Incentives, Globalization, and Redistribution*

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Abstract

We offer a new explanation for why taxes have become less redistributive in many countries while the concentration of incomes has increased. Our argument is based on the prevalence of incentive contracts in modern economies, in conjunction with increased product market integration. Globalization widens the spread of project returns and makes contract choices more responsive to tax changes. This can result in a lower optimal income tax rate while simultaneously increasing the income share of top earners. These results are confirmed in a calibrated version of our model based on U.S. income data.

KEY WORDS: Performance Contracts; Market Integration; Redistributive Taxation

JEL CLASSIFICATION: D63, F15, H21

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1 Introduction

Starting from the 1980s, the distribution of income in many developed economies has progressively become more unequal and more concentrated.[1] And yet, tax-transfer systems have not become more redistributive—on the contrary, in a number of countries they have actually become less so. Egger et al. (2019) have recently shown that, since the mid-1990s, economic globalization has resulted in a higher labor tax burden on the middle classes of OECD countries and a lower labor tax burden for the top one percent of earners. Similarly, Immervoll and Richardson (2011, Table 4), in a comprehensive study of redistribution policy among OECD countries, find that the gap between the Gini coefficient of market incomes and that of disposable incomes—a broad measure of redistribution—has fallen from the mid-1990s onwards.[2] For the U.S., several studies find a reduced progressivity of the tax system (Bargain et al., 2015; Piketty et al., 2018; Wu, 2021), which is only partially offset by changes in the transfer system (Heathcote et al., 2020).[3]

The observation of greater inequality going hand-in-hand with less redistribution through taxation poses a puzzle, and one that is of major policy importance. Standard theories of optimal taxation would predict an increase in tax levels when top incomes rise (Saez, 2001; Slemrod and Bakija, 2001). A combination of higher levels of inequality with less redistributive taxes can only be reconciled with those theories if the increase in inequality is accompanied by an increase in the elasticity of the tax base. And indeed, the evidence points towards a substantially increased tax elasticity of high incomes since the 1980s (e.g., Rubolino and Waldenström, 2019). Accordingly, one prominent argument in the literature is that the tax base has become more elastic at the upper end of the income distribution because high-income earners have become more inter-jurisdictionally mobile (e.g., Lehmann et al., 2014). However, for a significant fraction of individuals at the top of the income distribution, international mobility remains limited (Battisti et al., 2018; Kleven et al., 2020).[4]

In this paper we advance an alternative, and complementary, explanation for the concurrent observation of higher income concentration and lower redistribution. Our

[1] In many countries this has mainly happened at the top of the income distribution (Atkinson et al., 2011). But in some countries, like the United States, it has been shown to apply to the entire distribution (Piketty et al., 2018). Detailed international evidence on the development of various measures of income inequality on income and wealth is collected by the OECD (the IDD and WDD databases) and is summarized in the World Inequality Database (Alvaredo et al., 2017).

[2] According to both studies, this reverses the pattern from the 1980s and early 1990s, when globalization led to higher tax progressivity and increased income redistribution.

[3] This reduction in the progressivity of the U.S. tax system is however disputed, see, e.g., Splinter (2020).

[4] One likely reason for this limited mobility is that many high-earning occupations, such as the provision of legal services, often involve jurisdiction-specific human capital investment.

argument focuses on how optimal redistributive policies are affected by the internationalization of *product markets*—rather than labor markets— and how this feeds back on the structure of incentive contracts in the labor market.

Our starting point is the observation that labor markets are fundamentally shaped by incentive contracts. In a narrow sense, performance-based contracts can be distinguished by an explicit bonus element that is based on measured performance. In the UK, Bell and Van Reenen (2014) show that bonus income represents more than 10% of the total salary for the top 10% of earners employed in financial services, and for the top 5% of earners in other sectors. More generally, Lemieux et al. (2009) find, for a panel of more than 3,000 employees in the U.S., that almost 40% of workers receive some form of performance pay. In other OECD countries, the share of incentive contracts is somewhat lower, but still above 20% (Bryson et al., 2012). In a broader interpretation, many employed individuals who do not explicitly receive bonuses still face implicit performance-related incentives. Fama (1980) and Holmstrom (1999) have emphasized the role of implicit incentive contracts in a dynamic setting where satisfactory performance of a worker today is rewarded by promotions and a higher (nominally fixed) pay tomorrow. The importance of such implicit incentives has been empirically confirmed with both field and experimental data (Frederiksen, 2013; Sliwka and Werner, 2017). Increased reliance on performance pay is also a core reason for why U.S. wages have become substantially more volatile since the mid-1980s (Champagne and Kurmann, 2013; Nucci and Riggi, 2013). With incentive contracts, income inequality stems from two different sources: differences in individual abilities and outcome-dependent wage differentials for individuals of identical abilities. Redistributive taxation can address the first source of wage inequality but not the second, as the latter arises as a second-best market solution to a moral hazard problem. Performance pay thus limits the redistributive role of tax policy for any empirically observed distribution of earnings.

The second building block in our argument is the observation that the globalization of product markets is associated with higher individual income risk and steeper pay incentives. Rodrik (1997, 1998) was among the first to show that rising trade exposure is associated with higher aggregate income volatility. At industry and firm levels, Autor et al. (2017, 2020) have documented rising concentration indices in major industry groups of the U.S. economy and have proposed a *superstar firm* model to explain why industries seem to be increasingly characterized by 'winner-takes-most' features. This matches international evidence of 'export superstars', showing that the top percentile of firms is responsible for 80% of a country's exports (Bernard et al., 2018), and that the top firm alone is able to create sectoral comparative advantage (Freund and Pierola, 2015). Analyzing the labor market implications of globalization, Cuñat and Guadalupe (2009) provide empirical evidence that increased foreign competition raises the share of performance pay and increases wage differentials among executives in U.S. firms. Similarly, Dasgupta et al. (2018) report that major industry-level tariff cuts induced CEO turnover in U.S. firms and increased incentive pay for the new, outside CEOs. On the exporting side, Ma and Ruzic (2020) show that China's accession to the WTO in 2001 increased within-firm earnings differentials among U.S. firms that exported to China before the trade shock. In line with these findings, we model product market integration as a process that increases aggregate productivity but also raises income risks for firms and their workers as a result of increasingly global product market competition.

To develop our arguments, we describe a model of second-best contracting where incomplete insurance is required to elicit effort in the presence of moral hazard. Risk-averse workers with heterogeneous abilities face a continuous choice of labor supply, and a discrete choice between a performance-based contract that induces effort and a less efficient fixed-wage contract that does not. In equilibrium, higher productivity workers select into performance contracts, whereas less productive workers choose fixed-wage contracts. We then introduce a model of international competition in product markets, where market integration leads to a concentration of project returns. This increases the variance of returns within incentive contracts, which in turn raises the critical productivity level above which a worker will select into a performance-based contract.

Finally, we ask how these changes feed into the choice of an optimal linear tax rate financing a lump-sum transfer.[5] To this end, we characterize optimal tax policy in our model of incomplete contracting, before studying how the optimal tax formula is affected by a wider spread in market returns that follows from globalization. The increased prevalence of lower-productivity, fixed-wage contracts induced by this increase in income uncertainty, and the rising costs of disrupting higher-productivity performance-based contracts through taxes, both contribute to a push for lower taxes. As a result, we show that economic globalization can lead to a reduction in taxes, despite the concomitant increase in income concentration. Results obtained from a numerical version of the model calibrated to 2016 U.S. data shows that a globalization-induced increase in income concentration leads to a fall in the optimal tax rate under plausible parameter values. In contrast, we show that a similar increase in income concentration in a standard optimal tax model with complete contracting leads to an increase in the optimal tax rate.

Our study is related to several strands of literature, starting with the large literature on the optimal progressivity of income taxes (see Diamond and Saez, 2011, for an overview), and, more specifically, on redistributive taxation in the presence of earnings risk (see Boadway and Sato, 2015, for a synthesis). Following Varian (1980), most of this literature takes earnings volatility as exogenous, driven by luck. The implications of endogenous earnings risk are considered in a small literature strand that focuses on the 'crowding out' of private insurance by social insurance or redistributive taxation

[5]Our analysis thus perceives government policies as being chosen in the best interest of citizens, rather than being determined in a political market. Recent empirical evidence, surveyed in Potrafke (2017), indicates that the impact of partisan politics on tax policies has significantly fallen since the 1990s.

(Golosov and Tsyvinski, 2007; Chetty and Saez, 2010; Krueger and Perri, 2011; Chang and Park, 2021). Most closely related to our analysis is Doligalski et al. (2022), who analyze redistributive taxation in a model of performance pay contracts where individuals make continuous effort decisions within contracts. Besides differences in the way they model effort and contracts, their focus is on the implications of performance pay for the optimal non-linear income tax. Our focus is instead on how the internationalization of product markets affects the optimal linear income tax through its effects on the structure of labor market contracts.[6]

Our study also connects to prior research analyzing the optimal tax implications of the internationalization of labor markets, which largely focuses on the increased mobility of high-income earners (Simula and Trannoy, 2010; Bierbrauer et al., 2013; Lehmann et al., 2014; Tóbias, 2016; Landier and Plantin, 2017). In these models, changes in optimal income tax rates are exclusively driven by efficiency considerations related to the level and the slope of the semi-elasticity of migration.[7] They tend to find that labor market integration leads to inefficiently low redistributive income taxes, although Janeba and Schulz (2023) show that the downward effect of migration on redistributive income taxes is partly offset by general equilibrium effects.[8] Here we focus instead on the global competition of product markets and its effects on performance-based contracts as an alternative channel through which economic globalization influences tax policy choices. In our model, the increase in income dispersion within contracts induced by economic globalization generates an effect analogous to the 'superstar effect' examined by Scheuer and Werning (2017). However, introducing superstar effects for a given distribution of abilities in the setting they study leaves the optimal redistributive tax rate unchanged, because the higher redistributive gain from the tax is exactly offset by the larger elasticity of the tax base. In our setting instead, the increase in the dispersion of income within contracts can lead to a fall in the optimal tax rate.

Our analysis proceeds as follows. Section 2 describes our model of incomplete contracting, studies the sorting of heterogeneous workers into performance-based versus fixed-wage contracts, and analyzes how taxation affects the structure of contracts. Sec-

[6]A number of recent studies (Lemieux et al., 2009; Abraham et al., 2017) have emphasized the contribution of performance-based pay to rising wage inequality, while a number of older studies (Schmidt, 1997; Raith, 2003) have stressed the role of market competition in the determination of incentive pay. Our analysis connects these findings to the optimal tax literature.

[7]In line with their focus on efficiency effects, Simula and Trannoy (2010) and Lehmann et al. (2014) only consider revenue maximizing governments. Bierbrauer et al. (2013) consider utilitarian governments but assume that the relocation of workers is costless, implying that the government cannot levy positive taxes on individuals with above-average incomes.

[8]Empirical contributions to this literature have studied the migration responses of high-income earners both at the international level (e.g., Kleven et al., 2014) and at the national level (e.g., Agrawal and Foremny, 2019). See Kleven et al. (2020) for a review.

tion 3 introduces a model of international trade and discusses the relationship between the structure of contracts and economic globalization. Section 4 turns to redistributive taxation: it analyzes the effects of economic globalization on the optimal tax rate and presents numerical simulation results from a calibrated version of the model. Section 5 discusses our findings and their robustness to extensions. Section 6 concludes.

2 A model of incomplete contracting

2.1 Preferences, technologies, and contracts

We consider an economy with risk-averse individuals who are heterogeneous in their productivity type, α, drawn from a continuous distribution with positive support characterized by a cumulative density function, $F(\alpha)$. Production takes place through risky projects that are run by risk-neutral firms earning zero profits in expectations. Each project involves a single individual, hired by a firm as a worker.

In this setting, individuals face three decisions: (i) a discrete contract choice between a fixed-wage contract and an incentive contract, (ii) a discrete effort choice $e \in \{0, 1\}$ that affects the likelihood of success of a project, and (iii) a continuous choice of labor supply ℓ that determines the level of output generated in case of success, but does not affect the likelihood of success.

A project succeeds with probability $\pi \in (0, 1)$ when positive effort is exerted and with probability $\eta\pi < \pi$ otherwise. A project that employs an individual of productivity type α supplying labor ℓ yields return $\alpha\ell/\pi$ if successful, and nothing otherwise. As a result, the expected return of a project is

$$\begin{cases} \alpha\ell & \text{if } e = 1, \\ \eta\alpha\ell & \text{if } e = 0. \end{cases} \tag{1}$$

In other words, exerting effort discontinuously increases a project's expected return through a discrete change in the likelihood of success governed by the parameter $\eta \in [0, 1)$, independently of productivity, α, or hours worked, ℓ.

For tractability, we assume preferences to be additively separable between the utility from consumption, the disutility from effort, and the disutility from labor supply. Utility from consumption is logarithmic, implying a constant coefficient of relative risk aversion equal to unity—consistent with available evidence in the context of labor supply (Chetty, 2006). Exerting positive effort entails a fixed cost $c > 0$, independent of productivity or hours worked. The disutility of labor supply is convex and isoelastic: it equals $\kappa\ell^{1+\varepsilon}/(1+\varepsilon)$, where $\kappa > 0$, and where $\varepsilon > 0$ governs the elasticity of labor supply (Saez, 2001).

We restrict our attention to linear tax systems. We assume that the government levies taxes on labor income, z, at a flat rate, $t \geq 0$, and uses the revenue to finance a lump-sum transfer, $g \geq 0$. Disposable income, y, is thus equal to $y = (1 - t)z + g$.

Incentive contracts

Productivity, α, hours worked, ℓ, and the project's ex-post outcome are fully observable to the firm and verifiable, but effort, e, is not. Since effort is non-verifiable, wage payments cannot be conditioned on it. Contracting between firms and workers thus runs against a moral hazard problem, which can only be (partially) addressed through incentive-compatible contracts that induce workers to exert positive effort by conditioning wage payments on a signal that is positively correlated with effort. These performance-based contracts pay a high gross income, z_H, resulting in disposable income y_H, if the project is successful and a low income, z_L, resulting in disposable income y_L, otherwise. Hours worked, ℓ, are verifiable and contractible, implying that ℓ is independent of effort provision.

When exerting effort, a worker's expected utility in a performance-based contract is

$$EU^P_{e=1} \equiv \pi \ln y_H + (1-\pi) \ln y_L - c - \kappa \frac{\ell^{1+\varepsilon}}{1+\varepsilon}. \tag{2a}$$

In the absence of effort, expected utility in a performance-based contract is instead

$$EU^P_{e=0} \equiv \eta\pi \ln y_H + (1-\eta\pi) \ln y_L - \kappa \frac{\ell^{1+\varepsilon}}{1+\varepsilon}. \tag{2b}$$

To induce positive effort from workers, incentive contracts must satisfy the incentive-compatibility constraint $EU^P_{e=1} \geq EU^P_{e=0}$.[9] Profit maximizing firms will choose the contract that involves the lowest expected wage cost to them and still induces workers to exert effort. Hence, $EU^P_{e=1} = EU^P_{e=0}$ by profit maximization, which implies

$$\frac{y_H}{y_L} \equiv \frac{(1-t)z_H + g}{(1-t)z_L + g} = e^{\frac{c}{\pi(1-\eta)}} \equiv \Gamma > 1. \tag{3}$$

Condition (3) determines the equilibrium spread between the high payment, z_H, and the low payment, z_L, that just induces effort. This condition is expressed in terms of disposable income after taxes and transfers, which highlights that pre-tax income levels, z_H and z_L, in performance-based contracts are endogenous to the tax system.

A risk-neutral firm makes zero profits in expectations, implying that the expected gross income of a worker is equal to the project's expected return:

$$\pi z_H + (1-\pi) z_L = \alpha\ell \equiv z^P. \tag{4}$$

[9] An incentive contract that does not induce effort is strictly dominated by a fixed-wage contract. Indeed, an incentive contract weakly preferred by a risk-averse worker to a fixed-wage contract must feature an expected payment that is strictly higher than that in the fixed-wage contract, which would not be offered by a profit-maximizing firm. Conversely, an incentive contract weakly more profitable to the firm than a fixed-wage contract must yield a strictly lower expected utility to a risk-averse worker, who would not accept it.

The incentive-compatibility constraint (3) and the zero-profit condition (4) jointly determine the equilibrium levels of pre-tax income in each of the two states:

$$z_L = \frac{1}{1+\pi(\Gamma-1)}\left(\alpha\ell - \pi(\Gamma-1)\frac{g}{1-t}\right), \tag{5a}$$

$$z_H = \frac{1}{1+\pi(\Gamma-1)}\left(\Gamma\alpha\ell + (1-\pi)(\Gamma-1)\frac{g}{1-t}\right). \tag{5b}$$

where $\Gamma > 1$ is given in (3).

In performance-based contracts, individuals are thus paid the expected product of their labor, $z^P \equiv \alpha\ell$. However, in order to induce effort, this needs to be delivered in the form of a lottery that leaves the worker exposed to income risk: a high income, $z_H > z^P$, in favorable realizations and a low income, $z_L < z^P$, in unfavorable realizations.[10]

Given that workers are risk-averse and firms are risk-neutral (and therefore able, in principle, to insure workers at no cost), this outcome is inefficient and the result of the moral hazard problem between firms and workers. Yet, there is no scope for the government to provide insurance against income risk, since pre-tax income levels endogenously respond to changes in the tax system. Indeed, an increase in the transfer g or in the tax t leads to an increase in z_H and a decrease in z_L.

To see this point more formally, plug the equilibrium pre-tax income in each state, (5a) and (5b), into the expression for expected utility in performance contract, (2b), to obtain, after simplification,[11]

$$EU^P = \ln y_P - \kappa\frac{\ell^{1+\varepsilon}}{1+\varepsilon} + \ln\left(\frac{\Gamma^{\eta\pi}}{1+\pi(\Gamma-1)}\right). \tag{6}$$

This expression breaks down expected utility into two distinct components: a first component that is fully independent of income risk within contracts and corresponds to the utility of expected consumption, $y_P \equiv (1-t)\alpha\ell + g$, net of the disutility of labor supply, ℓ; and a second component that captures the utility cost associated with income risk and only depends on the structural parameters c, η, and π that determine the equilibrium spread of income levels through (3).[12] As the tax-transfer system only features in the first component, it can only redistribute income across individuals that differ in relation to their productivity, α, but it cannot insure individuals against income risk within contracts.

Maximizing (6) with respect to ℓ, the first-order condition characterizing the optimal

[10] Abstracting from redistribution (i.e, setting $g = 0$), equations (5a) and (5b) imply that the incentive payments, $z_H - z_L$, are exactly proportional to the workers expected income, $z^P \equiv \alpha\ell$. This is consistent with the empirical evidence, presented in Edmans et al. (2009), that the value of a CEO's incentive pay (measured by the value of the stock of shares and options) is a fixed share of, and hence proportional to, the CEO's total pay that can be seen as a proxy for the size of the firm managed by the CEO.

[11] Since $EU^P_{e=1} = EU^P_{e=0}$, we can use either (2a) or (2b).

[12] This second component is indeed negative for any $c > 0$, $\eta \in [0,1]$, and $\pi \in [0,1]$—see Appendix A.1.

level of labor supply, ℓ^P, contracted with the firm in an incentive contract is[13]

$$\frac{(1-t)\alpha}{(1-t)\alpha\ell^P + g} = \kappa\left(\ell^P\right)^{\varepsilon}; \tag{7}$$

this is independent of the dispersion of pre-tax income within the contract and coincides with the solution of a standard labor supply model for a productivity level α.

