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ABSTRACT

Good Jobs, Bad Jobs and Redistribution*

We analyse the question of optimal taxation in a dual economy, when the policy-maker is concerned about the distribution of labour income. Income inequality is caused by the presence of sunk capital investments, which creates a 'good jobs' sector due to the capture of quasi-rents by trade unions. With strong unions and high planner preference for income equality the optimal policy is a combination of investment subsidies and progressive income taxation. If unions are weaker, the policy-maker may instead choose to tax investment.

JEL Classification: H20, J42 and J51
Keywords: optimal taxation, redistribution, rent sharing and segmented labour markets

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1 Introduction

This paper concerns itself with redistribution policy specifically and optimal taxation more generally in a dual labour market setting. We portray the economy as divided in a primary 'good jobs' sector and a secondary sector with 'bad jobs'. The good jobs sector is characterised by sunk capital investments and by the fact that labour, by forming a trade union or otherwise, manages to capture parts of the quasi-rents that are generated. The good jobs sector is 'good' because wages are higher there, and all workers would prefer a good job if they could only get one. In turn, the fact that labour captures quasi-rents will typically lead to underinvestment and a too small primary sector, as in Grout (1984) and Manning (1987).

There are several options available for a government that cares about distribution. Should the government try to tax away some of the income of the primary sector workers and redistribute towards secondary sector ones? Should the government instead seek to tax away the quasi-rent from the primary sector directly through an investment tax? Or by using a profit tax? Or should the government try to expand the primary sector by subsidising investment, so that more workers can enjoy high primary sector wages? The attempt to disentangle questions as these is the core contents of the current work.

The public economics literature on optimal redistributive taxation (e.g., Dixit and Sandmo (1977), Sandmo (1983, 1998) and Parker (1999)) typically discusses redistribution in a setting with *competitive* labour markets. Here a high income is the result of high ability and/or effort, the relevant trade-off is between more redistribution and distorted labour supply incentives.[1] There is also a large literature on trade unions, wage bargaining and taxation.[2] The mere existence of trade unions means that we depart from the competitive labour market assumption. Almost all of these papers employ a one-sector model and income distribution is not an explicit issue. Rather, attention is typically on whether or not progressive taxation can have positive employment effects with wage bargaining. Theoretical results turn out to depend crucially on the specific model assumptions, and also empirically findings are ambiguous.

[1] Sandmo (1998) stresses that without distributional concerns it is difficult even to give a welfare-theoretic justification for the use of distortive income taxation, as uniform lump-sum taxes could then be used.

[2] An early paper is Hersoug (1984). From the recent theoretical literature we mention Aronsson et al. (2002), Fuest and Huber (2000), Kolm (2000), Koskela and Vilmunen (1996) and Sørensen (1999). Recent empirical evidence can be found in Brunello et al. (2002), Hansen et al. (2000), Holmlund and Kolm (1995) and Lockwood et al. (2000).

There are, however, a few papers that discuss optimal public policy, and sometimes even issues regarding redistribution, within a dual labour market framework. All of these papers, however, are quite different from the present model. Kleven and Sørensen (2003) study taxation in dual labour markets with efficiency wages in the primary sector. The focus is wholly on the employment effects of progressive taxation, not on distribution. A progressive tax will interact with the required efficiency wage in the primary sector, and the authors warn that their results are more pessimistic as regards the employment effects of progressive taxation: employment is distorted further away from the primary sector, and even aggregate employment may fall. Wauthy and Zenou (2002) present a model that is almost a traditional trade union model on its head: while many trade union models study situations where firms undertake sunk investments and workers subsequently have some power over wage setting, here workers first invest in education, then wages are set by firms with some degree of market power in the labour market. The focus is on the choice between education or wage subsidies to correct the ensuing inefficiency, and also this paper is not concerned with income distribution. The work closest to ours is perhaps a couple of studies of optimal policy within a Harris-Todaro (1970) framework.[3] Fields (2001), building on work by Temple (2003), investigates the effect of policies to decrease primary sector wages, increase secondary sector wages, or enlarge the primary sector. Income distribution is a central issue in these papers, but policy measures are studied one by one. In our paper, the focus on the public budget constraint links the optimal use of all policy instruments, and this allows us to study the optimal *policy mix* in various circumstances rather than only the effects of various individual policies.[4]

A few other papers on optimal policy in dual labour market settings should be mentioned. Agell and Lommerud (1997) use a model similar to the one in this paper, but a primary sector minimum wage is the only policy instrument. The focus is on the consequences for education and employment, not on redistribution. A minimum wage may improve welfare in this model. Acemoglu (2001) is close to Agell and Lommerud. Acemoglu uses a model of matching frictions, but such models have often many similarities with simpler models of hold-up problems. Acemoglu

[3]A difference between our work and the H-T model is that we will assume that the good jobs are allocated randomly, rather than focussing on wait unemployment among the urban poor. Calvo (1978) introduced trade unions into the H-T framework, while Corden and Findlay (1975) and Neary (1981) introduced sector-mobile capital. Holmlund and Lundborg (1990) studied the incidence of different ways of financing unemployment benefits.

[4]Another important distinction between our paper and this work is that Temple and Fields do not allow for unions and wage bargaining.

studies both the use of a minimum wage and unemployment benefits, and also he finds that labour market regulations may improve productivity and welfare. Lommerud and Vagstad (2003) study, again in a good and bad jobs framework, how self-fulfilling prophecies about effort in later periods may hold women out of the primary sector – and discuss how policy can be used to correct for this.[5] Finally, Schöb and Koskela (2002) study optimal capital taxation in a dual economy with a unionised and a non-unionised sector. Their focus, however, is on efficiency rather than distributional issues.

