfare effects for both types of agents are increased when the extent of monopolistic competition in the product market increases. In particular, when firm power in the product market is sufficiently high (for our calibration, this occurs for $\theta < 0.98$), there are welfare gains to the worker to be observed after the capital tax cut. As can be seen, the effect of the tax reform on the labour market is positive in these cases, in the sense that employment is increased. This is because the monopolistic effect on firm's revenue is strong enough to outweigh, in the wage bargaining problem, the negative effects of increased labour taxes in

[20]Not that for all cases considered, the spending shares are re-calibrated so that the base in all cases is an economy with 7% unemployment and 27% labour tax rate. Otherwise, the parameters used are as in Table 1. Also note that the results in Tables 7 and 8 for consumption are in percent differences, whereas the unemployment rate is in percentage point differences.

the trade-off between the two market distortions discussed above.

Table 7: Firm power (θ) in the product market
(changes relative to current policy)

	0.900	0.950	0.980	0.990	1.000
C^k	0.400	0.240	0.150	0.122	0.093
C^w	0.009	0.004	0.000	-0.001	-0.001
$(1-e)$	-0.064	-0.024	-0.002	0.005	0.012
ζ^k	0.273	0.170	0.109	0.090	0.069
ζ^w	0.010	0.004	0.000	-0.001	-0.002
ζ	0.057	0.038	0.024	0.020	0.015

4.6 Changes in union power

We next examine the importance of union power in the labour markets on the welfare gains of a tax reform the eliminates the capital tax, for given firm's power in the product market (i.e. $\theta = 0.9$). The parameter that measures the relative power of unions *vis-a-vis* the firm in Nash-bargaining for the wage rate is ϕ. As discussed earlier, our base calibration above is based on a value for ϕ that is effectively in the middle of the range of the empirically relevant values. In what follows, we examine changes in ϕ that encompass the entire range used in the literature, (see e.g. Domeij (2005)). As in Table 7, for each case considered, the results are reported as changes from a tax reform that eliminates the capital tax relative to the current tax policy.

The results in Table 8 suggest that the welfare gains for all agents from a tax reform are increasing in ϕ. As ϕ increases, the unemployment benefit needs to fall in the pre-reform economy so that the new calibration implies the same labour tax and unemployment rate as in the base case.[21] This suggests that the relative power of the union in the labour market derives more from the institutional features associated with ϕ and less from the outside option or else, that $\overline{G}^u$ has a smaller effect on determining unemployment. As discussed above, after the capital tax cut and the concurrent increase in labour tax, the negative effect on unemployment takes place via the increase in the labour tax relative to the unemployment benefit, as they determine the relative weight of the outside option for unions. Therefore, given that the importance of this outside option has been reduced for a combination of

[21] As before, the spending shares are re-calibrated so that the base in all cases is an economy with 7% unemployment and 27% labour tax rate. Otherwise, the parameters used are as in Table 1.

higher ϕ and lower $\overline{G}^u$, the effect of the increase in the labour tax relative to $\overline{G}^u$ after the tax reform exerts a smaller negative effect on unemployment.

Table 8: Union power (ϕ) in the labour market
(changes relative to current policy)

	0.250	0.375	0.500	0.625	0.750
C^k	0.392	0.396	0.400	0.403	0.406
C^w	0.005	0.007	0.009	0.011	0.013
$(1-e)$	-0.060	-0.062	-0.064	-0.066	-0.068
ζ^k	0.268	0.271	0.273	0.276	0.278
ζ^w	0.006	0.008	0.010	0.012	0.014
ζ	0.052	0.055	0.057	0.059	0.060

5 Conclusions

This paper examined the long-run welfare effects of tax reforms under heterogeneity in capital holdings assuming imperfect competition in product and labour markets. Given the relevance of these market failures, our analysis can help to inform current policy discussions regarding the potential impacts of capital tax reforms. Using a calibrated model whose steady-state reproduced the main features of the UK economy, our main findings are as follows.

First, in the presence of the labour market distortion only, a tax reform that implements a zero capital tax implies welfare losses for the workers, whereas capitalists' and aggregate welfare increases. We find that the unemployment channel is the critical link that modifies the results from the benchmark model with competitive labour markets. In particular, although labour productivity and the after-tax wage increase, the workers cannot capture the full benefit of this as unemployment also increases.

Second, under competitive labour markets but non-competitive product markets, a zero capital tax leads to welfare gains for the capitalists and losses for the workers as well as the aggregate economy. This occurs since, the government has to forego revenue from a non-distortionary tax base comprised of "pure profits" so that the required increase in the labour tax is larger and thus the net wage falls after the tax reform.

Finally, monopolistic competition in the product market, under unionised labour markets, introduces a market failure that works to correct the negative implications of imperfect labour markets. In particular, monopolistic competition tends to reduce the positive revenue effects of the increase in output after a capital tax cut and thus reduce the benefits to the firm for a

successful outcome of wage bargaining. In turn, this implies that the relative attractiveness of the firm's outside option in bargaining and its power relative to the union increases. This tends to increase employment and the benefits to all agents after a tax cut.

Given that most modern economies are characterised by imperfect competition in both product and labour markets, we would consider the final set of results to be potentially the most useful. However, the above analysis also makes clear that combining market failures that, independently, have similar welfare effects, does not necessarily lead to total effects which work in the same direction. Instead, the welfare implications can be completely reversed. Thus, our results also imply that omission of relevant market and policy failures may bias the results in ways that cannot always be predicted *ex ante*.

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