Fixed-wage contracts

Alternatively, firms can offer fixed-wage contracts that fully insure the worker and pay the same wage level, w_F, in all contingencies, whether or not the project is successful.[14] The firm then fully anticipates that, absent any incentive to exert effort, workers will choose to exert no effort. The expected return of the project in this case is thus $\eta\alpha\ell < \alpha\ell$.

Expected profits under this contract must also be zero, which implies a non-stochastic level of labor income equal to

$$z^F = \eta\alpha\ell. \tag{8}$$

The expected utility of a worker in a fixed-wage contract is thus

$$EU^F = \ln y_F - \kappa\frac{\ell^{1+\varepsilon}}{1+\varepsilon}. \tag{9}$$

with (deterministic) consumption $y_F = (1-t)\eta\alpha\ell + g$. Hence, a fixed-wage contract removes the welfare cost associated with income risk but replaces it with a welfare cost that comes from inefficient production choices, translating in a lower labor income, $\eta\alpha\ell$. Maximizing (9) with respect to ℓ, the optimal level of labor supply contracted with the firm in a fixed-wage contract, ℓ^F, solves

$$\frac{(1-t)\eta\alpha}{(1-t)\eta\alpha\ell^F + g} = \kappa\left(\ell^F\right)^{\varepsilon}, \tag{10}$$

where the marginal benefit to increase hours worked (LHS) is increasing in the expected wage rate $\eta\alpha$. Hence, with $\eta < 1$,

$$\ell^P > \ell^F, \tag{11}$$

meaning that a given type α always works more hours in an incentive contract than in a fixed-wage contract, reinforcing the efficiency loss associated with selecting a fixed-wage contract over a performance-based contract.

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[13]Since labor supply is observable and contractible, the level of ℓ can be entered directly in the incentive contract. Moreover, the firm's zero-profit condition (4) implies that the worker's optimal choice of labor supply will also be profit-maximizing for firms; no other choice of ℓ will survive under competition.

[14]The choice between performance-based and fixed-wage contracts in the model is a stylized representation of what would in reality be a choice within a continuum of possible contract structures all featuring some performance-based element to a greater or lesser extent. Here we just restrict the contract choice to the two endpoints of this distribution. From this perspective, fixed-wage employment contracts that do not provide full job security would correspond to some combination between these two extremes rather than to what we call here a 'fixed-wage contract'.

2.2 Contract choice

Sorting by productivity type

Here we analyze the conditions under which individuals select performance-based contracts and the sorting of different productivity types into different contract forms. Individuals will select a performance-based contract if it yields a higher expected utility than a fixed-wage contract does, i.e., if $EU^P > EU^F$.

In the absence of redistribution through taxes and transfers, either all individuals choose performance-based contracts or none do. In the latter case individuals always choose fixed-wage contracts and we obtain a standard optimal linear tax model (Sheshinski, 1972). We thus focus on the former case and we show in Appendix A.2 that this implies

$$\Gamma^{\eta\pi} - \eta\big(1 + \pi\,(\Gamma - 1)\,\big) \geq 0, \tag{12}$$

which places an upper bound $\bar{c}$ on the fixed cost c, for particular values of η and π. More generally, (12) defines the set of admissible parameters (c, η, π).[15]

The monotonic sorting of productivity types into contract forms then relies on the fact that the attractiveness of the performance-based contract is increasing with an individual's productivity type (see Appendix A.2):

$$\frac{\partial(EU^P - EU^F)}{\partial\alpha} > 0. \tag{13}$$

Therefore, if $EU^P \geq EU^F$ for a productivity type α, this must also be true for all productivity types $\alpha' \geq \alpha$; and if $EU^P < EU^F$ for a productivity type α, this must also be true for productivity types $\alpha'' < \alpha$. This implies a cut-off rule for the choice of contracts around the productivity level, $\hat{\alpha}$, for which $EU^P = EU^F$, given by

$$\hat{\alpha} = \frac{g}{1-t}\frac{1}{K}\,, \tag{14}$$

where K is defined as

$$\frac{1}{K} \equiv \frac{1 + \pi\,(\Gamma - 1) - \Gamma^{\eta\pi} e^{-\frac{\kappa}{1+\varepsilon}\left(\left(\ell^P\right)^{1+\varepsilon} - \left(\ell^F\right)^{1+\varepsilon}\right)}}{\ell^P \Gamma^{\eta\pi} e^{-\frac{\kappa}{1+\varepsilon}\left(\left(\ell^P\right)^{1+\varepsilon} - \left(\ell^F\right)^{1+\varepsilon}\right)} - \eta\ell^F\,(1 + \pi\,(\Gamma - 1))}\,, \tag{15}$$

and is guaranteed to be positive under condition (12)—see Appendix A.2.

The critical value $\hat{\alpha}$ thus partitions the range of productivity types into two intervals:

[15] We are grateful to an anonymous reviewer for pointing out that, when $\eta \to 0$, the choice between a performance contract and a fixed-wage contract becomes an extensive margin choice between working and not working. Indeed, labor income in fixed-wage contracts then converges to zero ($z^F \to 0$), implying that individuals can choose to stay inactive and receive the transfer g, rather than incurring the fixed cost of effort c and work in performance-based contracts.

Proposition 1. *For any tax-transfer system* (t, g)*, and any set of parameters* (c, η, π) *satisfying condition* (12)*, there exists a productivity level* $\hat{\alpha} \geq 0$ *such that:*

- *individuals with productivity* $\alpha \geq \hat{\alpha}$ *select into incentive contracts with state-contingent labor incomes,* z_H *and* z_L*, given by* (5a)-(5b)*, and exert positive effort;*
- *individuals with productivity* $\alpha < \hat{\alpha}$ *select into fixed-wage contracts with a deterministic labor income,* $z^F = \eta \alpha \ell$*, and exert no effort.*

PROOF*:* See Appendix A.2.

Proposition 1 states that, in the presence of redistributive income taxes, performance-based contracts are concentrated among high-ability individuals. Our analysis thus focuses on bonuses in managerial positions, rather than on other forms of incentive pay, such as piece rates.[16] For these 'managerial workers', our prediction is aligned with the empirical evidence. Bell and Van Reenen (2014, Figure 3) document a strong and positive relationship between the percentile of earners in the U.K. wage distribution, and their bonus share in the total pay. Similarly, Lemieux et al. (2009, Table 1) show that workers in performance-pay jobs earn more, have higher levels of education, and are more often paid a salary, as compared to workers in fixed-wage jobs.

Effects of taxes and transfers on contract choices

The productivity cut-off, $\hat{\alpha} = \frac{g}{1-t}\frac{1}{K}$, depends on taxes and transfers directly through $\frac{g}{1-t}$ and indirectly through the effect of taxes and transfers on labor supply choices, ℓ^P and ℓ^F, that enter K. Since labor supply choices are utility maximizing, these indirect effects cancel out (as a consequence of the envelope theorem). As a result, we show in Appendix A.3 that changes in the productivity cut-off are related to changes in the tax rate t or in the transfer g through

$$\frac{\partial \hat{\alpha}}{\partial t} = \frac{\hat{\alpha}}{1-t} \geq 0, \qquad \frac{\partial \hat{\alpha}}{\partial g} = \frac{\hat{\alpha}}{g} \geq 0. \tag{16}$$

An increase in the tax rate raises the critical productivity level $\hat{\alpha}$ below which workers select low-return, fixed-wage contracts. This result corresponds to the standard labor supply distortion in models with continuous effort choice (e.g., Doligalski et al., 2022), as the fixed-wage contract substitutes leisure in exchange for a lower expected wage. An increase in the transfer also raises $\hat{\alpha}$ through income effects, because it reduces the marginal utility of income and hence the benefits of receiving higher expected income in incentive contracts.

The comparative statics effects discussed above do not take into account the fact that t and g are linked, in equilibrium, through the government's budget resource constraint

[16] The latter are found mostly in low-productivity jobs. See, e.g., Bandiera et al. (2005) for an analysis of the effects of piece rates on the productivity of low-income fruit pickers.

(which we formally introduce in Section 4). The total effect of a change in t must incorporate the induced change in the transfer g, which yields

$$\frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}t} = \frac{\partial\hat{\alpha}}{\partial t} + \frac{\partial\hat{\alpha}}{\partial g}\frac{\mathrm{d}g}{\mathrm{d}t} \geq 0 \,. \tag{17}$$

This total derivative has to be positive if the amount of transfer increases with taxes, $\mathrm{d}g/\mathrm{d}t \geq 0$. It can never be optimal, however, to select a tax rate where this is not the case—this would imply being on the wrong side of the Laffer curve. Therefore, an increase in taxes unambiguously raises $\hat{\alpha}$ and reduces the number of individuals in incentive contracts:

Proposition 2. *Consider two tax levels, t' and $t'' > t'$. The range of productivity types that select into performance contracts is narrower under t'' than under t', and the tax base is thus smaller.*

PROOF*:* See Appendix A.3.

Proposition 2 highlights the novel efficiency cost associated with redistribution in this model. Levying taxes to finance redistribution will destroy some incentive contracts and replace them with less efficient fixed-wage contracts.

Figure 1 illustrates this result. An increase in the tax rate leads to an upward shift in $\hat{\alpha}$, implying that a larger range of productivity types select into fixed-wage contracts. Also, productivity types that still select into performance-based contracts now face a larger variability in their pre-tax income, because incentive contracts respond to offset the tax change by increasing the pre-tax wage differential in order to still induce effort under the higher tax rate. Last, an increase in the tax rate triggers a reduction in labor supply, which is what drives the decrease in pre-tax income in fixed-wage contracts in Figure 1.

Effects of a change in π on contract choices

A reduction in the probability of success, π, corresponds to a mean-preserving spread in returns realizations. This raises income risk in performance-based contracts, making them less attractive to risk-averse workers by comparison with the fixed-wage alternative. As a result, the direct effect of a fall in π, holding tax policy constant, is to induce risk-averse workers to switch to fixed-wage contracts; i.e., by (14), the productivity cutoff $\hat{\alpha}$ increases. At the same time, by (3), a reduction in the probability of success π raises the income spread that is needed to induce effort in performance contracts, raising the payment in favorable realizations (z_H) and lowering the payment in unfavorable realizations (z_L). This implies that a decrease in π unambiguously raises the fraction of total income that accrues to a subset of high earners in favorable realizations:

Proposition 3. *Holding tax policy, (t, g), constant, a reduction in the probability of success of all projects from π' to $\pi'' < \pi'$ reduces the range of productivity types that select into performance contracts ($\hat{\alpha}'' > \hat{\alpha}'$) and raises the fraction of pre-tax income accruing to individuals above a given percentile point in the distribution of realized incomes.*

PROOF*:* See Appendix A.4.

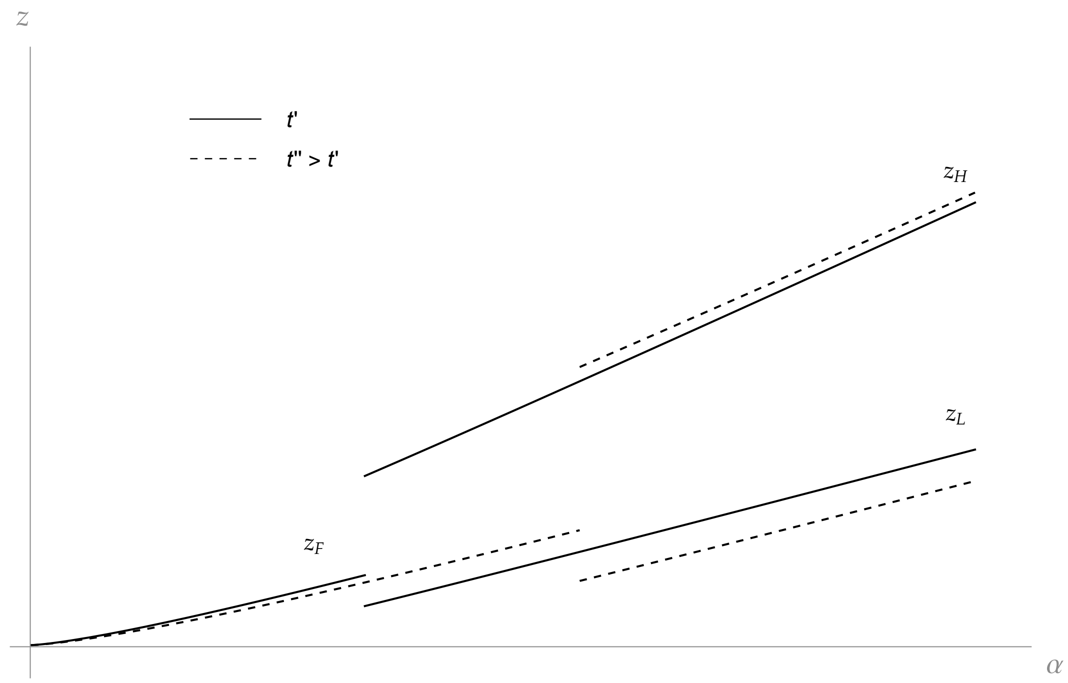

Figure 1: Equilibrium contracts for different levels of taxation

These results are illustrated in Figure 2, which shows that a reduction in the probability of success raises the productivity cut-off $\hat{\alpha}$ as well as the dispersion of pre-tax incomes within incentive contracts. Both effects lead to an increase in the concentration of realized income.

In the next section, we will relate the fall in the success probability π to an increase in economic globalization, and more specifically to a reduction in the costs of international trade. In this light, our results in Proposition 3 are consistent with the empirical evidence that economic globalization increases wage inequality (Goldberg and Pavcnik, 2007; Dreher and Gaston, 2008).[17] It is also consistent with evidence showing that stronger competition in global markets increases the sensitivity of performance contracts and leads to increased pay differentials within firms (Cuñat and Guadaloupe, 2009; Ma and Ruzic, 2020).

Cuñat and Guadaloupe (2009, Table 5) also show that the changes in compensation contracts brought about by increased import competition are stronger the higher up executives are in the wage hierarchy: their fixed salary falls by more and their success-related income component rises by more following stronger import penetration than is true in the average of all executives. This can be seen as evidence in favor of a continuous version of our model where the share of performance-related pay rises with the productivity type, and this relation is accentuated by stronger import competition.

[17]Dorn et al. (2022) re-examine the link between globalization and income inequality for 140 countries over the period 1970-2014. They find a robust positive relationship between globalization and wage inequality for most countries, including China and Eastern Europe, though the effect is not significant for the most advanced economies.

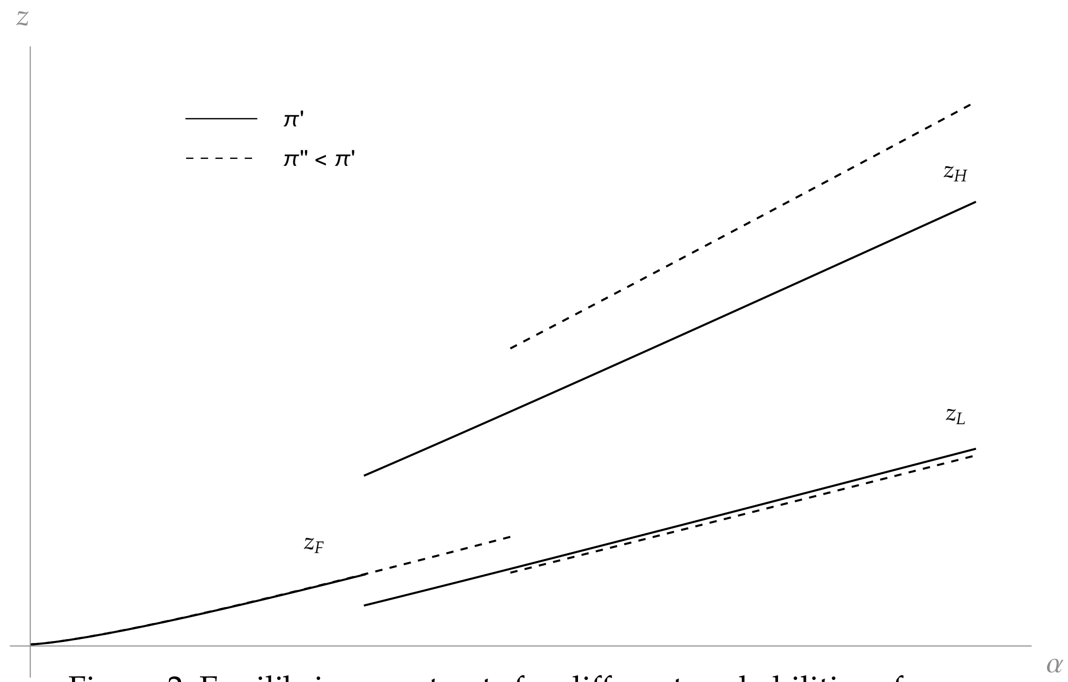

Figure 2: Equilibrium contracts for different probabilities of success

3 Economic globalization and incentive contracts

In this section, we describe a model of international competition and trade where economic globalization (a fall in trade costs) leads to a concentration of project returns, which feeds back on the structure of incentive contracts on the labor market.

3.1 International trade and international competition

The model features symmetrically differentiated intermediate good varieties, iceberg trade costs, and a finite number of ex-post heterogeneously productive firms competing in the international market for each variety (the term 'firm' to be interpreted here as being synonymous with 'project').[18] These are the same basic ingredients found in Eaton and Kortum (2002), where comparative-advantage driven trade is the result of productivity differentials that arise from a stochastic sampling process.

Our key departure from that model is in considering technologies that exhibit decreasing rather than constant average costs, which gives rise to an oligopolistic (Bertrand) rather than a perfectly competitive market structure in the intermediate goods market. Combined with the stochastic process generating the distribution of firm productivity levels, this leads to an equilibrium where ex-ante symmetric firms obtain heterogeneous ex-post levels of revenue, with positive profits being concentrated in a subset of firms—and the more so the smaller trade costs are.

[18]In this interpretation, real-world business entities consist of a collection of individual projects.

This property is akin to that of the 'superstar firm' model of Autor et al. (2017, 2020), and is consistent with empirical evidence on 'export superstars' (Freund and Pierola, 2015; Bernard et al., 2018). Market integration through globalization gives each firm access to a larger combined market with more competitors. This increases the revenues a firm can obtain if it manages to capture more markets, but it makes capturing any particular market comparatively less likely because of the larger number of competitors.

Production structure and price competition

Consider a world economy with L symmetric locations (or countries), each denoted by l. There are two different types of produced goods. First, there is a non-traded composite good that is the final consumption good for consumers and serves as the numeraire in each country.[19] Second, there are symmetrically differentiated intermediate goods that are traded on international markets. In addition, there are two non-produced and non-traded inputs: labor, whose supply is elastic, and (physical) capital, whose supply is fixed.