As our work builds on the assumption that there is rent-sharing in the economy's primary sector, the empirical literature on labour rent sharing more specifically and firm and industry wage differentials more generally is clearly relevant. A recent study is Margolis and Salvanes (2001), that also contains many further references. Several of these studies support the notion that labour shares in rents even in countries as the US where unions tend to be weak, but contrasting views are also aired. Goos and Manning (2003) provide evidence from the UK on what they call 'job polarisation'.

Before turning to the detailed presentation of the model, we will now briefly sketch a couple of the main findings of the paper. In the main version of the model, we consider the optimal policy of a social planner that is only concerned about the level and distribution of labour income. If trade unions are strong and the planner's preference for equality is high, it turns out to be the best policy to combine progressive income taxation and investment subsidies. In the choice between trying to transfer money from primary to secondary workers and seeking to expand the number of primary sector jobs, one chooses both. This result holds regardless of whether or not the social planner cares for the incomes of capital owners.

On the other hand, if trade unions are not very strong, the investment subsidy policy will be abandoned to the benefit of an investment tax. Expanding the primary sector now mostly benefits capitalists, which cools the desire for investment subsidies. Instead, the government seeks to capture those rents that the union could not by taxing investment. The investment tax is supplemented by progressive income taxation.

[5] Austen-Smith and Wallerstein (2003) are also concerned with discrimination and redistribution in a dual labour market, but the perspective is a political economy one: how can for example the primary sector whites buy the support of secondary sector whites through income distribution, to block a coalition among poor whites and black workers?

2 Model

There are two sectors in the economy; a capital-intensive 'primary sector' and a labour intensive 'secondary sector'. As a simplification we assume that primary sector production necessitate the use of both labour and capital, whereas self-employed labour is the only factor of production in the secondary sector. By forming a trade union, workers in the primary sector are able to capture a share of the rents generated by sunk capital investments. This is the key assumption of the model.

There are two periods in our model. In the first period primary sector investments, K, are sunk. For simplicity we assume a fixed relationship between employment and capital in the primary sector. Thus, employment is indirectly determined in the first period by

$$L = \frac{1}{\gamma} K, \tag{1}$$

where γ is a measure of the degree of capital intensity in production.

Production takes place in the second period. Workers are initially identical, and sorting to the sectors is assumed to be arbitrary.[6] The wage rate in the primary sector, w_1, is determined through ex-post bargaining between the union and the firm(s). In the secondary sector, labour is used in a constant-returns-to-scale process and the workers in this sector earn w_2. All workers, in both sectors, supply one unit of labour inelastically.

2.1 Wage bargaining

Since employment is determined prior to bargaining, primary sector workers are only concerned about maximising wages. We assume that the number of working hours per worker in the primary sector is fixed by the employers before bargaining.[7]

Due to some entry costs, there is a fixed number of firms in the primary sector. Assuming a linear revenue function, with the marginal revenue of capital given by ϕ, the second period profit of a representative

[6] In line with Kleven and Sørensen (2003), but as opposed to Wathau and Zenou (2002), we concentrate on the sectoral allocation of labour by abstracting from education investments. Agell and Lommerud (1997) picture a double-sided hold-up problem with investments both from the worker and employer side, but with minimum wages as the only policy instrument. Intuitively, redistributive taxation would weaken education incentives, but education could be at an excessive level to begin with, if education matters for access to the primary sector.

[7] If employers and unions had bargained over an hourly wage and then let workers choose their desired work effort, we would have oversupply of labour effort. Working more would for each individual worker be a way of securing more rents for himself.

employer is

$$\pi = \phi K - w_1 L. \tag{2}$$

We assume Nash bargaining and let the relative bargaining strength of the trade union be denoted by $\alpha \in [0,1]$. Primary sector workers can always obtain w_2, so this is taken to be the threat-point of the union. The threat-point of the firm is zero.[8] Let $t \in [0,1]$ be the marginal tax rate on labour income. The primary sector wage rate is given by the solution to the following problem:

$$\max_{w_1} \alpha \ln \{(w_1 - w_2)(1-t)\} + (1-\alpha)\ln\{\phi K - w_1 L\},$$

which yields

$$w_1 = w_2 + \alpha(\phi\gamma - w_2) \tag{3}$$

and

$$\pi = (1-\alpha)(\phi K - w_2 L). \tag{4}$$

The equilibrium wage is given by the fall-back wage and a share in the higher productivity of labour in the primary sector, $\phi\gamma - w_2$. Obviously, we have to assume that $\phi\gamma > w_2$.

Normalising the size of the total labour force to 1, the average pre-tax labour income in the economy is given by

$$\overline{w} := Lw_1 + (1-L)w_2. \tag{5}$$

2.2 Capital investments

Abstracting from discounting, the first-period problem facing the firm is to choose the level of investments that maximises present-value profits, given by

$$\Pi = \pi - C(K,s). \tag{6}$$

The cost of investment depends on the amount of capital acquired and the investment subsidy, s. We propose a very simple convex cost function, given by

$$C(K,s) = \frac{1}{2}K^2 - sK. \tag{7}$$

[8]There is some controversy as to how best to model the fall-back in Nash bargaining. Here the fall-back is seen as the situation where production is closed and workers move to alternative employment. Arguably, the fall-back could be seen as utilities during delayed bargaining, which is typically set to $(0,0)$. Using this formulation would not change the flavour of our main results, but expressions would become a little bit more long-winded. What is important, is that we do not allow sunk investments to be reused with unorganised labour after failure of the wage bargaining. That would in effect remove the assumption that capital investement is relation-specific and vulnerable to hold-up.

Using (1), (3) and (4) the optimal investment level is

$$K = (1-\alpha)\left(\phi - \frac{w_2}{\gamma}\right) + s. \tag{8}$$

Without unionisation, the firm would be able to hire workers at the wage w_2. In this case it is easily shown that the optimal investment level is

$$K^* = \phi - \frac{w_2}{\gamma}. \tag{9}$$

Comparing (8) and (9), we see that, in the absence of investment subsidies, the presence of unions always leads to under-investment, as long as the union has some bargaining power.

2.3 Policy-making

In designing an optimal tax scheme a policy maker, sometimes dubbed as 'the government', is assumed to have three different policy instruments at its disposal; a proportional income tax rate (t), a uniform lump-sum transfer to all workers (b) and a capital investment subsidy (s). Whereas b is assumed to be non-negative, s is allowed also to take on negative values, making it then a tax on investments. Note that $t > 0$ in conjunction with $b > 0$ implies progressive income taxation.

In addition to labour income taxes, there is also a proportional tax on the present value of profits. However, we assume that firms can evade this tax whenever the profit tax rate exceeds some exogenously given level. This feature is captured in the simplest possible way by assuming an exogenous profit tax rate $\tau \in [0, 1]$. Furthermore, we also introduce some impediments to the taxation of labour income. We make the standard assumption that income taxation is costly, and that the marginal cost of taxation is increasing. Technically, this cost is incorporated in a very simple way by assuming that for every extra tax dollar levied on the working population, the government receives $1 - \lambda t$ in extra tax revenues, where $\lambda \in [0, 1]$.[9] The two parameters λ and τ represent the limits to taxation: without them, tax authorities could simply collect all income in society and redistribute after their own liking.

[9] As labour supply is exogenous in the model, the cost of taxation must be thought of as administrative costs of tax collection. In the primary sector, there is a rent element in the wage, so workers might want to work as much as they are allowed to, but at least in the secondary sector, income taxation will in practice influence labour supply. Endogenous labour supply would complicate the model quite dramatically, and we think that the present, simpler formulation with an increasing marginal cost of taxation at least in a crude way captures the essential point that there is an efficiency cost of driving progressive labour income taxation too far.

We want to characterise optimal policy not for *any* social planner, but for a policy maker that cares for equality. This policy maker concerns himself not only with total labour income, but cares also for the *distribution* of income across the working population. Capital income typically accrues disproportionately to the richest in society, so it seems reasonable that such a policy maker would place less weight on capital income than on labour income. For the time being, we make the exaggerated assumption that profits do not enter the policy maker's objective function at all. In this case we can also naturally interpret the policy maker as a 'labour government'. In Section 4 we will extend the analysis in order to investigate how the inclusion of profits in the welfare function influences the optimal policy.

A relatively simple welfare function that has the required properties is[10]

$$W = \widetilde{w}\left(1 - \beta G\right), \tag{10}$$

where

$$\widetilde{w} := \overline{w}\left(1 - t\right) + b \tag{11}$$

is average *post-tax* labour income. $G \in [0, 1]$ is the Gini coefficient, a standard measure of income inequality. A more equal distribution of income would imply a lower value of G. The parameter $\beta \in [0, 1)$ is thus a measure of the policy maker's aversion towards income inequality. This choice of welfare function is clearly unconventional.[11] However, besides having tractability advantages in the current context, there are at least two attractive features of this type of function. First, it can be argued that this functional form generally gives a better fit to individuals' attitudes towards inequality than more traditional forms based on constant relative or constant absolute inequality aversion.[12] Second, if we think of W as the objective function of a policy maker, it captures – by the use of easily operationable level ($\widetilde{w}$) and spread (G) measures of income – precisely the kind of trade-off that arguably characterises actual policy-making.

[10] This kind of social welfare function is also suggested by Lambert (1993). Lambert speaks of this as an 'abbreviated welfare function', that directly focuses on the labour market statistics that a policy maker has information about. Recent work on income distribution in Harris-Todaro models uses approaches akin to this (Temple (2003), Fields (2001)), see also Janeba (2003).

[11] The welfare function is non-welfarist in the sense that it does not build on individual utility functions and arbitrary assumptions about cardinal properties of these functions. However, the assumption that $\beta < 1$ makes sure that the welfare function is Paretian in that it obeys the Pareto criterion for workers. Thus, moving a worker from the bad-jobs to the good-jobs sector always improves welfare. The same is true for an increase of the primary sector wage, all else equal.

[12] This has been shown by Amiel et al. (1999), using survey data.

In our model, the Gini coefficient is given by[13]

$$G = \frac{L(1-L)(w_1 - w_2)(1-t)}{\widetilde{w}}. \tag{12}$$

If the government wants to decrease income inequality, there are several options available. From (12) we can easily show that $\frac{\partial G}{\partial t} < 0$ and $\frac{\partial G}{\partial b} < 0$. An increase in t or b will both contribute towards a more equal distribution of labour income.

Another – less obvious – option for the government is to alter the relative share of 'good jobs' in the economy, for instance by subsidising capital investments. Let $\widehat{w}_i$ be post-tax labour income per worker in sector i. Then it can easily be shown that

$$\frac{\partial G}{\partial L} < 0 \quad if \quad \frac{\widehat{w}_1}{\widehat{w}_2} > \frac{(1-L)^2}{L^2}.$$

This is always true if $L > \frac{1}{2}$. Thus, expanding the primary sector contributes to a more equal income distribution if more than half of the working population is already situated in this sector, or if the difference in post-tax income between the sectors is sufficiently high. For illustration, assume that all workers work in bad jobs. Giving a good job to only one worker then makes the income distribution more uneven. On the other hand, if all but one worker have good jobs, moving this last worker to the primary sector obviously evens out the income distribution. Although one can think of an expansion of the primary sector as 'redistribution policy', at least in the imprecise sense that some previously disadvantaged workers benefit from the policy, we see that such a policy is a rather blunt instrument to decrease a spread measure of incomes as the Gini coefficient. Such expansion does only contribute to redistribution in this more narrow sense when the primary sector is 'large' to begin with.