The production of the composite numeraire good combines the different varieties of intermediate goods with capital. The production of intermediate varieties combines the composite numeraire good with labor. In each location, the composite numeraire thus serves both as the final consumption good for consumers and as an input for the production of intermediate goods.[20]

More precisely, the composite numeraire good is produced at each location by atomistic, perfectly-competitive, zero-profit making firms using as inputs a unit mass of intermediate varieties, $i \in [0,1]$, and capital through a nested CES/Cobb-Douglas technology with constant returns to scale, represented by the following aggregate production function:

$$Y_l = n_l^{1-\xi} \left(\int {x_{li}}^{(\sigma-1)/\sigma} \, \mathrm{d}i \right)^{\xi\sigma/(\sigma-1)}, \quad \sigma > 1, \ \xi \in (0,1), \tag{18}$$

where, at each location l, Y_l is the total output of the numeraire good, x_{li} is the input quantity of variety i, ξ is the input share of the intermediate good varieties, and σ is the elasticity of substitution between varieties.

Our focus is on the production of the symmetrically differentiated intermediate goods that are traded on international markets. At each location, there is a finite and endogenous number of firms, M, that may produce a certain variety, i. Within varieties, outputs are homogeneous across firms and thus perfect substitutes. Setting up a firm, k, requires a fixed amount, ω, of labor input. Once this fixed cost has been incurred, the firm obtains a productivity draw, $\phi_{ki} > 1$, from a probability distribution with c.d.f.

[19]Strictly speaking, the price of the non-traded composite good can be normalized to unity only in one location. However, because of the symmetry of the model, the equilibrium value of this price is the same at all locations.

[20]The use of the numeraire good as a produced input follows Eaton and Kortum (2002).

$F_\phi(.)$. This productivity level determines firm k's marginal cost of producing variety i using the numeraire good: the firm's marginal input requirement in terms of the numeraire is $1/\phi_{ki}$.

The variable profit of firm k in its home market, $l = h$, when selling at a price p_{khi} and facing demand x_{khi}, is then given by

$$\Lambda_{khi} = \left(p_{khi} - \frac{1}{\phi_{ki}} \right) x_{khi}. \tag{19}$$

When selling in a foreign market, $l = f$, the presence of iceberg trade costs, τ, will inflate marginal costs. The variable profit of firm k selling in a foreign market at a price p_{kfi} and facing demand x_{kfi} is thus given by

$$\Lambda_{kfi} = \left(p_{kfi} - \frac{\tau}{\phi_{ki}} \right) x_{kfi}, \tag{20}$$

where firm-specific demands, x_{khi} and x_{kfi}, depend on the prices charged by all firms (domestic or foreign) selling the same variety at the given location. Since firms engage in price (Bertrand) competition, and since their outputs are perfect substitutes, the only firm to produce variety i for a given location l will be, in equilibrium, the one with the lowest marginal cost: either a "national champion" or a "superstar exporter". Trade costs thus shield national champions from international competitors, implying that a reduction in trade costs reduces the probability of any given firm making positive profits and leads to the concentration of profits in superstar exporters. Before establishing this result, we complete the exposition of the model.

Consumption and labor supply

In each country there is a unit mass of individuals of different productivity types α, each elastically supplying $\alpha\ell(\alpha)$ effective units of labor paid at factor price q_ℓ and consuming $y(\alpha)$ units of the numeraire good. Carrying over the functional form assumptions we made in Section 2, the utility of an individual of type α with disposable income $y(\alpha)$ equals

$$u(\alpha) = \ln y(\alpha) - \kappa \frac{\ell(\alpha)^{1+\epsilon}}{1+\epsilon} . \tag{21}$$

Capital income is apportioned proportionally to labor income.[21] Normalizing the capital endowment to unity in each country and introducing factor price r, this implies an additional income of $q_r \equiv r/E[\alpha\ell]$ per effective units of labor. The pre-tax income of an individual with productivity type α supplying $\ell(\alpha)$ units of labor is thus equal to $z(\alpha) = (q_\ell + q_r)\alpha\ell(\alpha)$. With a linear tax, t, used to finance a transfer, g, after-tax (disposable) income is then equal to $y(\alpha) = (1-t)(q_\ell + q_r)\alpha\ell(\alpha) + g$. As a result, the condition

[21] This amounts to assuming that capital ownership is perfectly correlated with productivity, α. Bernard et al. (2019) make an analogous assumption in relation to profits.

identifying, $\ell(\alpha)$, the utility-maximizing level of labor supply—condition (B.2) in Appendix B.1—coincides with the solution of a standard labor supply model, i.e., (7), given a productivity level $(q_\ell + q_r)\alpha$.[22] The aggregate amount of efficiency units of labor supplied in each country is then given by $E[\alpha\ell] = \int_\alpha \alpha\ell(\alpha)\,\mathrm{d}F_\alpha(\alpha)$.

Equilibrium number of firms

We next characterize the equilibrium number of firms, M, that may produce a given variety in each country and the equilibrium wage per efficiency unit of labor, q_ℓ. Since there is a unit mass of symmetrically differentiated varieties, M is the same for each variety and is also the total number of firms in a local economy. The aggregate amount of efficiency units of labor supplied in each country is $E[\alpha\ell]$ and the fixed labor input to set up a firm is ω. Labor market clearing and free entry of firms thus imply that the total number of firms is

$$M = \frac{E[\alpha\ell]}{\omega}. \tag{22}$$

As we assume that the fixed labor input cost is sunk before the realization of productivity draws, a firm must employ the labor input and commit to a contracted compensation before observing its productivity draw. With free entry, the fixed labor costs incurred by a firm, $q_\ell\,\omega$, must therefore be equal to its expected variable profits, $E\left[\Lambda\right]$—the same for all firms in a symmetric equilibrium:

$$q_\ell\,\omega = E\left[\Lambda\right]. \tag{23}$$

This zero-profit condition in the production of intermediate varieties determines the equilibrium wage per efficiency unit of labor, q_ℓ, and allows us to bridge workers' compensation in this trade model with workers' compensation in the contracting model of Section 2—see Section 3.3 for a formal link and a discussion.

A complete characterization of the equilibrium conditions is given in Appendix B.1.

3.2 Market integration and the concentration of project returns

In the context of the contracting problem between workers and firms we set out in Section 2, we are interested in understanding how the probability of a firm k making overall positive gross returns, $\Pr\{\Lambda_k \equiv \sum_l \Lambda_{kl} > 0\}$, varies with the level of international economic integration as measured by the size of trade costs, τ.

With price (Bertrand) competition in the market for traded good variety $i \in [0,1]$ in a given location l, profit-maximizing firms select a price that undercuts the lowest-price competitor while still securing positive variable profits.[23] In equilibrium, the only firm

[22] As we show in Section 3.3 below, our model is invariant to a shift in productivity levels by a multiplicative factor, implying that this re-scaling of productivity levels by a factor $q_\ell + q_r$ is innocuous.

[23] By symmetry, the analysis is the same for any variety. We thus omit i going forward.

to make positive variable profits on this market is thus the lowest-cost firm. Firm k can therefore "take" the market in location l and secure positive gross returns Λ_{kl} in that market, if and only if its marginal cost, $1/\phi_k$, is the lowest amongst all its competitors—or equivalently, its productivity ϕ_k is the highest. Otherwise, its gross returns is zero in that market. (If two or more firms are tied, each gets an equal share of the market, but all have zero gross returns.)

With iceberg trade costs $\tau > 1$, the relevant comparison in each market is between firms' trade cost-adjusted productivity levels. A firm k is then able to take its home market, h, if and only if, its productivity is higher than that of all its domestic competitors (located in $l = h$) and higher than the trade cost-adjusted productivity of all its foreign competitors (located in $l \neq h$). Firm k takes its home market h, if and only if,

$$\phi_k \geq \widehat{\phi}_h(\tau) \equiv \max \left\{ \widetilde{\phi}_h, \frac{\widetilde{\phi}_f}{\tau} \right\}, \tag{24}$$

where $\widetilde{\phi}_h$ is the highest productivity draw by domestic firms other than k, $\widetilde{\phi}_f$ is the highest productivity draw by foreign firms, and $\widehat{\phi}_h(\tau)$ is the highest trade-cost adjusted productivity draw by any firm that potentially sells in firm k's domestic market.

If condition (24) is fulfilled, then firm k may take not only its domestic market, but also a number of foreign markets. However, an outcome where a firm only takes one or more foreign markets without also taking its domestic market cannot occur. Indeed, if firm k takes a given foreign market f, then its trade cost-adjusted productivity must be higher than the productivity of any domestic firm in f and its productivity must be higher than the productivity of any firm not located in f. This means that the productivity of firm k must be higher than the productivity of its domestic competitors and higher than the trade cost-adjusted productivity of its foreign competitors. The probability that firm k makes positive gross returns is thus equal to the probability that firm k takes its home market:

$$\Pr\{\Lambda_k > 0\} = \Pr\{\Lambda_{kh} > 0\} = \Pr\left\{\phi_k \geq \widehat{\phi}_h(\tau)\right\}. \tag{25}$$

Conditional on a particular productivity draw, ϕ_k, the probability that firm k takes its own market is

$$\Pr\left\{\phi_k \geq \widehat{\phi}_h(\tau) \mid \phi_k\right\} = F_\phi\big(\phi_k\big)^{M-1} F_\phi\big(\tau\,\phi_k\big)^{(L-1)\,M}, \tag{26}$$

where the right-hand side represents the probability that all of k's $(M-1)$ domestic competitors get a productivity draw that is less than ϕ_k, and that all of k's $(L-1)M$ foreign competitors get a trade cost-adjusted productivity draw that is less than $\tau\,\phi_k$.[24]

As a result, the ex-ante (unconditional) probability of a given firm, k, to experience positive gross returns is

$$\Pr\{\Lambda_k > 0\} = \int_{\phi_k} F_\phi\big(\phi_k\big)^{M-1} F_\phi\big(\tau\,\phi_k\big)^{(L-1)\,M} \,\mathrm{d}F_\phi(\phi_k). \tag{27}$$

[24] Indeed, the probability that all ϱ independent draws of a random variable, X, with c.d.f. $F_X(\cdot)$, lie below a particular value $\tilde{X}$ is: $\Pr\left\{ \max_k\{X_k\} \leq \tilde{X} \right\} = F_X(\tilde{X})^\varrho$.

This probability is increasing in the level of trade costs, τ, through the second term in the integral. Hence, a decrease in τ—corresponding to a fall in institutional or technological trade costs and marking an increase in economic globalization—lowers the probability that a firm k experiences positive gross returns:

Proposition 4. *A reduction in trade costs, τ, lowers the probability that a representative firm experiences positive gross returns across all markets.*

Intuitively, trade costs shield firms in each market from foreign competitors that are potentially more productive. If trade costs are prohibitively high, there will be in each country and for each variety one "national champion" that takes its entire domestic market and makes positive gross returns. As trade costs fall, it becomes more likely that a foreign competitor is able to underbid the national champion and capture the market, leading to the concentration of profits in "superstar exporters". [25]

In addition, globalization also affects real incomes. A reduction in τ lowers the cost of intermediates and thus leads to a uniform increase in net real output of the numeraire good. This in turn implies an increase in overall real income $(q_\ell + q_r)E[\alpha\ell]$ (which equals net output) and in the total factor return per efficiency unit of labor, $q_\ell + q_r$, translating into an increase in real income for all productivity types. We take up this additional effect of globalization in the following section.

3.3 Market integration, incomplete contracting and productivity shifts

Link with the model of incomplete contracting

So far, we have characterized the relationship between economic globalization and the probability that a firm succeeds (makes positive profits), abstracting from performance contracts. We now present a full correspondence between workers' compensation in the international trade model described above and workers' compensation in the model of incomplete contracting presented in Section 2.

This correspondence is achieved by assuming that the distribution of firm's k productivity draw, ϕ_k, also depends on the effort, $e_k \in \{0,1\}$, exerted by the worker who supplies labor (used as a fixed input to set up the firm). Specifically, we assume that the distribution of productivity realizations when exerting positive effort, $e_k = 1$, first-order stochastically dominates the corresponding distribution when exerting no effort, $e_k = 0$, such that, $F_\phi(\phi_k \,|\, e_k = 1) > F_\phi(\phi_k \,|\, e_k = 0)$. Denoting the probability that a firm succeeds

[25] This is broadly analogous to the effect of market integration in heterogeneous firms models with firm-differentiated varieties and monopolistic competition (e.g., Melitz, 2003), where the proportion of active firms decreases and ex-post gross profits for the remaining active firms increase.

when effort is exerted, π, this implies that there exists a value $\eta \in [0,1)$ such that[26]

$$\pi \equiv \Pr\left\{\Lambda_k > 0 \,|\, e_k = 1\right\} > \Pr\left\{\Lambda_k > 0 \,|\, e_k = 0\right\} \equiv \eta\pi. \tag{28}$$

As in Section 2, wage payments cannot be conditioned on effort and can only be conditioned on a signal that is correlated with effort, i.e., on ex-post gross returns being zero or strictly positive. The introduction of discrete effort choices thus leads to the same contracting problem, thereby establishing a full link between the two models.[27]

A key assumption in establishing this link is that labor is used in a fixed amount in each firm and does not enter variable costs. This ensures that the production of an intermediate variety within a firm can always be scaled upwards by using inputs other than labor in response to a positive demand shock that follows from a favorable productivity draw. In the international trade model presented above, this (produced) variable input is the numeraire, which motivates the two different uses of the numeraire. At the same time, since expected profits and fixed labor cost are equal in equilibrium, this assumption also implies that returns to effort ultimately accrue to labor. As a result, by reducing the probability of firms' success, π, the globalization of product markets feeds back on the structure of labor contracts and affects the incentives to exert effort.

The effect of productivity shifts

A second effect of globalization is to induce a uniform increase in real incomes through real increases in the overall payment, $q_\ell + q_r$, accruing to each efficiency unit of labor. This effect is equivalent to a positive shift that raises the productivity of each worker by a multiplicative factor $\beta > 1$. Our model of redistribution with incomplete contracting is fully invariant to this second effect: it does not affect the structure of contracts nor responses to taxation.

To see this, consider an economy where the productivity cut-off above which individuals select into performance contracts is $\hat{\alpha}_0$, the tax rate is t_0 and the transfer is g_0. Keeping t_0 constant, a uniform shift in productivity levels by a multiplicative factor β increases pre-tax incomes and thus tax revenue by the same factor β, resulting in a new transfer equal to $g_1 = \beta g_0$. This implies that labor supply decisions are unaffected as can be seen from the first-order conditions for labor supply, (7) and (10), and that the new productivity cut-off is then $\hat{\alpha}_1 = \beta\hat{\alpha}_0$, implying that contract choices are also unaffected. As a result, disposable incomes rise by a (multiplicative) factor β, which shifts all utility levels by some (additive) constant, since utility is logarithmic in consumption. Anticipating our discussion of optimal taxes in the next section, this leaves responses to taxation, and thus the optimal tax rate, unaffected—see Appendix B.3 for a formal proof.

[26]In general, η varies with trade costs, τ. However, η is invariant if we assume that the distribution of ϕ is Pareto (as in Chaney, 2008) with c.d.f. $F_\phi(\phi) = 1 - (\underline{\phi}/\phi)^\nu$, $\underline{\phi} \geq 1$, $\alpha > 1$, and that first-order stochastic dominance across distributions is obtained by varying the value of the parameter $\underline{\phi}$.

[27]Since a firm only employs ω units of labor, a worker supplying $\alpha\ell$ efficiency units of labor is formally involved in $\alpha\ell/\omega$ firms (or projects). See Appendix B.2 for a detailed discussion.

Proposition 5. *An economy-wide change in productivity that increases all productivity levels by a multiplicative factor β has no effect on contract choices or on responses to taxes.*

PROOF*:* See Appendix B.3.

Since our model of redistribution with incomplete contracting is fully invariant to a multiplicative re-scaling of productivity levels, the rest of our analysis abstracts from this second effect of globalization. We thus model economic globalization as a process that solely increases income risk and income concentration through a reduction in the probability of success, π.

4 Optimal redistribution and economic globalization

We now turn to our main question: how optimal redistribution is affected by an increase in income risk and income concentration brought about by market integration. First, we characterize optimal redistribution in an economy with performance contracts. Second, although market integration (modeled as a reduction in the probability of success in performance contracts) increases inequality, we show that it may concomitantly decrease the optimal tax rate. We conclude with numerical simulations showing that this prediction applies to a calibrated economy with performance contracts, whereas a similar increase in income concentration in a comparable economy with complete contracts would lead to an increase in the optimal tax rate.

4.1 Optimal redistribution with incomplete contracting

As the tax-transfer system cannot insure individuals against the income risk they face conditional on their productivity type, its role is limited to redistributing income across individuals of different productivity types.[28] However, since income taxation is conditioned on income realizations, and since performance contracts imply that the ranking of income realizations is not fully aligned with the ranking of productivity types, redistribution via income taxation is imperfectly targeted and distorts contract design and contract choice. We analyze how this affects optimal redistribution.

We consider the problem of a government (social planner) seeking to maximize a weighted sum of individuals' expected utilities,

$$W = \int_{\alpha \le \hat{\alpha}} \mu(\alpha) EU^F(\alpha) \mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \mu(\alpha) EU^P(\alpha) \mathrm{d}F(\alpha), \tag{29}$$

[28]The optimal income tax literature often distinguishes between an *insurance role* of the income tax, which reduces the variance of exogenous earnings risk for a given productivity type, and a *redistributive role*, which reduces the after-tax variation in the incomes of different productivity types. See Boadway and Sato (2015) for a theoretical survey and Hoynes and Luttmer (2011) for an empirical analysis of tax-and-transfer programs in the U.S. states.

where $\mu(\alpha)$ are the Pareto-weights attached to individuals of productivity α, which encapsulate the government's tastes for redistribution. The government's budget constraint is

$$t\,\underbrace{\left(\int_{\alpha\leq\hat{\alpha}}\eta\alpha\ell^F\,\mathrm{d}F(\alpha)+\int_{\alpha\geq\hat{\alpha}}\alpha\ell^P\,\mathrm{d}F(\alpha)\right)}_{\equiv Q}\geq g, \tag{30}$$

where Q is the aggregate tax base. The Lagrangian associated with this problem is

$$\mathcal{L}=W+\lambda\big(tQ-g\big), \tag{31}$$

where λ is the multiplier of the resource constraint, equal to the social marginal value of public funds at the optimum.