3 Optimal taxation

Inserting the expression for G into (10) we obtain

$$W = (1-t)\left[\overline{w} - \beta L(1-L)(w_1 - w_2)\right] + b. \tag{13}$$

The optimal tax package is a vector (t^*, b^*, s^*) that maximises W, subject to the public budget constraint

$$\tau\Pi + \left(1 - \frac{\lambda}{2}t\right) t\overline{w} - b - sK \geq 0. \tag{14}$$

[13] See Appendix A for an explicit derivation of the Gini coefficient.

Before turning to a partly graphical discussion of the explicit solution, some insights into the mechanisms of the model can be obtained by inspection of the first-order conditions of the problem. Assuming that the public budget constraint holds with equality, we can solve it for b and insert into the maximand, thereby eliminating one choice variable.

The first-order conditions for an interior solution can be expressed as

$$(t): \quad \frac{\partial b}{\partial t} + \beta L\left(1-L\right)\left(w_1 - w_2\right) = \overline{w}, \tag{15}$$

$$(s): \quad \left(w_1 - w_2\right)\left(1-t\right)\left(1-\beta\left(1-2L\right)\right)\frac{\partial L}{\partial s} = -\frac{\partial b}{\partial s}, \tag{16}$$

where

$$\frac{\partial b}{\partial t} = \left(1-\lambda t\right)\overline{w} \tag{17}$$

and

$$\frac{\partial b}{\partial s} = \tau\frac{\partial \Pi}{\partial s} + \left(1-\frac{\lambda}{2}t\right)t\left(w_1-w_2\right)\frac{\partial L}{\partial s} - \left(K + s\frac{\partial K}{\partial s}\right). \tag{18}$$

The left hand side of (15) can be interpreted as the marginal social benefit of income taxation. The first term is the marginal increase in average post-tax income due to a tax-financed increase in lump-sum transfers, whereas the second term is the benefit from a more equal distribution of income. We see that the magnitude of this second term is dependent on the degree of inequality aversion, the wage gap between the sectors, and the relative size of the primary sector. The more equal the sectors are in terms of employment, the higher is the effect of increased income taxation on reducing income inequality, as measured by the Gini coefficient.

The right hand side of (15) is the direct income loss for workers due to a marginal increase in income taxation, which is the average pre-tax wage. In this context, we can interpret $\overline{w}$ as the marginal social cost of income taxation. An important observation is that if $\beta > 0$, the marginal benefit of income taxation always exceeds the social costs at $t = 0$. There is no efficiency loss associated by collecting the first income tax dollar, and by handing out this dollar in equal portions to the entire working population, social welfare is increased. Since complete equalisation of income is only obtained at $t = 1$, this must be true irrespective of the sizes of s and b. Thus, corner solutions with $t^* = 0$ can be ruled out.

Now turning to the first-order condition for the investment subsidy (tax). If $s > 0$, the left hand side of (16) can be interpreted as the marginal social benefit of investment subsidies. The primary social benefit of increasing the investment subsidy is a higher average wage, due to the fact that a larger share of the working population is allowed into the 'good' sector. The magnitude of this benefit is determined by the initial wage gap between the sectors. In addition, if $L > \frac{1}{2}$ initially, an influx of workers into the primary sector contributes towards decreasing income inequality.

The right hand side of (16) can be interpreted as the marginal social costs of investment subsidies. Looking at (18), the last term represents the direct costs of a marginal increase in s. These costs are mitigated, however, by an increase in tax revenue when the primary sector is expanded. If $s < 0$, the interpretation of (16) is of course reversed.

Another useful observation is that the trade-off between income redistribution and income maximisation for the whole working population is only present when the planner cares about income equality ($\beta > 0$) *and* income taxation is costly ($\lambda > 0$). We see from (15) and (17) that $\lambda = 0$ yields a corner solution with $t = 1$, since complete equalisation of labour income can be achieved at no cost. In the extreme cases of either $\beta = 0$ or $\lambda = 0$, the optimisation problem reduces to choosing a tax package that maximises average after-tax income.

We can use the above analysis to identify the different tax regimes in the model. We know that $t^* = 0$ cannot be a solution as long as $\beta > 0$. Furthermore, from the budget constraint we know that $b^* = 0$ must imply $s^* > 0$. This leaves us with three possible regimes:

- Regime I: Progressive income taxation and investment subsidies ($b^* > 0$, $s^* > 0$).
- Regime II: Proportional income taxation and investment subsidies ($b^* = 0$, $s^* > 0$).
- Regime III: Progressive income taxation and an investment tax ($b^* > 0$, $s^* \leq 0$).

The full analytical solution (which is reported in Appendix B) turns out to be rather messy. Instead of performing standard comparative statics experiments, our strategy will be to fix the two tax impediment parameters (λ and τ) at various given levels, and then illustrate graphically which tax regime is induced by different combinations of α and β – the two central parameters of the model. At this point, we also make some rather innocent simplifications, by setting $\phi = 1$, $\gamma = 1$ and $w_2 = 0$. These simplifications preserve all the important mechanisms of the model. Furthermore, in order to secure an optimal solution for the entire set of parameter values we will assume that the exogenous profit tax rate, τ, is not too high.[14]

The optimal solution is characterised in Figures 1-3. Using Figure 1 as a benchmark, Figure 2 shows the effect of more costly income taxation, whereas Figure 3 shows the effect of a higher profit tax rate.