To characterize optimal taxes and transfers, it is helpful to introduce the following labor supply elasticities, measuring the magnitude of changes in ℓ^P and ℓ^F upon changes in the net-of-tax-rate, $1-t$, and in the transfer, g:[29]

$$\mathcal{E}^{\ell^P}_{1-t}\equiv\frac{1-t}{\ell^P}\frac{\partial\ell^P}{\partial(1-t)}\geq 0,\qquad \mathcal{E}^{\ell^P}_{g}\equiv-\frac{g}{\ell^P}\frac{\partial\ell^P}{\partial g}\geq 0, \tag{32}$$

$$\mathcal{E}^{\ell^F}_{1-t}\equiv\frac{1-t}{\ell^F}\frac{\partial\ell^F}{\partial(1-t)}\geq 0,\qquad \mathcal{E}^{\ell^F}_{g}\equiv-\frac{g}{\ell^F}\frac{\partial\ell^F}{\partial g}\geq 0. \tag{33}$$

We further introduce

$$\mathcal{A}^{\ell}_{1-t}\equiv\int_{\alpha\leq\hat{\alpha}}z^F(\alpha)\mathcal{E}^{\ell^F}_{1-t}\mathrm{d}F(\alpha)+\int_{\alpha\geq\hat{\alpha}}z^P(\alpha)\mathcal{E}^{\ell^P}_{1-t}\mathrm{d}F(\alpha), \tag{34}$$

$$\mathcal{A}^{\ell}_{g}\equiv\int_{\alpha\leq\hat{\alpha}}z^F(\alpha)\mathcal{E}^{\ell^F}_{g}\mathrm{d}F(\alpha)+\int_{\alpha\geq\hat{\alpha}}z^P(\alpha)\mathcal{E}^{\ell^P}_{g}\mathrm{d}F(\alpha), \tag{35}$$

$$\mathcal{S}^{P,F}\equiv\Big(z^P(\hat{\alpha})-z^F(\hat{\alpha})\Big)\,\hat{\alpha}f(\hat{\alpha}), \tag{36}$$

where $\mathcal{A}^{\ell}_{1-t}$ and $\mathcal{A}^{\ell}_{g}$ measure the aggregate income-weighted labor supply elasticities upon changes in tax or transfer and $\mathcal{S}^{P,F}$ measures the reduction in the tax base induced by individuals switching from performance-based to fixed-wage contracts around the productivity threshold, $\hat{\alpha}$. Indeed, the individual reduction in pre-tax income from switching contracts is given by the difference $z^P(\hat{\alpha})-z^F(\hat{\alpha})$ and this has to be scaled by the number of individuals switching contracts, which is proportional to $\hat{\alpha}f(\hat{\alpha})$.

Denoting, for each type α, expected output by $z(\alpha)$ and expected disposable income (equal to consumption) by $y(\alpha)$, the net change in tax revenue and the welfare loss upon a change in the tax rate t are given by,

$$\mathrm{Rev}_t\equiv\frac{\partial(tQ)}{\partial t}=\int_{\alpha}z(\alpha)\mathrm{d}F(\alpha)-\frac{t}{1-t}\left(\mathcal{A}^{\ell}_{1-t}+\mathcal{S}^{P,F}\right), \tag{37}$$

$$\mathrm{Wel}_t\equiv\frac{1}{\lambda}\frac{\partial W}{\partial t}=\int_{\alpha}\frac{\mu(\alpha)}{\lambda}z(\alpha)u'(y(\alpha))\mathrm{d}F(\alpha)\;. \tag{38}$$

[29] We use elasticity concepts to ease comparison with optimal tax formulas in other papers, but in this setting closed-form expressions for these elasticities can be obtained by differentiating (7) and (10).

On the revenue side, an increase in the tax rate induces a mechanical increase in tax revenue holding the tax base constant (the first term of (37)) but also reduces the tax base through two types of behavioral responses: labor supply responses within contracts captured by $\mathcal{A}^{\ell}_{1-t}$ and changes in contract choice captured by $\mathcal{S}^{P,F}$. On the welfare side, an increase in the tax rate reduces disposable incomes in proportion to pre-tax income, $z(\alpha)$, which in turn reduces individual utility in proportion to the marginal utility from consumption, $u'(y(\alpha))$. These reductions in individual utility are then weighted by the government in proportion to the Pareto-weight of each type, $\mu(\alpha)$, and scaled by the social marginal value of public funds, λ, to be expressed in money-metric terms.

We characterize the optimal income tax and transfer system through the first-order necessary conditions for an interior optimum.[30] More precisely, the optimal tax rate is such that the revenue and welfare impacts of tax changes exactly compensate each other, $\text{Rev}_t = \text{Wel}_t$. This leads to the following characterization of the optimal income tax and transfer in this economy with both fixed-wage contracts and performance-based contracts:

Proposition 6. *At an interior optimum, the optimal tax rate t satisfies*

$$\frac{t}{1-t} = \frac{1}{\mathcal{A}^{\ell}_{1-t} + \mathcal{S}^{P,F}} \int_{\alpha} z(\alpha) \left(1 - \frac{\mu(\alpha)}{\lambda}\, u'(y(\alpha))\right) \mathrm{d}F(\alpha)\,, \tag{39}$$

and the optimal transfer g satisfies

$$1 + \frac{t}{g}\left(\mathcal{A}^{\ell}_{g} + \mathcal{S}^{P,F}\right) = \int_{\alpha} \left(\frac{\mu(\alpha)}{\lambda}\, u'(y(\alpha))\right) \mathrm{d}F(\alpha)\,. \tag{40}$$

PROOF*:* See Appendix C.1.

Proposition 6 characterizes optimal redistribution as the solution to an equity-efficiency trade-off, where the behavioral responses to taxes are traded off against their mechanical and welfare effects. Condition (39) is a direct extension of the optimal linear income tax formula when workers adjust labor supply along the intensive margin (Sheshinski, 1972). The optimal tax rate decreases with the size of labor supply responses, $\mathcal{A}^{\ell}_{1-t}$, and, new to this setting, with the size of contract choice responses, $\mathcal{S}^{P,F}$. In contrast, the optimal tax rate increases with redistribution motives governed by the profile of Pareto-weights, $\mu(\alpha)$, and by the profile of marginal utilities from consumption, $u'(y(\alpha))$, across types. Stronger redistribution motives translate into a more strongly decreasing profile of social marginal welfare weights, $\frac{\mu(\alpha)}{\lambda}\, u'(y(\alpha))$, and thus a higher optimal tax rate.

Condition (40) has the standard interpretation that social marginal welfare weights average to one at the optimum, adjusted for the revenue effects of behavioral responses.

[30] In our numerical application, we then check that these conditions are also sufficient implying that the optimum is indeed interior.

Indeed, the value to society of providing an additional dollar of transfers to all individuals must be equal to the cost of doing so (Saez, 2001). Besides the mechanical cost of this dollar, additional revenue losses are triggered by income effects: an increase in the transfer reduces labor supply within contracts as captured by $\mathcal{A}_g^\ell$, and it induces some individuals to switch from performance-based to fixed-wage contracts as given by $\mathcal{S}^{P,F}$.

By comparison to a standard optimal tax model, income taxes cause additional distortions in this model through their effect on contract choice, suggesting that the optimal level of redistribution may be lower. While interesting, this is not the question that we seek to answer.[31] Instead, we are after the impact of economic globalization on optimal redistribution.

4.2 The impact of globalization on optimal taxes

We decompose the impact of economic globalization, represented here by a decrease in the probability of success, π, on the efficiency and equity concerns at the heart of optimal income tax policy. The only direct effect of a decrease in the probability of success, π, on this equity-efficiency trade-off is to reduce the attractiveness of performance contracts and thus to increase the productivity cut-off $\hat{\alpha}$ (Proposition 3). Yet, through the induced changes in tax policy, this triggers indirect effects on labor supply choices and further adjustments in contract choices that, in turn, affect the optimal tax through both changes in revenue and changes in welfare.

Efficiency concerns

The general effect of changes in π on the marginal revenue collected from a tax increase, Rev_t, is given in Appendix C.2. Here we report this effect for the special case where labor supply is exogenous (i.e., $\mathcal{A}_{1-t}^\ell = 0$) and taxes only distort contract choices. In this case,

$$\frac{\mathrm{dRev}_t}{\mathrm{d}\pi} = \mathcal{S}^{P,F}\left(-\frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}\pi}\frac{1}{\hat{\alpha}}\left(1+\frac{t}{1-t}\left(2+\frac{\hat{\alpha}f'(\hat{\alpha})}{f(\hat{\alpha})}\right)\right)-\frac{\mathrm{d}t}{\mathrm{d}\pi}\frac{1}{(1-t)^2}\right). \tag{41}$$

Equation (41) highlights the channels through which a change in π changes the revenue gains from increasing taxes. To interpret this expression, note that an effect that enters positively in $\mathrm{dRev}_t/\mathrm{d}\pi$ will reduce the revenue gains from increasing taxes upon a *fall* in π, therefore pushing for a decrease in the optimal tax rate.

There are three direct effects operating via the increase in the productivity cutoff $\hat{\alpha}$ that is induced by a *fall* in π (so that $-\mathrm{d}\hat{\alpha}/\mathrm{d}\pi > 0$, see Proposition 3). First, there is a reduction in the size of the tax base, which decreases the mechanical revenue effect of tax increases and pushes for a lower tax rate. Second, the higher productivity cut-off $\hat{\alpha}$ increases the revenue loss associated with switches to fixed-wage contracts, which also

[31] Doligalski et al. (2022) study a related question in a setting with continuous effort choices within performance contracts. They find that optimal tax rates are lower for bonus payments than for base salaries, because of the additional, distorting effect of bonus taxes on performance contracts.

pushes for a lower tax rate. A third counteracting effect is a reduction in the mass of individuals at this higher cut-off, $f'(\hat{\alpha}) < 0$, which reduces the revenue loss associated with switches to fixed-wage contracts and pushes for a higher tax rate.

The last term in (41) captures indirect effects, that is the effect of equilibrium adjustments in the tax rate. They counteract (but do not overturn) direct effects: if the sum of direct effects is positive, a *fall* in π reduces the tax rate t so that $-\mathrm{d}t/\mathrm{d}\pi < 0$ and the last effect is negative, thus pushing for a higher tax rate; and vice versa if the sum of direct effects is negative.

When the government is revenue-maximizing, the tax rate is defined by $\mathrm{Rev}_t = 0$, implying that (41) is nil. Equilibrium changes in the revenue-maximizing tax are then directly proportional to the sum of direct effects. The revenue-maximizing tax rate is thus increasing in π—meaning that the tax rate falls if π falls as a result of economic globalization—whenever the sum of direct effects is positive. This holds whenever the density of types at the productivity cut-off $\hat{\alpha}$ does not decrease too steeply, i.e., iff

$$\frac{\hat{\alpha} f'(\hat{\alpha})}{f(\hat{\alpha})} > -\frac{1+t}{t}. \tag{42}$$

When condition (42) is satisfied, pure efficiency concerns imply that globalization tends to push optimal tax rates down while concomitantly raising income concentration:[32]

Proposition 7. *With exogenous labor supply, efficiency concerns push for a reduction in the optimal tax rate upon a mean-preserving spread in returns realizations (a fall in π), if and only if, the distribution of productivity types does not decrease too steeply around the cut-off $\hat{\alpha}$ (i.e., when* (42) *is satisfied).*

PROOF*:* See Appendix C.2.

The inclusion of endogenous labor supply (hours choice) introduces further efficiency effects going in opposite directions. For instance, to the extent that a fall in π reduces the tax rate t, labor supply will tend to increase, thereby increasing the size of the tax base and pushing for a higher tax rate. Yet, this increase in labor supply may also increase the earnings differential between fixed-wage contracts and performance-based contracts, thereby increasing $\mathcal{S}^{P,F}$ and pushing for a lower tax rate by (39). At the same time, the greater fraction of people in fixed-wage contracts will tend to increase $\mathcal{A}^{\ell}_{1-t}$ through the fact that the elasticity of labor supply is greater in fixed-wage contracts than performance-based contracts, $\mathcal{E}^{\ell^F}_g > \mathcal{E}^{\ell^P}_g$. This also pushes for a lower tax rate. The impact of endogenous labor supply on the desirability to reduce the tax rate t upon a fall in π is therefore ambiguous.

[32]For a given distribution of types, it is easy to check whether condition (42) is satisfied. For a Pareto distribution defined by $f(\alpha) = p\,(\alpha_m)^p\,/\alpha^{p+1}$, the LHS of (42) equals $-(p+1)$. Hence the condition reduces to $p < 1/t$, which implies a direct comparison of the parameter p governing the thickness of the tail with the tax rate t. For top incomes, p often lies between 1.5 and 3 (see, e.g., Atkinson et al., 2011) implying that this condition is satisfied for tax rates up to 30 percent. In our empirical application, this condition is satisfied in all calibration scenarios that we consider.

Distributional concerns

A general characterization of how a change in π affects the distributional side, Wel_t/λ, of the efficiency-equity trade-off is

$$\frac{\mathrm{dWel}_t}{\mathrm{d}\pi} = -\frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}\pi} f(\hat{\alpha}) \left(\frac{\mu(\hat{\alpha})}{\lambda} \left(z^P(\hat{\alpha}) u'(y^P(\hat{\alpha})) - z^F(\alpha) u'(y^F(\alpha)) \right) - \frac{t}{\mathcal{C}_g} \left(z^P(\hat{\alpha}) - z^F(\hat{\alpha}) \right) \mathcal{K}_{\hat{\alpha}} \right)$$
$$- \frac{1}{\lambda} \frac{\mathrm{d}\lambda}{\mathrm{d}\pi} \mathcal{K}_\lambda + \frac{\mathrm{d}t}{\mathrm{d}\pi} \mathcal{K}_t, \tag{43}$$

where $\mathcal{C}_g > 0$, $\mathcal{K}_{\hat{\alpha}} > 0$, $\mathcal{K}_\lambda > 0$, and $\mathcal{K}_t$ are defined in Appendix C.2. To interpret this expression, note that an effect that enters positively in $\mathrm{dWel}_t/\mathrm{d}\pi$ will reduce the welfare loss associated with an increase in the tax rate upon a *fall* in π, therefore pushing for an increase in the optimal tax rate.

Equation (43) highlights that the increase in the productivity cut-off $\hat{\alpha}$ arising from a fall in π ($-\mathrm{d}\hat{\alpha}/\mathrm{d}\pi > 0$) has two counteracting effects on optimal tax rates in relation to their distributional effects. First, since the reduction in individual utility from higher taxes, $z(\hat{\alpha})u'(y(\hat{\alpha})) = z/\big((1-t)z + g\big)$, is increasing in the level of pre-tax income, z, the fact that some individuals are induced to switch to fixed-wage contracts reduces the marginal social welfare cost of taxation and pushes for higher tax rates (the first term). Second, by reducing the size of the tax base, the increase in the cut-off level reduces the transfer g, which in turn raises the marginal utility of disposable income and thus the marginal welfare cost of taxation, thereby pushing for lower tax rates (the second term, with $\mathcal{K}_{\hat{\alpha}} > 0$).

The third effect in (43) arises because a reduction in π increases income inequality and therefore increases the value of higher redistributive taxes, $\mathrm{d}\lambda/\mathrm{d}\pi < 0$. Hence the third effect is positive, therefore pushing for higher tax rates. Finally, the fourth term is an indirect equilibrium effect, with an analogous interpretation as the last term in (41).

The overall impact of globalization on both the efficiency-side and the equity-side of the trade-off is therefore generally ambiguous, and clear-cut analytical results can only be obtained for special cases. For the case with exogenous labor supply, a utilitarian objective, and a uniform distribution of types, our working paper version (Haufler and Perroni, 2020) shows analytically that globalization (a fall in π) indeed *reduces* the welfare-maximizing tax rate while, at the same time, increasing income concentration. For this reference case, the analysis shows that the higher efficiency costs arising from taxation when economic integration proceeds dominate the changes in the redistributive value of income taxation.

In the next subsection, we turn to numerical simulations to assess whether this result also obtains in a realistic calibration of the economy where we account for endogenous labor supply responses and a calibrated distribution of productivity types.

4.3 Model calibration and numerical simulation

To gauge whether the conditions under which economic globalization causes the optimal tax to fall are met in an empirically relevant scenario, we calibrate the model using U.S.

income data and an empirically plausible combination of tax rate, transfer level, and structural parameters to simulate the effects of a reduction in π on the optimal tax rate.

Income distribution and the tax-transfer system

The income distribution is calibrated using data from Piketty et al. (2018) on pre-tax income percentile thresholds for adults in the U.S. for the year 2014, derived from the fiscal income reported by taxpayers to the IRS on individual income tax returns. Using this information, and assuming a smooth distribution within percentile intervals, we recover an empirical c.d.f. $H(z)$ with mean pre-tax income in the baseline economy equaling $\bar{z}_{BL} \equiv$ US\$ 69, 334.

The same source also reports post-tax income percentile thresholds, measuring disposable income after all taxes and transfers, and where all public expenditures have been directly allocated to the population. Running a linear regression of the difference between pre-tax and post-tax income on pre-tax income, the calibrated tax rate in the baseline economy is $t_{BL} \equiv 0.271$ and the calibrated transfer is $g_{BL} \equiv t_{BL}\bar{z}_{BL} =$ US\$ 18, 789.[33]

Distribution of types and contracts

For a given income distribution, and a given tax-transfer system, the underlying distribution of productivity types is usually obtained by inverting individuals' first-order labor supply condition (Saez, 2001). Indeed, in a setting without contracts, the relationship between an individual's pre-tax income and that individual's productivity would be given by

$$\tilde{z}(\tilde{\alpha}) = \tilde{\alpha}\ell(t_{BL}, g_{BL}, \tilde{\alpha}), \tag{44}$$

where $\ell(t, g, \tilde{\alpha})$ solves the first-order condition $(1-t)\tilde{\alpha}/\big((1-t)\tilde{\alpha}\ell + g\big) = \kappa\ell^{\varepsilon}$. Assuming $\varepsilon = 2$ to match a (compensated) elasticity of labor supply, $e \approx 1/(1+\varepsilon) = 0.33$ (Chetty, 2012), and setting $\kappa = 1$ without loss of generality, the c.d.f. of $\tilde{\alpha}$ would then be recovered as $G(\tilde{\alpha}) = H\big(\tilde{z}(\tilde{\alpha})\big)$.

In a setting with contracts, however, pre-tax income not only depends on labor supply but also on the choice and structure of contracts. For instance, since individuals in fixed-wage contracts earn only $\eta\tilde{\alpha} < \tilde{\alpha}$ per unit of labor supply in our model, the distribution of abilities, $G(\tilde{\alpha})$, derived in the previous step will deliver an overall level of income (and tax base) that falls short of its corresponding empirical level. The above calibration procedure must therefore be adjusted in order to recover a distribution of types that is consistent with observed incomes.

The parameters that determine the structure of contracts are chosen as follows. First, consistent with evidence presented in Lazear (2000) and Freeman et al. (2019) on the effect of incentive contracts on worker's productivity, we set $\eta = 2/3$, meaning that

[33] This large transfer value follows from the methodology of Piketty et al. (2018) to allocate all national spending, including that on public goods, to post-tax income.

switching from a performance-based contract to a fixed-wage contract reduces productivity by 33%.[34] Second, based on evidence that about one-half of all U.S. workers are in performance contracts (Doligalski et al., 2022) as well as on evidence that about one-half of all U.S. jobs are in firms that trade internationally (Handley et al., 2021), we assume that a fraction $\rho = 1/2$ of the population is in performance contracts. Third, based on Doligalski et al. (2022) who suggest that the probability of individuals in performance-based contracts to receive a bonus is close to 20%, we select $\pi = 0.2$. This implies that 10% of the population ends up receiving bonus payments in incentive contracts ($\rho\pi = 0.1$).

Given this set of exogenously specified parameters, we jointly infer: (i) the fixed cost of effort in performance contracts, c, such that, for the resulting productivity threshold, $\hat{\alpha}$ (as given by (14)), a fraction ρ of the population is in performance contracts; (ii) a scaling parameter for the compensation per unit of labor supply, $\psi > 0$, such that average pre-tax income matches the empirical mean, $\bar{z}_{BL}$; (iii) a dispersion parameter for productivity levels, $\nu > 0$, such that the share of pre-tax income accruing to the top 10% earners matches its empirical value, which is about 47.5% (Piketty at al., 2018).[35] In mechanical terms, this is achieved by setting $\tilde{\alpha} = \alpha^{\nu}$ and using the re-scaling parameter ψ to replace (44) with

$$z(\alpha) = \psi \alpha^{\nu} \ell(t_{BL}, g_{BL}, \alpha^{\nu}) \tag{45}$$

and numerically deriving parameter values such that, under the resulting distribution of types $G(\alpha) = H\big(z(\alpha)\big)$, our calibrated economy with contracts matches the three aforementioned empirical targets.

Planner's objective

We specify the Pareto weights of the generalized utilitarian objective (29) as $\mu(\alpha) = \alpha^{-\theta}$, where θ reflects the planner's preferences for redistribution, with a Rawlsian objective (or, equivalently, revenue maximization) corresponding to the limit case $\theta \to \infty$. We select θ such that the optimal tax and transfer in this calibrated model coincide with the baseline tax and transfer, t_{BL} and g_{BL}—in the spirit of the inverse optimum approach (Bourguignon and Spadaro, 2012; Lockwood and Weinzierl, 2016; Jacobs et al., 2017).

All parameter values are summarized in Table 1.[36] In the calibrated economy, the distribution of productivity types satisfies condition (42).

[34] Lazear (2000) documents a 44% increase in productivity found in a U.S. manufacturing firm after the switch from hourly wages to piece-rate pay. Similarly, Freeman et al. (2021) find a 40-50% increase in productivity in a Chinese insurance company after switching to a non-linear compensation scheme with high returns above a performance threshold.

[35] Since our model generates distributional predictions that specifically relate to the top earners, we choose to calibrate the model using a tail moment, the share of income accruing to the top 10% earners.

[36] We report the values for ψ and ν for the sake of completeness; these parameters only intervene in the calibration of the model.

Table 1: Calibrated parameters

Exogenously specified	
ε	2
η	2/3
ρ	1/2
π	1/5
Inferred through the calibration procedure	
c	0.089
ψ	1,747
ν	1.69
θ	−0.223

4.4 Simulation results

Optimal tax responses to a fall in π

Our main counterfactual experiment consists of decreasing π from its baseline level of 0.2 to 0.19. If the tax stayed at its baseline level, $t_{BL} = 0.271$, the reduction in π would cause the income share of the top 10% earners to rise from 47.5% to 49.8% and the proportion of individuals in performance contracts to fall from 50% to 41.4%.

The reduction in π, however, causes the optimal tax to fall from $t_{BL} = 0.271$ to $t = 0.255$. A one percentage point fall in the probability of success thus translates into a 1.6 percentage points fall in the optimal tax. After the tax adjustment, the income share of the top 10% earners falls back partially, to 49.3%, and the proportion of individuals in performance contracts rises to 45.5%. Hence, a fall in π triggers an increase in income concentration at the top. At the same time, despite this increase in income concentration, a fall in π triggers a decrease in the optimal tax rate and thus in redistribution.

To assess the robustness of these results, we consider changes in structural parameters around their central values chosen in our baseline scenario. We vary the probability of receiving a bonus, $\pi \in \{0.17, 0.25\}$; the workers' productivity in the fixed-wage contract, $\eta \in \{0.6, 0.75\}$; the fraction of the population in incentive contracts, $\rho \in \{0.4, 0.6\}$; and the parameter governing the elasticity of labor supply, $\varepsilon \in \{1, 3\}$. In each of our robustness checks, the parameters inferred through the calibration procedure (see Table 1) are adjusted so that the initial tax rate of $t^* = 0.271$ remains optimal and the income share of the top 10% earners remains at $sh_{10\%} = 0.475$.

Table 2 shows that in all cases our core result remains valid that an increase in globalization (a reduction in π) reduces the optimal income tax rate. In particular, changes in the elasticity of labor supply, as measured (inversely) by the parameter ε, have virtually no effect on the optimal tax rate in the post-reform equilibrium. This suggests that the counteracting effects of changes in the labor supply elasticity discussed in Section 4.2

Table 2: Simulation results – sensitivity analysis

		optimal tax rate	income share of top 10%
A. Variation in π			
central case:	$\pi: 0.20 \rightarrow 0.19$	$t^*: 0.271 \rightarrow 0.255$	$sh_{10\%}: 0.475 \rightarrow 0.493$
low π:	$\pi: 0.17 \rightarrow 0.16$	$t^*: 0.271 \rightarrow 0.243$	$sh_{10\%}: 0.475 \rightarrow 0.507$
high π:	$\pi: 0.25 \rightarrow 0.24$	$t^*: 0.271 \rightarrow 0.259$	$sh_{10\%}: 0.475 \rightarrow 0.459$
Exogenous parameters: $\varepsilon = 2$, $\eta = 0.67$, $\rho = 0.5$			
B. Variation in η			
central case:	$\eta = 0.67$	$t^*: 0.271 \rightarrow 0.255$	$sh_{10\%}: 0.475 \rightarrow 0.493$
low η:	$\eta = 0.60$	$t^*: 0.271 \rightarrow 0.239$	$sh_{10\%}: 0.475 \rightarrow 0.482$
high η:	$\eta = 0.75$	$t^*: 0.271 \rightarrow 0.261$	$sh_{10\%}: 0.475 \rightarrow 0.489$
Exogenous parameters: $\varepsilon = 2$, $\rho = 0.5$, $\pi: 0.20 \rightarrow 0.19$			
C. Variation in ρ			
central case:	$\rho = 0.50$	$t^* := 0.271 \rightarrow 0.255$	$sh_{10\%}: 0.475 \rightarrow 0.493$
low ρ:	$\rho = 0.40$	$t^* := 0.271 \rightarrow 0.256$	$sh_{10\%}: 0.475 \rightarrow 0.495$
high ρ:	$\rho = 0.60$	$t^* := 0.271 \rightarrow 0.244$	$sh_{10\%}: 0.475 \rightarrow 0.457$
Exogenous parameters: $\varepsilon = 2$, $\eta = 0.67$, $\pi: 0.20 \rightarrow 0.19$			
D. Variation in ε			
central case:	$\varepsilon = 2$	$t^* := 0.271 \rightarrow 0.255$	$sh_{10\%}: 0.475 \rightarrow 0.493$
low ε:	$\varepsilon = 1$	$t^* := 0.271 \rightarrow 0.256$	$sh_{10\%}: 0.475 \rightarrow 0.493$
high ε:	$\varepsilon = 3$	$t^* := 0.271 \rightarrow 0.254$	$sh_{10\%}: 0.475 \rightarrow 0.493$
Exogenous parameters: $\rho = 0.5$, $\eta = 0.67$, $\pi: 0.20 \rightarrow 0.19$			

indeed offset each other almost exactly in their impact on the optimal tax response to increased globalization. Moreover, in most—though not in all—of the sensitivity checks carried out, the concentration of incomes at the top, as measured by the share of pre-tax income earned by the top 10% earners, increases.

Finally, in light of our theoretical discussion (see footnote 32), we check whether our main result also holds when optimal income tax rates are higher. For this purpose we use our benchmark calibration (see Table 1), but then modify the government's objective by specifying values of θ that can rationalize higher tax rate levels as being optimal. Specifically, we choose $\theta_1 = 0.141$ implying an optimal tax rate $t_1^* = 0.33$ and $\theta_2 = 0.464$ implying an optimal tax rate of $t_2^* = 0.40$. We then lower π from 0.20 to 0.19 and recompute optimal tax rates. In both cases the optimal tax rate falls, from 0.33 to 0.313, and from 0.40 to 0.389. Hence our main result that globalization can lower optimal tax rates also holds when initial tax rates are substantially higher than in our calibrated U.S. economy.

Optimal tax responses to increased income concentration with complete contracts

It is interesting to contrast the optimal policy response in the experiment above, where the increase in income concentration is driven by a change in π, with the optimal policy response in a setting with complete contracts, where an increase in income concentration would (necessarily) be driven by changes in the distribution of types.

For this purpose, we calibrate a complete-contracting model going through the first few steps of the procedure described above so that it matches the same baseline moments as the model with incentive contracts. We then simulate the effects of a skill-biased change in the distribution of productivity types, modeled as an iso-elastic change in productivity from $\tilde{\alpha}$ to $\tilde{\alpha}^{\varphi}$ with $\varphi > 1$. We select φ such that the change in the income share of the top 10% earners matches the change—from 47.5% to 49.8%—that occurs following a fall in π in our central case with performance-based contracts, before taxes are optimally readjusted. This implies $\varphi = 1.056$.

In this case, following this increase in income concentration, the optimal tax rises from its baseline level of 0.271 to 0.289, implying an increase in redistribution.[37] The source of the increase in income concentration thus crucially matters for how optimal redistribution responds to it.

5 Discussion

The predictions we have derived in the previous sections have direct implications for the relationship between changes in tax policy and changes in the distribution of income when this relationship is mediated through a change in globalization-induced, idiosyncratic income risk. In Sections 2 and 3, we have shown that economic globalization, characterized as a decrease in π, raises wage inequality and the concentration of earnings at the top of the income distribution. At the same time, we have shown in Section 4 that this can be accompanied by a fall in the optimal rate of redistributive taxation. Our results are thus consistent with the simultaneous increase in pre-tax income concentration and the reduction in redistributive income tax rates that has been documented in the empirical literature (Immervoll and Richardson, 2011; Egger et al., 2019). There is also evidence that globalization changes the structure of labor contracts and leads to lower fixed salary components and higher incentive pay, particularly for the top earners (Cuñat and Guadaloupe, 2009).

However, reforms that reduce the progressivity of the income tax could also be driven by a rising international mobility of top income earners (Lehmann et al., 2014).[38]

[37] Since the economy is scale invariant, meaning that re-scaling all productivity levels by a multiplicative factor ψ has no impact on the economy, the change in productivity levels is irrelevant and only the change in the shape of the type distribution affects the optimal tax rate.

[38] Egger et al. (2019) base their empirical analysis on the mobility of high-skilled labor as the fundamental mechanism driving down top tax rates. At the same time, however, they use international *commodity* trade as their principal measure of globalization.

We are not aware of any empirical analysis that tries to directly discriminate between an explanation based on the mobility of highly skilled workers versus an argument based on increasing product market integration, as pursued in our paper. As Egger et al. (2019) mention, migration data are much scarcer and less reliable as compared to trade data. Still, some simple test may be feasible. For example, one could separate countries with a high share of immigrants/emigrants in the total population from countries where these shares are low. Evidence that the income tax responses to globalization are similar (dissimilar) in these two groups of countries would then tend to support (reject) our trade-based explanation, relative to an explanation based on the mobility of highly-skilled individuals, when both country groups are highly integrated in the world economy with respect to commodity trade.

The increase in the concentration of income is generated in our model by the wider dispersion of pre-tax wages under incentive contracts that can be attributed to increased competition under market integration. This characterization is consistent with the increase in *between-firm* wage inequality that has been documented in the empirical labor economics literature (Song et al., 2019). If performance incentives are dynamically interpreted, it is also consistent with the observation of rising *within-firm* wage inequality that has been documented in the empirical literature on life-cycle wage dynamics (Heathcote et al., 2010; Bayer and Kuhn, 2019).

Our analysis, however, captures only a subset of the relevant effects that are associated with economic globalization. While our results are invariant to an equi-proportional change in productivity levels (as discussed in Section 3.3), a key assumption is that *relative* productivity levels remain unchanged. To the extent that globalization raises the relative productivity of high-ability vis-à-vis low-ability types, the redistributive argument for a progressive income tax is strengthened. Yet, even in this extended setting, the increase in observed income inequality induced by globalization would be partly driven by the higher income spread in incentive contracts, and our analysis reveals that this mechanism would not provide a motive to increase redistributive taxes.

In addition, our framework predicts that globalization leads to a reduction in the share of performance contracts in the economy. As such, it may appear inconsistent with the increased reliance on performance contracts that has been documented for the U.S. and other countries, and its impact on wage volatility (Champagne and Kurmann, 2013; Nucci and Riggi, 2013). However, as discussed in Appendix D, one can construct a variant of our model where an increase in income dispersion within contracts (and in overall income inequality) is accompanied by an increase in the proportion of individuals in performance-based contracts. This feature appears when the productivity gains associated with globalization disproportionately accrue to projects that are comparatively more sensitive to effort.[39]

[39] A further possible extension would be to generalize the tax schedule, and allow for directly progressive (or regressive) taxation. We have numerically analyzed local deviations from a linear tax to a tax schedule with a constant-rate-of-progressivity (see, e.g., Heathcote et al., 2017). The results from these simulations indicate that introducing a small degree of direct progressivity is welfare-reducing, suggesting

6 Conclusion

Empirical studies have shown that economic globalization is associated with both an increase in income concentration and a reduction in redistribution (Egger et al., 2019). In this paper we have offered an explanation for these simultaneous developments.

Our explanation is based on the prevalence of incentive contracts in modern economies, in conjunction with the globalization of product markets. Increased product market integration reduces the likelihood of earning positive profits for any single firm, but gives high rewards to successful firms. This feeds back onto labor markets by increasing the idiosyncratic income risk that performance-based contracts must impose on high productivity workers to overcome moral hazard. The higher volatility of individual earnings makes incentive contracts more sensitive to the disincentive effects caused by income taxes and raises the efficiency cost of redistribution. At the same time, steeper incentive contracts increase the income share of workers in successful firms. For a numerical simulation calibrated to U.S. income data, we find that globalization indeed lowers the optimal redistributive tax rate while simultaneously increasing the income share of top earners. In contrast, a similar increase in income concentration in an economy with complete contracts would lead to an increase in the optimal tax rate.

Our analysis could be extended in several directions. One example is to allow for a continuous choice of projects and contract types by each ability type in the context of a continuous distribution of possible returns realizations. At the same time, one could allow for heterogeneous effects of globalization on both the size and the volatility of returns across different ability types and occupations. Such extensions would yield a general framework that lends itself to structural estimation in future work.

Appendix

A Details and proofs for Section 2

A.1 Utility cost associated with income risk in performance contracts

We show here that the last term in the expression of expected utility in performance contracts, (6), capturing the utility cost associated with income risk is negative for any $\pi \in [0,1]$, $\eta \in [0,1]$, and $c > 0$.

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that the optimal non-linear tax schedule is indeed regressive. A full analysis of this extension is, however, beyond the scope of the present paper.

We have

$$\ln\left(\frac{\Gamma^{\eta\pi}}{1+\pi\left(\Gamma-1\right)}\right)\leq 0 \iff \frac{\Gamma^{\eta\pi}}{1+\pi\left(\Gamma-1\right)}\leq 1$$
$$\iff \left(e^{\frac{c}{(1-\eta)}}\right)^{\eta}-1\leq \pi\left(e^{\frac{c}{(1-\eta)\pi}}-1\right)$$
$$\iff \left(e^{\frac{c}{(1-\eta)}}\right)^{\eta}-\pi e^{\frac{c}{(1-\eta)\pi}}\leq 1-\pi. \tag{A.1}$$

First, we show that, for any $\pi\in[0,1]$,

$$\phi_1(\pi)\equiv\pi\left(e^{\frac{c}{(1-\eta)\pi}}-1\right)\geq\left(e^{\frac{c}{(1-\eta)}}\right)^{\eta}-1\,. \tag{A.2}$$

Noting that $\phi_1(0)=+\infty$ and that $\phi_1(1)=e^{\frac{c}{(1-\eta)}}-1$, (A.2) holds for $\pi=0$ and $\pi=1$. Since $\phi_1(\pi)$ is decreasing over $[0,1]$, it follows that (A.2) holds for any $\pi\in[0,1]$. Indeed, the derivative of $\phi_1(\pi)$, after some simplification, is equal to

$$\phi_1'(\pi)=e^{\frac{c}{(1-\eta)\pi}}\left(1-\frac{c}{\left(1-\eta\right)\pi}\right)-1, \tag{A.3}$$

which is negative for any $\pi\in[0,1]$. [40]

Second, we show that for any $\eta\in[0,1]$,

$$\phi_2(\eta)\equiv\left(e^{\frac{c}{(1-\eta)}}\right)^{\eta}-\pi e^{\frac{c}{(1-\eta)\pi}}\leq 1-\pi. \tag{A.4}$$

Noting that $\phi_2(0)=1-\pi e^{\frac{c}{\pi}}$, (A.4) holds for $\eta=0$. Since $\phi_2(\eta)$ is decreasing over $[0,1]$, it follows that (A.4) holds for any $\eta\in[0,1]$. Indeed, the derivative of $\phi_2(\eta)$ is, after some simplification, equal to

$$\phi_2(\eta)'=\frac{c}{(1-\eta)^2}\left(\left(e^{\frac{c}{(1-\eta)\pi}}\right)^{\eta\pi}-e^{\frac{c}{(1-\eta)\pi}}\right), \tag{A.5}$$

which is negative for any $\eta\pi\in[0,1]$ as $\Gamma>1$.

Third, we show that, for any $c>0$,

$$\phi_3(c)\equiv e^{\frac{c\eta}{(1-\eta)}}-\pi e^{\frac{c}{(1-\eta)\pi}}\leq 1-\pi. \tag{A.6}$$

Noting that $\phi_3(0)=1-\pi$, (A.6) holds for $c=0$. Since $\phi_3(c)$ is a decreasing function, it follows that (A.6) holds for any $c>0$. Indeed, the derivative of $\phi_3(c)$, after some simplification, is equal to

$$\phi_3'(c)=\frac{\eta}{1-\eta}\left(e^{\frac{c}{(1-\eta)\pi}}\right)^{\eta\pi}-\frac{1}{1-\eta}e^{\frac{c}{(1-\eta)\pi}}, \tag{A.7}$$

which is negative, since

$$\begin{cases}1<\left(e^{\frac{c}{(1-\eta)\pi}}\right)^{\eta\pi}<e^{\frac{c}{(1-\eta)\pi}},\\ \frac{\eta}{1-\eta}<1<\frac{1}{1-\eta},\end{cases}\implies \frac{\eta}{1-\eta}\left(e^{\frac{c}{(1-\eta)\pi}}\right)^{\eta\pi}<\frac{1}{1-\eta}e^{\frac{c}{(1-\eta)\pi}}. \tag{A.8}$$

[40] We have that $\phi_1'(0)=-\infty$ and that $\phi_1'(1)=e^{\frac{c}{1-\eta}}\left(1-\frac{c}{1-\eta}\right)-1<0$, while $\phi_1'(\pi)$ is strictly increasing as $\phi_1''(\pi)=\frac{c^2}{(1-\eta)^2\pi^3}e^{\frac{c}{(1-\eta)\pi}}>0$.