We see that whether the government should subsidise or tax capital investments (the choice between regimes I or II on the one side and regime III on the other) is primarily dependent on the relative bargaining strength of the trade unions. If unions are strong, then the wage gap between the sectors is large, and an expansion of the primary sector will have a pronounced effect on both the average wage and income tax revenues. Consequently, the optimal policy implies investment subsidies. Conversely, if the unions are weak, the major share of the revenues created by investment subsidies will go to the capital owners, so the government would do better by taxing investments.

The optimal tax policy implies proportional income taxation (Regime II) if the unions are relatively strong, and the degree of inequality aversion is relatively low. We know that $b^* = 0$ only when investments are subsidised, and this will be the case when unions are sufficiently strong. If, in addition, the planner puts a low weight on equality considerations, it is more likely that all tax revenues are used to subsidise investments, thereby increasing the average wage level, rather than redistribute income in a lump-sum manner. The fact that β does not play an important role for whether or not capital investments should be subsidised suggests that industrial policy of the kind we are considering is a relatively poor instrument for achieving income redistribution, compared with using income tax parameters.

An increase in the profit tax rate, τ, implies a contraction of Regime III. This is very intuitive: a high profit tax means that the subsidy is partly retrieved through profit taxation, which obviously makes subsidies more attractive. We also see that an increase in λ implies an expansion of Regime II. When the cost of income taxation increases, the optimal income tax rate goes down. Thus, less tax revenue is generated, and, since the marginal benefit of investment subsidies is decreasing, a larger share of the tax revenues is spent on subsidising the primary sector. Consequently, $b^* = 0$ for a larger set of parameter values.

What about within-regime effects of stronger concerns for income equality? Consider Regime I, with progressive taxation and investment subsidies. A priori, it is not obvious how a higher degree of aversion towards income inequality might affect the optimal policy in this regime, in which tax revenues are used for both lump-sum transfers and invest-

[14] Substituting for b in the welfare function, concavity of the maximand requires that $\tau \leq 2(1-\alpha\beta(1-t)) - \alpha\lambda(1-\alpha+s)$.

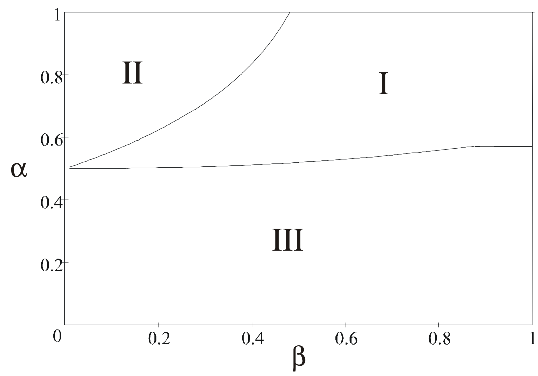

Figure 1: Optimal tax regimes when $\tau = 0$ and $\lambda = \frac{1}{2}$.

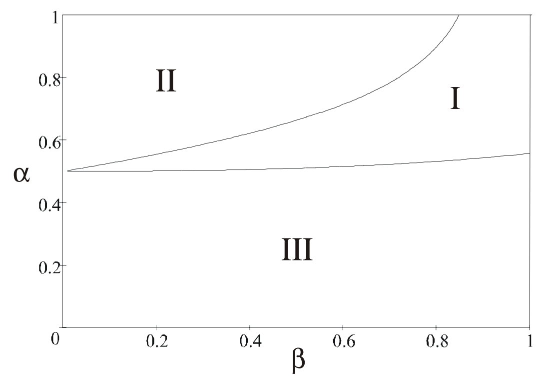

Figure 2: Optimal tax regimes when $\tau = 0$ and $\lambda = 1$.

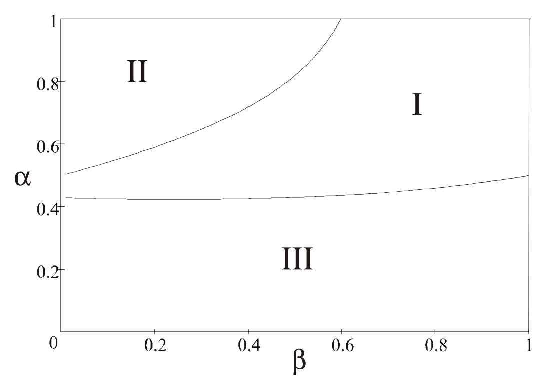

Figure 3: Optimal tax regimes when $\tau = \frac{1}{4}$ and $\lambda = \frac{1}{2}$.

ment subsidies. Should the government spend relatively more of its tax revenues on one or the other alternative, or should total tax revenues be increased in order to facilitate an increase in both lump-sum transfers and investment subsidies? In the case where profit taxation is not feasible (i.e., $\tau = 0$) it can be shown (see appendix B) that $\frac{\partial s^*}{\partial \beta} < 0$ and $\frac{\partial t^*}{\partial \beta} > 0$ for the entire parameter space in Regime I. When β is not too low, numerical simulations also suggest similar results for the case of $\tau > 0$. Thus, increased concerns for income equality mean that the government should increase income taxation, but at the same time *reduce* investment subsidies, implying that a larger share of total tax revenues is used for lump-sum transfers. Once again, this suggests that income tax progressivity and investment subsidies are not really complementary policy instruments with respect to achieving a more even income distribution. In our model, the main effect of investment subsidies is to increase the average post-tax income among workers, whereas income redistribution is better achieved through progressive income taxation.

4 Extension: capital owners

So far our analysis has been conducted for the case where the policy maker cares about the welfare of the working population only. In this section we investigate how results might change if the income of capital owners is included in the objective function of the policy maker. The most natural way to do this is to assume that net-of-tax profits, $\Pi(1-\tau)$, are evenly shared among C capitalists.[15] Preserving the assumptions of the previous analysis, the total population now consists of three different income groups – low-income workers, high-income workers and capital owners – with a total size of $1 + C$. Assuming capital owners to be the high-income group (which essentially means that C is not too high), we can construct a new Gini coefficient, G_C, based on the incomes of all three groups. The full derivation of this Gini coefficient is given in Appendix A.

As before, in order to facilitate the exposition of an explicit solution, we set $\phi = \gamma = 1$ and $w_2 = 0$. With these simplifications, the new Gini

[15] One could make the opposite (and unrealistic) assumption that capital income is spread evenly out among the working population. In our set-up, this mimics a situation with very good possibilities for profit taxation, and we already know that this implies more use of investment subsidies.

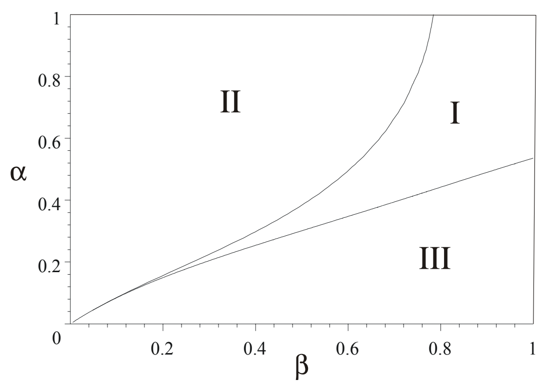

Figure 4: Optimal tax regimes when $\tau = 0$, $\lambda = \frac{1}{2}$ and $C = \frac{1}{10}$.

coefficient is given by[16]

$$G_C = \frac{\Pi(1-\tau) + (1-L)\,Lw_1(1-t) - [Lw_1(1-t)+b]\,C}{[Lw_1(1-t)+b+\Pi(1-\tau)]\,(1+C)}. \tag{19}$$

Including profits in the estimation of average post-tax income yields the following objective function for the policy maker:

$$W_C = \frac{Lw_1(1-t)+b+\Pi(1-\tau)}{1+C}\,(1-\beta G_C)\,. \tag{20}$$

Solving the public budget constraint for b and inserting into (20), the optimal tax package is given by the solution to the following first-order conditions:

$$t = \frac{(\alpha - s)\,\beta}{(1+C(1+\beta))\,\lambda}, \tag{21}$$

$$s = \frac{2\alpha\beta\Gamma + 2(1+C)(\alpha - \beta(1-\tau)) - \alpha t^2 \lambda (1+C(1+\beta))}{2[1+C(1+\beta(2-\tau)) + \beta(1-\tau-2\alpha(1-t))]}, \tag{22}$$

where $\Gamma := 2(1-\alpha(1-t)+C) - t - \tau(1+C)$.

Using the same numerical values of τ and λ as in the previous benchmark (Figure 1), the optimal tax regimes are illustrated in Figure 4 for $C = \frac{1}{10}$, which implies that the capitalists constitute about 9 per cent of the total population. We see that the optimal tax regimes follow much

[16] The validity of the expression requires

$$C < \frac{(1-\tau)(1-\alpha+s)^2}{2(\alpha(1-t)+b)}.$$

It can also easily be shown that $\frac{\partial G_C}{\partial C} < 0$.

the same patterns – broadly speaking – as in the previous analysis. In particular, the combination of investment subsidies and progressive income taxation (Regime I) constitutes an optimal tax package if unions' bargaining strength and the policy maker's concerns for income redistribution are both sufficiently high.

There are two main differences, however. First, including the income of capital owners enlarges the parameter space in which the optimal policy includes investment subsidies. Second, the optimal design of industrial policy – that is, whether or not investments should be subsidised – is now also highly dependent on the degree of inequality aversion. More specifically, stronger concerns for income equality reduces the scope for investment subsidies to be part of an optimal tax package. Consider the limit case of $\beta = 0$. In this case, the policy maker is only concerned about using the available tax instruments to maximise the average income in society, and since *all* incomes are equally valued, the policy maker will prefer to use all income tax revenues to subsidise investments, thereby alleviating the under-investment problem. For $\beta > 0$ there is a trade-off between using income tax revenues to increase the average income (by subsidising investments) or make the income distribution more even. The higher β is, the stronger are the incentives for income redistribution, and, consequently, the more likely it is that the policy maker uses the primary sector as a tax base. Given that $\beta > 0$, an investment tax (Regime III) is part of an optimal tax package if unions are sufficiently weak.

Although not reported, it can be shown that the effects of more costly income taxation (higher λ), or a higher profit tax rate, are qualitatively the same as before. The latter leads to a contraction of Regime III, whereas the former results in an expansion of Regime II. Also, if the capitalists constitute a larger share of the total population (higher C), the scope for an investment tax to be part of the optimal policy is reduced, as one would expect.

5 Concluding Remarks

This paper has examined optimal taxation issues in a dual economy, where labour shares in rents in a primary sector but not in the other, secondary sector of the economy. Labour rent sharing at the same time introduces an underinvestment problem in the primary sector and distributional issues within the working population. How should a benevolent planner tackle this?