A.2 Proof of Proposition 1

Monotonicity condition. The sorting of productivity types into different contracts relies on the monotonicity condition (13). Here we establish this monotonicity condition starting from the expressions of expected utilities, given by (6) and (9), which imply

$$\frac{\partial EU^P}{\partial \alpha} = \frac{(1-t)\ell^P + (1-t)\alpha\, \partial \ell^P/\partial \alpha}{(1-t)\alpha \ell^P + g} - \kappa (\ell^P)^{\varepsilon} \frac{\partial \ell^P}{\partial \alpha} = \frac{(1-t)\ell^P}{(1-t)\alpha \ell^P + g}, \tag{A.9}$$

$$\frac{\partial EU^F}{\partial \alpha} = \frac{(1-t)\eta\ell^F + (1-t)\eta\alpha\, \partial \ell^F/\partial \alpha}{(1-t)\eta\alpha \ell^F + g} - \kappa (\ell^F)^{\varepsilon} \frac{\partial \ell^F}{\partial \alpha} = \frac{(1-t)\eta\ell^F}{(1-t)\eta\alpha \ell^F + g}, \tag{A.10}$$

where the second equality follows each time from the first-order condition for ℓ, and amounts to an application of the envelope theorem. As a result, we obtain

$$\begin{aligned} \frac{\partial (EU^P - EU^F)}{\partial \alpha} &= \frac{(1-t)\ell^P}{(1-t)\alpha \ell^P + g} - \frac{(1-t)\eta\ell^F}{(1-t)\eta\alpha \ell^F + g} \\ &= \frac{g(1-t)\left(\ell^P - \eta \ell^F\right)}{\left((1-t)\alpha\ell^P + g\right)\left((1-t)\eta\alpha\ell^F + g\right)}. \end{aligned} \tag{A.11}$$

For $g > 0$ and $t < 1$, this expression is strictly positive for all productivity types, since $\eta < 1$ guarantees that $\ell^P > \ell^F$ and thus that $\ell^P - \eta\ell^F > 0$.[41]

Assumption on contract choice. We assume that, in the absence of taxes and transfers, all individuals would choose a performance contract, which means that $EU^P \geq EU^F$. Setting, $t = 0$ and $g = 0$ in (6) and (9), this means that

$$\ln\left(\alpha \ell^P\right) - \kappa \frac{(\ell^P)^{1+\varepsilon}}{1+\varepsilon} + \ln\left(\frac{\Gamma^{\eta\pi}}{1 + \pi\left(\Gamma - 1\right)}\right) \geq \ln\left(\eta\alpha\ell^F\right) - \kappa\frac{\left(\ell^F\right)^{1+\varepsilon}}{1+\varepsilon}. \tag{A.12}$$

Now, the first-order conditions for labor supply, (7) and (10), imply that in the absence of taxes and transfers, $\ell^P = \ell^F = \ell$. We can thus rewrite the previous inequality as

$$\ln\left(\frac{\Gamma^{\eta\pi}}{1 + \pi\left(\Gamma - 1\right)}\right) \geq \ln\left(\eta\alpha\ell\right) - \ln(\alpha\ell) = \ln\eta. \tag{A.13}$$

Taking exponentials and rearranging yields

$$\Gamma^{\eta\pi} \geq \eta\left(1 + \pi\left(\Gamma - 1\right)\right),$$

which is condition (12) in the main text.

[41] In the special case where there is no transfer ($g = 0$), this expression shows that all types find it equally attractive to work in a performance contract or in a fixed-wage contract. This is consistent with the assumption that, in the absence of taxes and transfers, all individuals would choose a performance contract.

Productivity cut-off. The productivity cut-off $\hat{\alpha}$ is defined by $EU^P(\hat{\alpha}) = EU^F(\hat{\alpha})$, that is,

$$\ln\left((1-t)\hat{\alpha}\ell^P + g\right) - \kappa\frac{(\ell^P)^{1+\varepsilon}}{1+\varepsilon} + \ln\left(\frac{\Gamma^{\eta\pi}}{1+\pi(\Gamma-1)}\right) = \ln\left((1-t)\eta\hat{\alpha}\ell^F + g\right) - \kappa\frac{\left(\ell^F\right)^{1+\varepsilon}}{1+\varepsilon}$$

$$\iff \ln\left(\frac{(1-t)\hat{\alpha}\ell^P + g}{(1-t)\eta\hat{\alpha}\ell^F + g}\,\frac{\Gamma^{\eta\pi}}{1+\pi(\Gamma-1)}\right) = \kappa\frac{(\ell^P)^{1+\varepsilon} - \left(\ell^F\right)^{1+\varepsilon}}{1+\varepsilon}$$

$$\iff \left((1-t)\hat{\alpha}\ell^P + g\right)\,\Gamma^{\eta\pi} = \left((1-t)\eta\hat{\alpha}\ell^F + g\right)\left(1+\pi(\Gamma-1)\right)e^{\kappa\frac{(\ell^P)^{1+\varepsilon}-\left(\ell^F\right)^{1+\varepsilon}}{1+\varepsilon}}$$

$$\iff \hat{\alpha} = \frac{g}{(1-t)}\,\frac{\left(1+\pi(\Gamma-1)\right)e^{\kappa\frac{(\ell^P)^{1+\varepsilon}-\left(\ell^F\right)^{1+\varepsilon}}{1+\varepsilon}} - \Gamma^{\eta\pi}}{\ell^P\Gamma^{\eta\pi} - \eta\ell^F\left(1+\pi(\Gamma-1)\right)e^{\kappa\frac{(\ell^P)^{1+\varepsilon}-\left(\ell^F\right)^{1+\varepsilon}}{1+\varepsilon}}}, \tag{A.14}$$

which is equation (14) where we rewrite the second fraction on the RHS as $\frac{1}{K}$ defined in equation (15).

We next show that condition (12) guarantees that $\frac{1}{K} > 0$, provided that $\eta < 1$. First, consider the denominator. Condition (12) together with $\eta < 1$ directly implies that the denominator is strictly positive, i.e.,

$$\ell^P\Gamma^{\eta\pi}e^{-\frac{\kappa}{1+\varepsilon}\left(\left(\ell^P\right)^{1+\varepsilon}-\left(\ell^F\right)^{1+\varepsilon}\right)} > \eta\ell^F\left(1+\pi(\Gamma-1)\right), \tag{A.15}$$

if we can also show that $\ell^P e^{-\frac{\kappa}{1+\varepsilon}\left(\left(\ell^P\right)^{1+\varepsilon}-\left(\ell^F\right)^{1+\varepsilon}\right)} \geq \ell^F$. To show this, note that

$$\ell^P e^{-\frac{\kappa}{1+\varepsilon}\left(\left(\ell^P\right)^{1+\varepsilon}-\left(\ell^F\right)^{1+\varepsilon}\right)} \geq \ell^F$$

$$\iff \frac{\kappa}{1+\varepsilon}\left(\left(\ell^P\right)^{1+\varepsilon} - \left(\ell^F\right)^{1+\varepsilon}\right) - \left(\ln\ell^P - \ln\ell^F\right) \leq 0, \tag{A.16}$$

and consider the function $\eta \mapsto \frac{\kappa}{1+\varepsilon}\left(\left(\ell^P\right)^{1+\varepsilon} - \left(\ell^F\right)^{1+\varepsilon}\right) - \left(\ln\ell^P - \ln\ell^F\right)$, where ℓ^F is an implicit function of η and ℓ^P is independent of η. When $\eta = 1$, we have $\ell^P = \ell^F$, meaning that this function is nil. Moreover, this function's first derivative is, after simplification, equal to

$$\frac{\partial\ell^F}{\partial\eta}\left(\frac{1}{\ell^F} - \kappa\left(\ell^F\right)^{\varepsilon}\right) = \frac{g}{\varepsilon\left((1-t)\eta\alpha\ell^F + g\right) + (1-t)\eta\alpha\ell^F}\,\frac{1}{\eta}\,\frac{g}{(1-t)\eta\alpha\ell^F + g} \geq 0, \tag{A.17}$$

implying that the function is increasing in η, and thus negative for any $\eta < 1$. This shows that the denominator is strictly positive.

Second, consider the numerator. If we can show that

$$1+\pi(\Gamma-1) \geq \Gamma^{\eta\pi}, \tag{A.18}$$

then $\eta < 1$ implies that $\ell^P > \ell^F$, which in turn means that $0 < e^{-\frac{\kappa}{1+\varepsilon}\left(\left(\ell^P\right)^{1+\varepsilon}-\left(\ell^F\right)^{1+\varepsilon}\right)} < 1$, and thus that the numerator is strictly positive:

$$1+\pi(\Gamma-1)\,\Gamma^{\eta\pi}e^{-\frac{\kappa}{1+\varepsilon}\left(\left(\ell^P\right)^{1+\varepsilon}-\left(\ell^F\right)^{1+\varepsilon}\right)}. \tag{A.19}$$

To complete the proof, consider the function $\eta \mapsto 1+\pi\big(\Gamma-1\big) - \Gamma^{\eta\pi}$. When $\eta = 0$, this function is strictly positive since it is equal to $\pi\big(e^{\frac{c}{\pi}} - 1\big)$. Moreover, this function is increasing with η since its derivative is, after simplification, equal to

$$\frac{c}{(1-\eta)^2}\left(\Gamma - \Gamma^{\eta\pi}\right), \tag{A.20}$$

which is strictly positive given that $\Gamma > 1$ and $0 \leq \eta\pi < 1$. Hence, this function is positive, which shows that the numerator is strictly positive. □

A.3 Proof of Proposition 2

By definition, $\hat{\alpha}$ is such that $EU^P(\hat{\alpha}) = EU^F(\hat{\alpha})$:

$$\ln\left((1-t)\hat{\alpha}\ell^P + g\right) - \kappa\frac{(\ell^P)^{1+\varepsilon}}{1+\varepsilon} + \ln\left(\frac{\Gamma^{\eta\pi}}{1+\pi(\Gamma-1)}\right) = \ln\left((1-t)\eta\hat{\alpha}\ell^F + g\right) - \kappa\frac{\left(\ell^F\right)^{1+\varepsilon}}{1+\varepsilon}.$$

Partially differentiating this equation with respect to t, changes in labor supply cancel out, and we obtain

$$\frac{-\hat{\alpha} + (1-t)\frac{\partial\hat{\alpha}}{\partial t}}{(1-t)\hat{\alpha}\ell^P + g}\ell^P = \frac{-\hat{\alpha} + (1-t)\frac{\partial\hat{\alpha}}{\partial t}}{(1-t)\eta\ell^F\hat{\alpha} + g}\eta\ell^F \tag{A.21}$$

$$\iff \left(-\hat{\alpha} + (1-t)\frac{\partial\hat{\alpha}}{\partial t}\right)\ell^P\left((1-t)\eta\ell^F\hat{\alpha} + g\right) = \left(-\hat{\alpha} + (1-t)\frac{\partial\hat{\alpha}}{\partial t}\right)\eta\ell^F\left((1-t)\hat{\alpha}\ell^P + g\right)$$

$$\iff (1-t)\frac{\partial\hat{\alpha}}{\partial t}\ell^P g - (1-t)\frac{\partial\hat{\alpha}}{\partial t}\eta\ell^F g = g\hat{\alpha}\ell^P - g\hat{\alpha}\eta\ell^F$$

$$\iff \frac{\partial\hat{\alpha}}{\partial t} = \frac{\hat{\alpha}}{1-t}.$$

Similarly, partially differentiating this equation with respect to g, changes in labor supply again cancel out, and we obtain

$$\frac{(1-t)\ell^P\frac{\partial\hat{\alpha}}{\partial g} + 1}{(1-t)\hat{\alpha}\ell^P + g} = \frac{(1-t)\eta\ell^F\frac{\partial\hat{\alpha}}{\partial g} + 1}{(1-t)\eta\ell^F\hat{\alpha} + g} \tag{A.22}$$

$$\iff \left((1-t)\ell^P\frac{\partial\hat{\alpha}}{\partial g} + 1\right)\left((1-t)\eta\ell^F\hat{\alpha} + g\right) = \left((1-t)\eta\ell^F\frac{\partial\hat{\alpha}}{\partial g} + 1\right)\left((1-t)\hat{\alpha}\ell^P + g\right)$$

$$\iff (1-t)\ell^P\frac{\partial\hat{\alpha}}{\partial g}g - (1-t)\eta\ell^F\frac{\partial\hat{\alpha}}{\partial g}g = (1-t)\hat{\alpha}\ell^P - (1-t)\eta\ell^F\hat{\alpha}$$

$$\iff \frac{\partial\hat{\alpha}}{\partial g} = \frac{\hat{\alpha}}{g}.$$

A.4 Proof of Proposition 3

The productivity cut-off is equal to $\hat{\alpha} = g/\left((1-t)K\right)$. Differentiating this expression with respect to π, while holding t and g constant, gives

$$\frac{\partial\hat{\alpha}}{\partial\pi} = -\frac{g}{1-t}\frac{1}{K^2}\frac{\partial K}{\partial\pi} = -\frac{\hat{\alpha}}{K}\frac{\partial K}{\partial\pi}. \tag{A.23}$$

Moreover, noting that labor supply choices are unaffected by changes in π when holding tax policy constant, (partially) differentiating K, as given by (15), yields, after simplification,

$$\frac{\partial K}{\partial\pi} = -\frac{\left(\eta\ell^F + K\right)\left((\Gamma-1) - \frac{c}{(1-\eta)\pi}\Gamma\right)}{1+\pi(\Gamma-1) - \Gamma^{\eta\pi}e^{-\frac{\kappa}{1+\varepsilon}\left((\ell^P)^{1+\varepsilon} - (\ell^F)^{1+\varepsilon}\right)}} > 0. \tag{A.24}$$

We can then conclude that the direct effect of an increase in π on $\hat{\alpha}$, through its effect on K, is negative. However, $\hat{\alpha}$ is also increasing in g, which, for a given t, is decreasing in $\hat{\alpha}$. Consider then an increase in K accompanied by a reduction in $\hat{\alpha}$. If the increase in g caused by the fall in $\hat{\alpha}$ were large enough to offset the negative effect on $\hat{\alpha}$ of a higher K, then $\hat{\alpha}$ would rise, and so g would have to fall rather than rise: a contradiction. This establishes that a fall in π leads to a rise in $\hat{\alpha}$.

Turning to the second part of the proposition, the fact that fewer types select into performance contracts implies that an increasing share of types derive lower incomes in fixed-wage contracts. By reducing total income in the economy, this increases the income share accruing to individuals above a given percentile p of the distribution. In addition, people in performance contracts now face a larger spread between pre-tax incomes z_H and z_L, with z_H increasing and z_L decreasing by equations (5a)-(5b). This implies that a lower share of individuals receive higher high-income payments, z_H, and that a larger share of individuals receive lower low-income payments, z_L, which also contributes to increasing the income share accruing to individuals above a given percentile p of the distribution. □

B Details and proofs for Section 3

B.1 Equilibrium characterization of the trade model of Section 3.1

A complete characterization of a symmetric equilibrium is given below. Since the equilibrium is symmetric, we omit location l and variety i from the arguments in most expressions.

For a given distribution of firm productivity draws, ϕ, a distribution of individual productivity types, α, trade costs, τ, and income tax rate, t, a symmetric equilibrium for this economy is identified by a distribution of transportation cost-inclusive prices for the traded varieties, having c.d.f. $F_p(\cdot)$; a level of labor supply, $\ell(\alpha)$, for each productivity type; an output level, Y, for the numeraire good in each locations; a number of firms, M, for each variety in each location; a level of transfer, g; a return to capital, r; and wages and capital returns per efficiency unit of labor, q_ℓ and q_r, satisfying the following conditions:

– For each variety i, there are ML firms that potentially produce this variety and sell it in location l. These firms choose trade costs-inclusive prices, p_{kli} to maximize profits at that location, which equal

$$\Lambda_{kli} \equiv (p_{kli} - \hat{\tau}_{kl} / \phi_{ki})\; x_{kli}, \quad \hat{\tau}_{kl} \equiv \begin{cases} 1 & \text{if } k \text{ is based in } l, \\ \tau & \text{otherwise,} \end{cases}$$

with ϕ_{ki} denoting firm k's productivity draw and x_{kli} firm-specific demand, which is defined as

$$x_{kli} \equiv \begin{cases} x(p_{li}) / n\big(\{p_{k''li} \,|\, p_{k''li} = p_{li}\}\big) & \text{if } \; p_{kli} = \min_{k'}\{p_{k'li}\} \equiv p_{li}, \\ 0 & \text{otherwise,} \end{cases}$$

where $x(p_{li})$ is the equilibrium demand for a given variety priced at p_{li} at location l (to be derived below), and $n\big(\{p_{k''li} \,|\, p_{k''li} = p_{li}\}\big)$ is the number of firms charging the same lowest price.[42]

Under Bertrand competition, the price of variety i in market l for a particular realization of the ϕ draws is the minimum between (1) the second lowest realization of trade-inclusive marginal cost across all producers of that variety, and (2) the profit-maximizing, monop-

[42]Division by n thus breaks ties by apportioning demand equally across firms, in the event that multiple firms charge the same lowest price.

olistic price of the lowest-cost producer.[43] The resulting trade cost-inclusive equilibrium prices for a representative variety, i, at a given location, l, and for a given configuration of productivity draws for that variety at all locations, are then identified by:

$$p_{li} = \min\left\{\min_k \left\{\{\hat{\tau}_{kl}/\phi_{ki}\} \setminus \{\underline{m}_{li}\}\right\},\ (\sigma/(\sigma-1))\,\underline{m}_{li}\right\}, \qquad \underline{m}_{li} \equiv \min_{k'}\{\hat{\tau}_{k'l}/\phi_{k'i}\}, \tag{B.1}$$

where $\underline{m}_{li}$ is the lowest trade cost-inclusive marginal cost across all producers of variety i, and "$A \setminus B$" indicates that element B is not in set A. This gives rise to an equilibrium distribution of trade cost-inclusive prices across all varieties, with c.d.f. $F_p(\cdot)$, the same across all locations in a symmetric equilibrium.

– Individuals choose consumption, y, and labor supply, $\ell(\alpha)$, to maximize utility, $\ln y(\alpha) - \kappa\,\ell(\alpha)^{1+\epsilon}/(1+\epsilon)$, subject to the budget constraint $y(\alpha) = (1-t)(q_\ell + q_r)\alpha\ell(\alpha) + g$. The solution to this problem is identified by

$$\frac{(1-t)(q_\ell + q_r)\alpha}{(1-t)(q_\ell + q_r)\alpha\ell(\alpha) + g} = \kappa\ell(\alpha)^\epsilon. \tag{B.2}$$

– Labor costs equal expected profits in all firms:

$$q_\ell\omega = E[\Lambda]. \tag{B.3}$$

– The capital income that is apportioned to individuals in proportion to their labor supply equals the return to capital:

$$q_r E[\alpha\ell] = r. \tag{B.4}$$

– The government budget is balanced:

$$g = t(q_\ell + q_r)E[\alpha\ell]. \tag{B.5}$$

– The price of the numeraire good, which we normalize to unity, equals its production cost:

$$\chi\, r^{1-\xi}\, P_I{}^\xi \equiv P = 1, \quad \chi > 0, \qquad P_I \equiv \left(\int p^{1-\sigma}\,\mathrm{d}F_p(p)\right)^{1/(1-\sigma)}. \tag{B.6}$$

– The sum of final demand and intermediate demand for the numeraire good equals its supply:

$$(q_\ell + q_r)E[\alpha\ell] + Y_I = Y, \tag{B.7}$$

with Y_I denoting the demand associated with production of the traded intermediates:

$$Y_I \equiv \iint x(p)\, m\, \mathrm{d}F_m(m \mid p)\, \mathrm{d}F_p(p)$$

[43]With CES-based differentiation over a continuum of good varieties and no other competitors for the given variety, the lowest-cost producer prices at a markup $\sigma/(\sigma-1)$ over marginal cost (Dixit and Stiglitz, 1977).

where $F_m(. \mid p)$ is the conditional c.d.f. of the distribution of trade cost-inclusive marginal costs (the trade-cost inclusive marginal cost faced by the firm that takes a given market at price p for any given variety), conditional on a given level of trade-cost inclusive equilibrium prices, and where, by Shephard's lemma, the equilibrium demand for each variety, $x(p)$, is given by

$$x(p) \equiv Y \frac{\partial P}{\partial p} = \xi \frac{Y}{P_I} \left(\frac{P_I}{p} \right)^{\sigma}.$$

– The demand for capital equals capital supply:

$$(1 - \xi) \frac{Y}{r} = 1. \tag{B.8}$$

– Total demand for labor equals total labor supply:

$$M\omega = E[\alpha\ell]. \tag{B.9}$$

B.2 Interpretation of the case $\alpha\ell \neq \omega$ in Section 3.3

Our characterization of incentive contracts in Section 2 assumes that each individual is employed in a single project and that each project employs a single individual, corresponding to a scenario where $\alpha\ell = \omega$. To understand how the case $\alpha\ell \neq \omega$ should be interpreted in relation to performance-based contracts, consider a scenario with $\omega = 1$ and an individual with $\alpha = 2$ choosing $\ell = 1$. In this case the individual's labor supply spans exactly two production units. The choice of the level of effort by that individual will also span two units (i.e., it will be either high effort in both or low effort in both), but there will be two separate productivity draws, one for each unit—implying that the number of productivity draws in each location remains equal to $E[\alpha\ell]/\omega$ independently of how the total supply of labor is distributed. The individual will enter into two formally separate contracts that are linked by a common signal. Specifically, the signal structure will be such that with probability 1/2, the signal is informative of the outcome in the first unit and reveals whether positive gross returns have been realized in the first unit and with probability 1/2 it is informative of the outcome in the second unit and reveals whether positive gross returns have been realized in the second unit.