Assume that we are in a situation with strong unions and a high planner preference for income equality. Optimal policy is then to use progressive taxation and investment subsidies in conjunction. This results holds regardless of whether the policy maker cares about the income of capital owners or not. A pure profit tax will be used to the extent this is possible, and a high profit tax points at more investment subsidies, as the subsidy cost then to a high degree is retrieved by the profit tax. This policy package is not dissimilar to actual policies used for example in Scandinavia in the first decades following World War II, and these countries were arguably marked by strong unions and a preference for equality. 'Progressive taxation' here means to tax away money from relatively high earning unionised workers to the less fortunate, so the welfare state system should indeed by seen as part of this 'progressivity'. Both redistributive taxation and active industrial policy have often been criticised as costly deviations from an efficient economy, but here we have argued that a package of these policies can be the optimal response to labour rent sharing, a package that partly is meant to restore efficiency.

The above package of policies is not optimal in all settings, however. Lower concerns for income equality make it more likely that investment subsidies are used in conjunction with proportional income taxation, while weaker unions increase the probability that the planner will tax – rather than subsidise – investments. Finally, if the policy maker cares about the income of capital owners, investments are more likely to be subsidised, and lower concerns for equality reduces the likelihood that an investment tax is part of the chosen policy even further.

By way of conclusion, it is interesting to discuss if the proposed policies can be characterised as 'union busting through the tax system'? Take as an example the situation with strong unions and strong preferences for equality. The joint policy of investment subsidies and progressive taxation does of course go some way towards undoing the actions of the unions. The primary sector wage premium that the unions have secured is partly taken away and given to less fortunate workers. The efficiency loss from unionisation is also partly restored through the investment subsidy. In the long run, the incentives for workers to form unions are weakened. This might very well be referred to as union busting, if one chooses. The planner is assumed to care for the whole working population, though, so an alternative angle is to say that policy here adjusts for the insider-outsider problem inherent in primary sector unionisation. The interests of *all* workers of course cannot be worse represented when union power is supplemented with the power to tax.

A Derivation of the Gini coefficient

Let $x \in [0, 1]$ denote the proportion of the working population when workers are ordered according to income, and let the function $L(x)$ –

commonly known as the Lorenz curve – denote the share of total income accruing to the share of the population given by x. Excluding capital owners, the Lorenz curve is a piece-wise linear function with a kink at $x = 1 - L$. The functional expression is found to be

$$L(x) = \begin{cases} \frac{\widehat{w}_2}{\widetilde{w}} x & if \quad 0 \le x \le 1 - L \\ -\frac{(1-L)(\widehat{w}_1 - \widehat{w}_2)}{\widetilde{w}} + \frac{\widehat{w}_1}{\widetilde{w}} x & if \quad 1 - L < x \le 1 \end{cases}, \tag{A.1}$$

where $\widehat{w}_i$ is post-tax income per worker in sector i, and $\widetilde{w}$ is average (and total) post-tax labour income. From the Lorenz curve we can derive the Gini coefficient by the formula

$$G = 1 - 2\int_0^1 L(x)\, dx. \tag{A.2}$$

Inserting the expression for $L(x)$ from (A.1) into (A.2), substituting for $\widehat{w}_i = w_i(1-t) + b$, and integrating, yields

$$G = \frac{L(1-L)(w_1 - w_2)(1-t)}{\widetilde{w}}. \tag{A.3}$$

The Lorenz curve with three income groups (and assuming capitalists to be the high-income group) has two kinks - at $x = \frac{1-L}{1+C}$ and $x = \frac{1}{1+C}$. The functional expression is given by

$$L_C(x) = \begin{cases} \frac{\widehat{w}_2(1+C)}{\widetilde{w}+\Pi(1-\tau)} x & if \quad 0 \le x \le \frac{1-L}{1+C} \\ -\frac{(1-L)(\widehat{w}_1 - \widehat{w}_2)}{\widetilde{w}+\Pi(1-\tau)} + \frac{\widehat{w}_1(1+C)}{\widetilde{w}+\Pi(1-\tau)} x & if \quad \frac{1-L}{1+C} < x < \frac{1}{1+C} \\ -\frac{\frac{\Pi(1-\tau)}{C} - \widetilde{w}}{\widetilde{w}+\Pi(1-\tau)} + \frac{\Pi(1-\tau)\left(1+\frac{1}{C}\right)}{\widetilde{w}+\Pi(1-\tau)} x & if \quad \frac{1}{1+C} \le x \le 1 \end{cases}. \tag{A.4}$$

The associated Gini coefficient is then given by

$$G_C = \frac{\Pi(1-\tau) + (1-L)L(\widehat{w}_1 - \widehat{w}_2) - \widetilde{w}C}{(\widetilde{w} + \Pi(1-\tau))(1+C)}. \tag{A.5}$$

By substituting for $\widehat{w}_i$ and $\widetilde{w}$, with $w_2 = 0$, we obtain (19).

B Explicit expressions for the optimal solution

Solving the budget constraint, (14), for b yields

$$b = \frac{1}{2}(1 - \alpha + s)\left[t\alpha(2 - t\lambda) + \tau(1-\alpha) - s(2-\tau)\right].$$

Inserting this expression into the welfare function and maximising, yields the following interior solution (i.e., Regime I or III) for the optimal tax parameters:

$$t^* = \frac{\tau\lambda + 2\beta\alpha\lambda + \beta^2\alpha - 2\lambda + \sqrt{\eta}}{3\beta\alpha\lambda}, \tag{B.1}$$

$$s^* = \frac{-\tau\lambda - 2\beta\alpha\lambda + 3\beta^2\alpha^2 - \beta^2\alpha + 2\lambda - \sqrt{\eta}}{3\beta^2\alpha}, \tag{B.2}$$

$$b^* = \frac{\left(\rho\left(\beta-\lambda\right) + \lambda\sigma - \sqrt{\eta}\right)\left(\sqrt{\eta}\left(\rho\left(3-\beta-2\lambda\right) + 5\sigma\lambda\right) - \kappa\right)}{54\left(\beta^4\alpha^2\lambda\right)}, \tag{B.3}$$

where

$$\eta := 4\tau\lambda^2\beta\alpha - 4\beta^2\alpha\tau\lambda + 4\beta^2\alpha^2\lambda^2 - 4\tau\lambda^2 + 4\lambda^2 + 2\beta^2\alpha\lambda - 2\beta^3\alpha^2\lambda,$$

$$\kappa := 5\tau^2\lambda^2 - 20\tau\lambda^2 - 6\beta\alpha\tau\lambda + 14\tau\lambda^2\beta\alpha - 8\beta^2\alpha\tau\lambda + 2\beta^4\alpha^2 + 6\beta^2\alpha^2\lambda$$
$$-6\beta^3\alpha^2 + 2\beta^3\alpha^2\lambda + 8\beta^2\alpha^2\lambda^2 + 12\beta\alpha\lambda + 20\lambda^2 - 8\beta^2\alpha\lambda - 28\beta\alpha\lambda^2,$$
$$\rho := 2\beta\alpha, \quad \sigma := \left(2-\tau\right).$$

There are two possible corner solutions. If the preference for income redistribution is sufficiently high, and if the cost of income taxation is sufficiently low, the optimal solution implies $t^* = 1$. In this case we find that the optimal values of s and b are given by

$$s^* = \frac{2 - 2\tau - 4\alpha + \alpha\lambda + 2\tau\alpha}{2\left(\tau-2\right)} \lesseqgtr 0, \tag{B.4}$$

$$b^* = \frac{\left(2-\alpha\lambda\right)^2}{8\left(2-\tau\right)} > 0. \tag{B.5}$$

On the other hand, if the inequality aversion is sufficiently low and the unions are sufficiently strong, the optimal solution implies $b^* = 0$. Furthermore, from the budget constraint we know that $b^* = 0$ implies $s^* > 0$, so this particular corner solution uniquely determines Regime II.

B.1 Comparative statics in Regime I

Assume $\tau = 0$. From (B.1) and (B.2) we derive

$$\frac{\partial s^*}{\partial \beta} = -\frac{1}{3}\lambda\left(2-\beta\alpha\right)\frac{\Phi}{\beta^3\alpha\sqrt{k}}, \tag{B.6}$$

$$\frac{\partial t^*}{\partial \beta} = \frac{1}{3}\frac{\Psi}{\lambda\beta^2\alpha\sqrt{k}}, \tag{B.7}$$

where

$$\Phi := 2\sqrt{k} + \beta\alpha\left(4\lambda - \beta\right) - 4\lambda,$$
$$\Psi := \left(2\lambda + \beta^2\alpha\right)\sqrt{k} + \beta^3\alpha^2\left(\beta-\lambda\right) - 4\lambda^2\left(1-\beta\alpha\right),$$
$$k := \beta^4\alpha^2 + 2\lambda\left(1-\beta\alpha\right)\left(\beta^2\alpha + 2\lambda\left(1-\beta\alpha\right)\right) > 0.$$

From (B.6) and (B.7) we see that

$$sign\left(\frac{\partial s^*}{\partial \beta}\right) = sign\left(-\Phi\right)$$

and

$$sign\left(\frac{\partial t^*}{\partial \beta}\right) = sign\left(\Psi\right).$$

It is not straightforward to determine the sign of Φ and Ψ. Our approach will be first to define the set

$$D = \{(\alpha, \beta, \lambda) : \alpha \in (0, 1), \beta \in (0, 1), \lambda \in (0, 1)\}.$$

We will then solve $\Phi = 0$ and $\Psi = 0$ for one of the parameters. The solutions define two sets

$$D_\Phi = \{(\alpha, \beta, \lambda) : \Phi = 0\}$$

and

$$D_\Psi = \{(\alpha, \beta, \lambda) : \Psi = 0\}.$$

If $D_\Phi \cap D = \varnothing$, we know that Φ is either negative or positive for the entire set of permissible parameter values, and we can then simply check the sign by inserting numerical values for the parameters. Of course, the same logic applies for Ψ.

Solving $\Phi = 0$ for α yields a unique solution, $\alpha = 0$. Thus, $D_\Phi \cap D = \varnothing$. By inserting numerical values, it is straightforward to check that $\Phi > 0$ for all $(\alpha, \beta, \lambda) \in D$.

Solving $\Psi = 0$ for λ yields three roots:

$$\lambda_1 = 0,$$

$$\lambda_2 = \frac{\left(-8 - \beta^2\alpha^2 + 8\beta\alpha + \sqrt{\left(16\beta^2\alpha^2 + \beta^4\alpha^4 - 16\beta^3\alpha^3\right)}\right)\alpha\beta^2}{16\left(1 - \beta\alpha\right)^2},$$

and

$$\lambda_3 = \frac{\left(-8 - \beta^2\alpha^2 + 8\beta\alpha - \sqrt{\left(16\beta^2\alpha^2 + \beta^4\alpha^4 - 16\beta^3\alpha^3\right)}\right)\alpha\beta^2}{16\left(1 - \beta\alpha\right)^2}.$$

It is easily checked that $\lambda_2 < 0$ and $\lambda_3 < 0$ for all combinations of $\alpha \in (0, 1)$ and $\beta \in (0, 1)$. Thus, $D_\Psi \cap D = \varnothing$. By numerical insertion it is confirmed that $\Psi > 0$ for all $(\alpha, \beta, \lambda) \in D$. Thus, we conclude that $\frac{\partial s^*}{\partial \beta} < 0$ and $\frac{\partial t^*}{\partial \beta} > 0$ in Regime I.

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