If there are multiple individuals each being fractionally involved in the same unit, then, for all individuals involved in that unit, the choice of effort level will be made by a single individual selected at random among them, with the costs and the consequences of that choice being incurred by all those individuals (i.e., team externalities are fully internalized).

Under these assumptions, the structure of individuals' incentives remains as we have described it and our formalization of performance-based contracts generalizes to any positive value of $\alpha\ell$.

B.3 Proof of Proposition 5

Denote $(\ell_0^P, \ell_0^F, \hat{\alpha}_0, g_0, t_0)$ the attributes of a baseline economy, and consider the attributes $(\ell_1^P, \ell_1^F, \hat{\alpha}_1, g_1, t_1)$ of a new economy where all productivity levels rise by a factor $\beta > 1$.

First, assume that $t_1 = t_0$ and $g_1 = \beta g_0$. Then, any productivity type $\alpha_1 = \beta\alpha_0$ in the new economy makes the same labor supply decisions as productivity type α_0 in the baseline economy.

Indeed, by (7) and (10), the first-order conditions identifying the labor supply choice of type $\beta\alpha_0$ in the new economy are

$$\frac{(1-t_0)\beta\alpha_0}{(1-t_0)\beta\alpha_0\ell_1^F+\beta g_0}=\kappa\left(\ell_1^F\right)^{\varepsilon} \iff \frac{(1-t_0)\alpha_0}{(1-t_0)\alpha_0\ell_1^F+g_0}=\kappa\left(\ell_1^F\right), \tag{B.10}$$

$$\frac{(1-t_0)\beta\eta\alpha_0}{(1-t_0)\beta\eta\alpha_0\ell_1^P+\beta g_0}=\kappa\left(\ell_1^P\right)^{\varepsilon} \iff \frac{(1-t_0)\eta\alpha_0}{(1-t_0)\eta\alpha_0\ell_1^P+g_0}=\kappa\left(\ell_1^P\right), \tag{B.11}$$

which coincide with first-order conditions for type α_0. This in turn implies that the new productivity cut-off is

$$\hat{\alpha}_1=\frac{g_1}{1-t_1}\frac{1}{K_1}=\beta\frac{g_0}{1-t_0}\frac{1}{K_0}=\beta\hat{\alpha}_0, \tag{B.12}$$

since, by (15), $K_1 = K_0$ (given that the labor supply decisions of $\beta\hat{\alpha}_0$ coincide with the labor supply decisions of $\hat{\alpha}_0$).

Second, assuming $t_1 = t_0$, we show that the above invariance implies that $g_1 = \beta g_0$. Indeed, since labor supply decisions are unaffected under $t_1 = t_0$ and $g_1 = \beta g_0$, we have that expected incomes are scaled by the factor β, i.e., $\alpha_1\ell = \beta\alpha_0\ell$, implying that the new tax base is $Q_1 = \beta Q_0$ which confirms that $g_1 = \beta g_0$ by the resource constraint (30).

Third, since pre-tax incomes increase by a factor β, i.e., $z_1 = \beta z_0$, this implies that, for $t_1 = t_0$, the disposable income of a type $\beta\alpha_0$ in the new economy increases by the same factor:

$$(1-t_1)z_1+g_1=(1-t_0)\beta z_0+\beta g_0=\beta\left((1-t_0)z_0+g_0\right). \tag{B.13}$$

Thus, given the previous results on labor supply choices, the expected utility of an individual of productivity type $\beta\alpha_0$ is equal to

$$EU_1(\beta\alpha_0)=\ln(\beta)+EU_0(\alpha_0), \tag{B.14}$$

implying that the marginal utility from consumption, which enters the optimal tax formula (39) is the same for a type $\beta\alpha_0$ in the new economy as for a type α_0 in the old economy. As a result, if t_0 satisfies the optimal tax formula (39) in the old economy, then t_0 still satisfies it in the new economy. □

C Details and proofs for Section 4

C.1 Proof of Proposition 6

Optimal tax rate. Partial differentiation of the Lagrangian (31) with respect to t yields

$$\frac{\partial\mathcal{L}}{\partial t}=\int_{\alpha\le\hat{\alpha}}\mu(\alpha)\frac{\partial EU^F(\alpha)}{\partial t}\mathrm{d}F(\alpha)+\int_{\alpha\ge\hat{\alpha}}\mu(\alpha)\frac{\partial EU^P(\alpha)}{\partial t}\mathrm{d}F(\alpha)+\lambda\left(Q+t\frac{\partial Q}{\partial t}\right), \tag{C.1}$$

where we use the fact that $EU^F(\hat{\alpha}) = EU^P(\hat{\alpha})$ to cancel out the term that is proportional to $\partial\hat{\alpha}/\partial t$, related to changes in the domains of integration. Applying the envelope theorem to labor supply choices, we have

$$\frac{\partial EU^F(\alpha)}{\partial t}=-\frac{\eta\alpha\ell^F}{(1-t)\eta\alpha\ell^F+g}, \qquad \frac{\partial EU^P(\alpha)}{\partial t}=-\frac{\alpha\ell^P}{(1-t)\alpha\ell^P+g}, \tag{C.2}$$

and, since $Q = \int_{\alpha \le \hat{\alpha}} \eta\alpha\ell^F \,\mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \alpha\ell^P \,\mathrm{d}F(\alpha)$, we also have that

$$\frac{\partial Q}{\partial t} = \int_{\alpha \le \hat{\alpha}} \eta\alpha \frac{\partial \ell^F}{\partial t} \,\mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \alpha \frac{\partial \ell^P}{\partial t} \,\mathrm{d}F(\alpha) + \left(\eta\hat{\alpha}\ell^F - \hat{\alpha}\ell^P\right) \frac{\partial \hat{\alpha}}{\partial t} f(\hat{\alpha}). \tag{C.3}$$

Introducing labor supply elasticities and using $\partial\hat{\alpha}/\partial t = \hat{\alpha}/(1-t)$, we can rewrite the change in the Lagrangian upon a change in t as

$$\begin{aligned}\frac{1}{\lambda}\frac{\partial \mathcal{L}}{\partial t} = &-\frac{t}{1-t}\left(\int_{\alpha \le \hat{\alpha}} \eta\alpha\ell^F \mathcal{E}^{\ell^F}_{1-t} \,\mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \alpha\ell^P \mathcal{E}^{\ell^P}_{1-t} \,\mathrm{d}F(\alpha) + \left(\hat{\alpha}\ell^P - \eta\hat{\alpha}\ell^F\right)\hat{\alpha} f(\hat{\alpha})\right) \\ &+ \int_{\alpha \le \hat{\alpha}} \eta\alpha\ell^F \left(1 - \frac{\mu(\alpha)}{\lambda}\frac{1}{(1-t)\eta\alpha\ell^F + g}\right) \mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \alpha\ell^P \left(1 - \frac{\mu(\alpha)}{\lambda}\frac{1}{(1-t)\alpha\ell^P + g}\right) \mathrm{d}F(\alpha).\end{aligned}$$

Characterizing the optimal tax rate through the first-order condition $\partial\mathcal{L}/\partial t = 0$ yields (39).

Optimal transfer. Partial differentiation of the Lagrangian (31) with respect to g yields

$$\frac{\partial \mathcal{L}}{\partial g} = \int_{\alpha \le \hat{\alpha}} \mu(\alpha) \frac{\partial EU^F(\alpha)}{\partial g} \mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \mu(\alpha) \frac{\partial EU^P(\alpha)}{\partial g} \mathrm{d}F(\alpha) + \lambda\left(t\frac{\partial Q}{\partial g} - 1\right), \tag{C.4}$$

where we use the fact that $EU^F(\hat{\alpha}) = EU^P(\hat{\alpha})$ to cancel out the term that is proportional to $\partial\hat{\alpha}/\partial t$, related to changes in the domain of integration. Applying the envelope theorem to labor supply choices, we have

$$\frac{\partial EU^F(\alpha)}{\partial g} = \frac{1}{(1-t)\eta\alpha\ell^F + g}, \qquad \frac{\partial EU^P(\alpha)}{\partial g} = \frac{1}{(1-t)\alpha\ell^P + g}, \tag{C.5}$$

and, since $Q = \int_{\alpha \le \hat{\alpha}} \eta\alpha\ell^F \,\mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \alpha\ell^P \,\mathrm{d}F(\alpha)$, we also have that

$$\frac{\partial Q}{\partial g} = \int_{\alpha \le \hat{\alpha}} \eta\alpha \frac{\partial \ell^F}{\partial g} \,\mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \alpha \frac{\partial \ell^P}{\partial g} \,\mathrm{d}F(\alpha) + \left(\eta\hat{\alpha}\ell^F - \hat{\alpha}\ell^P\right) \frac{\partial \hat{\alpha}}{\partial g} f(\hat{\alpha}). \tag{C.6}$$

Introducing labor supply elasticities and using $\partial\hat{\alpha}/\partial g = \hat{\alpha}/g$, we can rewrite the change in the Lagrangian upon a change in t as

$$\begin{aligned}\frac{1}{\lambda}\frac{\partial \mathcal{L}}{\partial g} = &-1 - \frac{t}{g}\left(\int_{\alpha \le \hat{\alpha}} \eta\alpha\ell^F \mathcal{E}^{\ell^F}_{g} \,\mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \alpha\ell^P \mathcal{E}^{\ell^P}_{g} \,\mathrm{d}F(\alpha) + \left(\hat{\alpha}\ell^P - \eta\hat{\alpha}\ell^F\right)\hat{\alpha} f(\hat{\alpha})\right) \\ &+ \int_{\alpha \le \hat{\alpha}} \frac{\mu(\alpha)}{\lambda}\frac{1}{(1-t)\eta\alpha\ell^F + g} \mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \frac{\mu(\alpha)}{\lambda}\frac{1}{(1-t)\alpha\ell^P + g} \mathrm{d}F(\alpha).\end{aligned}$$

Characterizing the optimal transfer through the first-order condition $\partial\mathcal{L}/\partial g = 0$ yields (40). □

C.2 Impact of globalization on optimal taxes and proof of Proposition 7

Changes in transfer. From the resource constraint, $g = tQ$ where the tax base is $Q = \int_{\alpha \le \hat{\alpha}} \eta\alpha\ell^F \mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \alpha\ell^P \mathrm{d}F(\alpha)$, we get

$$\begin{aligned}\frac{\mathrm{d}g}{\mathrm{d}\pi} =& \frac{\mathrm{d}t}{\mathrm{d}\pi}\left(\int_{\alpha \le \hat{\alpha}} \eta\alpha\ell^F \mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \alpha\ell^P \mathrm{d}F(\alpha)\right) \\ &+ t\left(\left(\eta\hat{\alpha}\ell^F - \hat{\alpha}\ell^P\right) f(\hat{\alpha})\frac{d\hat{\alpha}}{d\pi} + \int_{\alpha \le \hat{\alpha}} \eta\alpha\frac{d\ell^F}{d\pi}\mathrm{d}F(\alpha) + \int_{\alpha \ge \hat{\alpha}} \alpha\frac{d\ell^P}{d\pi}\mathrm{d}F(\alpha)\right).\end{aligned} \tag{C.7}$$

Differentiating the first-order conditions for labor supply (7) and (10), we get that for both ℓ^F and ℓ^P,

$$\frac{1}{\ell}\frac{\mathrm{d}\ell}{\mathrm{d}\pi} = -\mathcal{E}^{\ell}_{1-t}\left(\frac{1}{1-t}\frac{\mathrm{d}t}{\mathrm{d}\pi} + \frac{1}{g}\frac{\mathrm{d}g}{\mathrm{d}\pi}\right). \tag{C.8}$$

Totally differentiating (30) with respect to π, and taking these endogenous labor supply changes into account, characterizes the change in the transfer g upon a change in π,

$$\begin{aligned}
&\frac{\mathrm{d}g}{\mathrm{d}\pi}\underbrace{\left(1+\frac{t}{g}\left(\int_{\alpha\le\hat\alpha}\eta\alpha\ell^F\mathcal{E}^{\ell^F}_{1-t}\mathrm{d}F(\alpha)+\int_{\alpha\ge\hat\alpha}\alpha\ell^P\mathcal{E}^{\ell^P}_{1-t}\mathrm{d}F(\alpha)\right)\right)}_{\equiv\mathcal{C}_g}\\
&=\frac{\mathrm{d}t}{\mathrm{d}\pi}\underbrace{\left(\int_{\alpha\le\hat\alpha}\eta\alpha\ell^F\left(1-\frac{t}{1-t}\mathcal{E}^{\ell^F}_{1-t}\right)\mathrm{d}F(\alpha)+\int_{\alpha\ge\hat\alpha}\alpha\ell^P\left(1-\frac{t}{1-t}\mathcal{E}^{\ell^P}_{1-t}\right)\mathrm{d}F(\alpha)\right)}_{\equiv\mathcal{C}_t}\\
&\quad-\frac{\mathrm{d}\hat\alpha}{\mathrm{d}\pi}\left(t\left(\hat\alpha\ell^P-\eta\hat\alpha\ell^F\right)f(\hat\alpha)\right)
\end{aligned} \tag{C.9}$$

where $\mathcal{C}_g$ is always strictly positive, and $\mathcal{C}_t$ is strictly positive provided that $\mathcal{E}^{\ell}_{1-t} < \frac{1-t}{t}$.[44] Hence, (C.9) implies that, following a reduction in the probability of success π, changes in the tax rate t and in the transfer g must be positively related, and that we can therefore characterize changes in the equity-efficiency trade-off entirely in terms of changes in the productivity cut-off, $\hat\alpha$, and in the tax rate, t.

Efficiency concerns. As defined in (37), Rev_t is equal to

$$\begin{aligned}
\mathrm{Rev}_t &= \int_\alpha z(\alpha)\mathrm{d}F(\alpha) - \frac{t}{1-t}\left(\mathcal{A}^{\ell}_{1-t} + \mathcal{S}^{P,F}\right)\\
&= \int_{\alpha\le\hat\alpha} z^F(\alpha)\mathrm{d}F(\alpha) + \int_{\alpha\ge\hat\alpha} z^P(\alpha)\mathrm{d}F(\alpha)\\
&\quad -\frac{t}{1-t}\left(\int_{\alpha\le\hat\alpha} z^F(\alpha)\mathcal{E}^{\ell^F}_{1-t}\mathrm{d}F(\alpha)+\int_{\alpha\ge\hat\alpha} z^P(\alpha)\mathcal{E}^{\ell^P}_{1-t}\mathrm{d}F(\alpha)+\left(z^P(\hat\alpha)-z^F(\hat\alpha)\right)\hat\alpha f(\hat\alpha)\right)
\end{aligned} \tag{C.10}$$

where $z^F(\alpha) = \eta\alpha\ell^F$ and $z^P(\alpha) = \alpha\ell^P$. Differentiating this expression with respect to π yields

$$\begin{aligned}
\frac{\mathrm{dRev}_t}{\mathrm{d}\pi} &= \frac{\mathrm{d}\hat\alpha}{\mathrm{d}\pi}\left(\eta\hat\alpha\ell^F-\hat\alpha\ell^P\right)f(\hat\alpha)+\int_{\alpha\le\hat\alpha}\eta\alpha\frac{\mathrm{d}\ell^F}{\mathrm{d}\pi}\mathrm{d}F(\alpha)+\int_{\alpha\ge\hat\alpha}\alpha\frac{\mathrm{d}\ell^P}{\mathrm{d}\pi}\mathrm{d}F(\alpha)\\
&-\frac{1}{(1-t)^2}\frac{\mathrm{d}t}{\mathrm{d}\pi}\left(\int_{\alpha\le\hat\alpha}\eta\alpha\ell^F\mathcal{E}^{\ell^F}_{1-t}\,\mathrm{d}F(\alpha)+\int_{\alpha\ge\hat\alpha}\alpha\ell^P\mathcal{E}^{\ell^P}_{1-t}\,\mathrm{d}F(\alpha)+\left(\hat\alpha\ell^P-\eta\hat\alpha\ell^F\right)\hat\alpha f(\hat\alpha)\right)\\
&-\frac{t}{1-t}\left(\frac{\mathrm{d}\hat\alpha}{\mathrm{d}\pi}\left(\eta\hat\alpha\ell^F\mathcal{E}^{\ell^F}_{1-t}-\hat\alpha\ell^P\mathcal{E}^{\ell^P}_{1-t}\right)f(\hat\alpha)+\int_{\alpha\le\hat\alpha}\eta\alpha\frac{\mathrm{d}(\ell^F\mathcal{E}^{\ell^F}_{1-t})}{\mathrm{d}\pi}\mathrm{d}F(\alpha)+\int_{\alpha\ge\hat\alpha}\alpha\frac{d(\ell^P\mathcal{E}^{\ell^P}_{1-t})}{d\pi}\mathrm{d}F(\alpha)\right)\\
&-\frac{t}{1-t}\left(\left(\frac{\mathrm{d}\ell^P}{\mathrm{d}\pi}-\eta\frac{\mathrm{d}\ell^F}{\mathrm{d}\pi}\right)\hat\alpha^2 f(\hat\alpha)+\frac{\mathrm{d}\hat\alpha}{\mathrm{d}\pi}\left(\hat\alpha\ell^P-\eta\hat\alpha\ell^F\right)f(\hat\alpha)\left(2+\frac{\hat\alpha f'(\hat\alpha)}{f(\hat\alpha)}\right)\right).
\end{aligned} \tag{C.11}$$

Noting that for individuals of type $\hat\alpha$ changes in labor supply, ℓ^F or ℓ^P, are given by

$$\frac{1}{\ell}\frac{\mathrm{d}\ell}{\mathrm{d}\pi} = -\mathcal{E}^{\ell}_{1-t}\left(\frac{1}{1-t}\frac{\mathrm{d}t}{\mathrm{d}\pi}+\frac{1}{g}\frac{\mathrm{d}g}{\mathrm{d}\pi}-\frac{1}{\hat\alpha}\frac{\mathrm{d}\hat\alpha}{\mathrm{d}\pi}\right); \tag{C.12}$$

[44] This holds for any realistic tax rate since $\mathcal{E}^{\ell}_{1-t} = \frac{g}{(1+\varepsilon)(1-t)\alpha\ell+\varepsilon g} < 1$ and $\frac{1-t}{t} > 1$ for any $t < 0.5$.

and that, for types $\alpha \neq \hat{\alpha}$,

$$\frac{1}{\ell}\frac{\mathrm{d}\ell}{\mathrm{d}\pi} = -\mathcal{E}^{\ell}_{1-t}\left(\frac{1}{1-t}\frac{\mathrm{d}t}{\mathrm{d}\pi} + \frac{1}{g}\frac{\mathrm{d}g}{\mathrm{d}\pi}\right), \tag{C.13}$$

$$\frac{1}{\ell^P\mathcal{E}^{\ell^P}_{1-t}}\frac{\mathrm{d}(\ell^P\mathcal{E}^{\ell^P}_{1-t})}{\mathrm{d}\pi} = \frac{\mathcal{E}^{\ell^P}_{1-t}}{g}\left((1+\varepsilon)(1-t)\alpha\ell^P - \varepsilon g\mathcal{E}^{\ell^P}_{1-t}\right)\left(\frac{1}{1-t}\frac{\mathrm{d}t}{\mathrm{d}\pi} + \frac{1}{g}\frac{\mathrm{d}g}{\mathrm{d}\pi}\right), \tag{C.14}$$

$$\frac{1}{\ell^F\mathcal{E}^{\ell^F}_{1-t}}\frac{\mathrm{d}(\ell^F\mathcal{E}^{\ell^F}_{1-t})}{\mathrm{d}\pi} = \frac{\mathcal{E}^{\ell^F}_{1-t}}{g}\left((1+\varepsilon)(1-t)\eta\alpha\ell^F - \varepsilon g\mathcal{E}^{\ell^F}_{1-t}\right)\left(\frac{1}{1-t}\frac{\mathrm{d}t}{\mathrm{d}\pi} + \frac{1}{g}\frac{\mathrm{d}g}{\mathrm{d}\pi}\right), \tag{C.15}$$

we obtain, after simplification,

$$\begin{aligned}\frac{\mathrm{dRev}_t}{\mathrm{d}\pi} =& -\frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}\pi}\left(\hat{\alpha}\ell^P - \eta\hat{\alpha}\ell^F\right)f(\hat{\alpha})\left(1+\frac{t}{1-t}\left(2+\frac{\hat{\alpha}f'(\hat{\alpha})}{f(\hat{\alpha})}\right)\right)\\ &-\frac{1}{(1-t)^2}\frac{\mathrm{d}t}{\mathrm{d}\pi}\left(\mathcal{A}^{\ell}_{1-t} + \mathcal{S}^{P,F}\right) + \left(\frac{1}{1-t}\frac{\mathrm{d}t}{\mathrm{d}\pi} + \frac{1}{g}\frac{\mathrm{d}g}{\mathrm{d}\pi}\right)\mathcal{K}_{\mathcal{E}},\end{aligned} \tag{C.16}$$

where $\mathcal{K}_{\mathcal{E}}$, which can be either positive or negative, is defined as

$$\begin{aligned}\mathcal{K}_{\mathcal{E}} \equiv\; & \frac{t}{1-t}\left(\hat{\alpha}\ell^P\mathcal{E}^{\ell^P}_{1-t} - \eta\hat{\alpha}\ell^F\mathcal{E}^{\ell^F}_{1-t}\right)\hat{\alpha}f(\hat{\alpha}) - \int_{\alpha\le\hat{\alpha}}\eta\alpha\ell^F\mathcal{E}^{\ell^F}_{1-t}\mathrm{d}F(\alpha) - \int_{\alpha\ge\hat{\alpha}}\alpha\ell^P\mathcal{E}^{\ell^P}_{1-t}\mathrm{d}F(\alpha)\\ &-\frac{t}{1-t}\left(\int_{\alpha\le\hat{\alpha}}\eta\alpha\ell^F\mathcal{E}^{\ell^F}_{1-t}\frac{\mathcal{E}^{\ell^F}_{1-t}}{g}\left((1+\varepsilon)(1-t)\eta\alpha\ell^F - \varepsilon g\mathcal{E}^{\ell^F}_{1-t}\right)\mathrm{d}F(\alpha)\right)\\ &-\frac{t}{1-t}\left(\int_{\alpha\ge\hat{\alpha}}\alpha\ell^P\mathcal{E}^{\ell^P}_{1-t}\frac{\mathcal{E}^{\ell^P}_{1-t}}{g}\left((1+\varepsilon)(1-t)\alpha\ell^P - \varepsilon g\mathcal{E}^{\ell^P}_{1-t}\right)\mathrm{d}F(\alpha)\right),\end{aligned} \tag{C.17}$$

and measures the indirect efficiency effects associated with further adjustments in labor supply.

Using equation (C.9) to replace $\mathrm{d}g/\mathrm{d}\pi$ by its expression in terms of $\mathrm{d}\hat{\alpha}/\mathrm{d}\pi$ and $\mathrm{d}t/\mathrm{d}\pi$ yields, after rearranging,

$$\begin{aligned}\frac{\mathrm{dRev}_t}{\mathrm{d}\pi} =& -\frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}\pi}\frac{\mathcal{S}^{P,F}}{\hat{\alpha}}\left(1+\frac{t}{1-t}\left(2+\frac{\hat{\alpha}f'(\hat{\alpha})}{f(\hat{\alpha})}\right)+\frac{t}{g}\frac{\mathcal{K}_{\mathcal{E}}}{\mathcal{C}_g}\right)\\ &-\frac{\mathrm{d}t}{\mathrm{d}\pi}\left(\frac{\mathcal{A}^{\ell}_{1-t}+\mathcal{S}^{P,F}}{(1-t)^2} - \frac{\mathcal{K}_{\mathcal{E}}}{g}\left(\frac{g}{1-t}+\frac{\mathcal{C}_t}{\mathcal{C}_g}\right)\right).\end{aligned} \tag{C.18}$$

When labor supply is exogenous and thus both $\mathcal{A}^{\ell}_{1-t} = 0$ and $\mathcal{K}_{\mathcal{E}} = 0$, equation (C.18) simplifies to (41) in the main text.

In the general case where labor supply is endogenous, we also need to take into account the indirect efficiency effects associated with labor supply changes as captured by $\mathcal{K}_{\mathcal{E}}$ in (C.17). When $\mathcal{K}_{\mathcal{E}} > 0$, the increase in the productivity cut-off, $\hat{\alpha}$, additionally reduces the marginal revenue gains from increasing taxes and pushes for lower tax rates. Otherwise, these indirect effects push for higher tax rates. Since the sign of $\mathcal{K}_{\mathcal{E}}$ is theoretically ambiguous, the qualitative impact of these further adjustments in labor supply is also ambiguous.

Proof of Proposition 7. Note that, since the revenue-maximizing rate satisfies $\mathrm{Rev}_t = 0$, we then have $\mathrm{dRev}_t/\mathrm{d}\pi = 0$. With exogenous labor supply, this implies

$$\frac{\mathrm{d}t}{\mathrm{d}\pi}\frac{1}{(1-t)^2} = -\frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}\pi}\left(1+\frac{t}{1-t}\left(2+\frac{\hat{\alpha}f'(\hat{\alpha})}{f(\hat{\alpha})}\right)\right). \tag{C.19}$$

Now, totally differentiating the definition of $\hat{\alpha}$, (14), yields

$$\frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}\pi} = \hat{\alpha}\left(\frac{1}{g}\frac{\mathrm{d}g}{\mathrm{d}\pi} + \frac{1}{1-t}\frac{\mathrm{d}t}{\mathrm{d}\pi} - \frac{1}{K}\frac{\mathrm{d}K}{\mathrm{d}\pi}\right), \tag{C.20}$$

where $\mathrm{d}K/\mathrm{d}\pi = \partial K/\partial\pi > 0$ (by the envelope theorem). Using (C.9), we can rewrite this as

$$\frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}\pi} = \frac{\hat{\alpha}}{1 + \frac{1}{\mathcal{C}_g}\frac{t}{g}\left(\hat{\alpha}\ell^P - \eta\hat{\alpha}\ell^F\right)\hat{\alpha} f(\hat{\alpha})}\left(\frac{\mathrm{d}t}{\mathrm{d}\pi}\left(\frac{1}{1-t} + \frac{1}{g}\frac{\mathcal{C}_t}{\mathcal{C}_g}\right) - \frac{1}{K}\frac{\mathrm{d}K}{\mathrm{d}\pi}\right). \tag{C.21}$$

Substituting this into the initial equation finally yields

$$\frac{\mathrm{d}t}{\mathrm{d}\pi} = \frac{\frac{\hat{\alpha}}{1+\frac{1}{\mathcal{C}_g}\frac{t}{g}(\hat{\alpha}\ell^P - \eta\hat{\alpha}\ell^F)\hat{\alpha} f(\hat{\alpha})}\frac{1}{K}}{\frac{1}{(1-t)^2} + \hat{\alpha}\frac{\frac{1}{1-t}+\frac{1}{g}\frac{\mathcal{C}_t}{\mathcal{C}_g}}{1+\frac{1}{\mathcal{C}_g}\frac{t}{g}(\hat{\alpha}\ell^P - \eta\hat{\alpha}\ell^F)\hat{\alpha} f(\hat{\alpha})}\left(1 + \frac{t}{1-t}\left(2 + \frac{\hat{\alpha} f'(\hat{\alpha})}{f(\hat{\alpha})}\right)\right)}\frac{\mathrm{d}K}{\mathrm{d}\pi}\left(1 + \frac{t}{1-t}\left(2 + \frac{\hat{\alpha} f'(\hat{\alpha})}{f(\hat{\alpha})}\right)\right). \tag{C.22}$$

To conclude, note that the right-hand side is positive whenever condition (42) is verified:

$$1 + \frac{t}{1-t}\left(2 + \frac{\hat{\alpha} f'(\hat{\alpha})}{f(\hat{\alpha})}\right) > 0 \iff \frac{\hat{\alpha} f'(\hat{\alpha})}{f(\hat{\alpha})} > -\frac{1+t}{t}. \tag{C.23}$$

Equity concerns. Differentiating expression (38) for Wel_t with respect to π yields

$$\begin{aligned}
\frac{\mathrm{dWel}_t}{\mathrm{d}\pi} &= \frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}\pi}\frac{\mu(\hat{\alpha})}{\lambda}\left(\hat{\alpha}\eta\ell^F\left(\frac{1}{(1-t)\eta\hat{\alpha}\ell^F + g}\right) - \hat{\alpha}\ell^P\left(\frac{1}{(1-t)\hat{\alpha}\ell^P + g}\right)\right) f(\hat{\alpha}) \\
&+ \int_{\alpha\leq\hat{\alpha}} \alpha\eta\frac{\mathrm{d}\ell^F}{\mathrm{d}\pi}\left(\frac{\mu(\alpha)}{\lambda}\frac{1}{(1-t)\eta\alpha\ell^F + g}\right)\mathrm{d}F(\alpha) + \int_{\alpha\geq\hat{\alpha}} \alpha\frac{\mathrm{d}\ell^P}{\mathrm{d}\pi}\left(\frac{\mu(\alpha)}{\lambda}\frac{1}{(1-t)\alpha\ell^P + g}\right)\mathrm{d}F(\alpha) \\
&- \frac{1}{\lambda}\frac{\mathrm{d}\lambda}{\mathrm{d}\pi}\left(\int_{\alpha\leq\hat{\alpha}} \alpha\eta\ell^F\frac{\mu(\alpha)}{\lambda}\frac{1}{(1-t)\eta\alpha\ell^F + g}\mathrm{d}F(\alpha) + \int_{\alpha\geq\hat{\alpha}} \alpha\ell^P\frac{\mu(\alpha)}{\lambda}\frac{1}{(1-t)\alpha\ell^P + g}\mathrm{d}F(\alpha)\right) \\
&- \int_{\alpha\leq\hat{\alpha}} \alpha\eta\ell^F\frac{\mu(\alpha)}{\lambda}\frac{-\frac{\mathrm{d}t}{\mathrm{d}\pi}\eta\alpha\ell^F + (1-t)\eta\alpha\frac{\mathrm{d}\ell^F}{\mathrm{d}\pi} + \frac{\mathrm{d}g}{\mathrm{d}\pi}}{\left((1-t)\eta\alpha\ell^F + g\right)^2}\mathrm{d}F(\alpha) \\
&- \int_{\alpha\geq\hat{\alpha}} \alpha\ell^P\frac{\mu(\alpha)}{\lambda}\frac{-\frac{\mathrm{d}t}{\mathrm{d}\pi}\alpha\ell^P + (1-t)\alpha\frac{\mathrm{d}\ell^P}{\mathrm{d}\pi} + \frac{\mathrm{d}g}{\mathrm{d}\pi}}{\left((1-t)\alpha\ell^P + g\right)^2}\mathrm{d}F(\alpha).
\end{aligned} \tag{C.24}$$

Using again

$$\frac{1}{\ell}\frac{\mathrm{d}\ell}{\mathrm{d}\pi} = -\mathcal{E}^{\ell}_{1-t}\left(\frac{1}{1-t}\frac{\mathrm{d}t}{\mathrm{d}\pi} + \frac{1}{g}\frac{\mathrm{d}g}{\mathrm{d}\pi}\right), \tag{C.25}$$

$$\frac{\mathrm{d}g}{\mathrm{d}\pi}\mathcal{C}_g = \frac{\mathrm{d}t}{\mathrm{d}\pi}\mathcal{C}_t - \frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}\pi}t\left(\hat{\alpha}\ell^P - \eta\hat{\alpha}\ell^F\right) f(\hat{\alpha}), \tag{C.26}$$

and rearranging, yields, after simplification,

$$\begin{aligned}
\frac{\mathrm{dWel}_t}{\mathrm{d}\pi} &= -\frac{\mathrm{d}\hat{\alpha}}{\mathrm{d}\pi} f(\hat{\alpha})\left(\frac{\mu(\hat{\alpha})}{\lambda}\left(\frac{\hat{\alpha}\ell^P}{(1-t)\hat{\alpha}\ell^P + g} - \frac{\eta\hat{\alpha}\ell^F}{(1-t)\eta\hat{\alpha}\ell^F + g}\right) - \frac{t}{\mathcal{C}_g}\left(\hat{\alpha}\ell^P - \eta\hat{\alpha}\ell^F\right)\mathcal{K}_{\hat{\alpha}}\right) \\
&\quad + \frac{\mathrm{d}t}{\mathrm{d}\pi}\mathcal{K}_t - \frac{1}{\lambda}\frac{\mathrm{d}\lambda}{\mathrm{d}\pi}\mathcal{K}_\lambda,
\end{aligned} \tag{C.27}$$

which is equation (43), where

$$\mathcal{K}_{\hat{\alpha}} \equiv \int_{\alpha \leq \hat{\alpha}} \alpha \eta \ell^F \frac{\mu(\alpha)}{\lambda} \frac{1 + \mathcal{E}^{\ell^F}_{1-t}}{\left((1-t)\eta\alpha\ell^F + g\right)^2} \mathrm{d}F(\alpha) + \int_{\alpha \geq \hat{\alpha}} \alpha \ell^P \frac{\mu(\alpha)}{\lambda} \frac{1 + \mathcal{E}^{\ell^P}_{1-t}}{\left((1-t)\alpha\ell^P + g\right)^2} \mathrm{d}F(\alpha), \tag{C.28}$$

$$\mathcal{K}_t \equiv \int_{\alpha \leq \hat{\alpha}} \alpha \eta \ell^F \frac{\mu(\alpha)}{\lambda} \frac{\alpha\eta\ell^F - \mathcal{E}^{\ell^F}_{1-t}\frac{g}{1-t} - \frac{\mathcal{C}_t}{\mathcal{C}_g}\left(1 + \mathcal{E}^{\ell^F}_{1-t}\right)}{\left((1-t)\eta\alpha\ell^F + g\right)^2} \mathrm{d}F(\alpha)$$
$$+ \int_{\alpha \geq \hat{\alpha}} \alpha \ell^P \frac{\mu(\alpha)}{\lambda} \frac{\alpha\ell^P - \mathcal{E}^{\ell^P}_{1-t}\frac{g}{1-t} - \frac{\mathcal{C}_t}{\mathcal{C}_g}\left(1 + \mathcal{E}^{\ell^P}_{1-t}\right)}{\left((1-t)\alpha\ell^P + g\right)^2} \mathrm{d}F(\alpha), \tag{C.29}$$

$$\mathcal{K}_\lambda \equiv \int_{\alpha \leq \hat{\alpha}} \alpha \eta \ell^F \frac{\mu(\alpha)}{\lambda} \frac{1}{(1-t)\eta\alpha\ell^F + g} \mathrm{d}F(\alpha) + \int_{\alpha \geq \hat{\alpha}} \alpha \ell^P \frac{\mu(\alpha)}{\lambda} \frac{1}{(1-t)\alpha\ell^P + g} \mathrm{d}F(\alpha). \tag{C.30}$$

D Globalization and the prevalence of incentive contracts

In our model, a fall in π associated with globalization causes t^* to fall as well as $\hat{\alpha}$ to rise, and so the model predicts that a fall in the level of taxation should be associated with a reduction in the prevalence of incentive contracts. However, this feature is not essential to the central mechanism underlying our argument; which is that a fall in π can make the tax base more tax elastic.

One can construct model variants in which globalization leads to a fall in t^* and broadens the range of productivity types that choose performance-based contracts. To illustrate, we return to the productivity shift β introduced in Section 3, but now assume that the productivity increase associated with globalization affects only workers in incentive contracts. Suppose that, in addition to the project yielding, for an individual with productivity type α, a level of expected returns equal to $\beta\alpha$ with effort and equal to $\eta\beta\alpha$ with no effort, there is also a fallback, no-effort project option giving expected productivity $\zeta\alpha$, with $\eta\beta < \zeta < \beta$, where ζ is invariant to globalization.[45] Then, if individuals opt for a fixed-wage contract, they will choose this alternative project; i.e., productivity types below $\hat{\alpha}$ will select into a fixed-wage contract and carry out projects yielding a level of expected returns that is independent of β, and those above $\hat{\alpha}$ will select into performance-based contracts and carry out projects that vary with β.

In this set-up, the relevant expression for K that determines the cut-off point through the relationship $\hat{\alpha} = g/\big((1-t)K\big)$ is increasing in β, implying that $\hat{\alpha}$ is decreasing in β. Then, if we model economic globalization as a simultaneous reduction in π and an increase in β, the effect of the productivity shift, β, on $\hat{\alpha}$ can dominate the effect of a reduced success probability, π, leading to a fall in $\hat{\alpha}$ and an increase in the proportion of workers who are in incentive contracts.[46]

[45] This is equivalent to saying that the value of η that determines expected productivity in fixed-wage contracts is greater than the level of η that determines expected productivity with no effort in a performance-based contract.

[46] To give an example, in a scenario with exogenous labor supply, a uniform distribution of productivity types with support $[0,1]$, $\eta = 1/2$, $c = 4/100$, and $\zeta = 6/5$, for $\pi = 2/5$ and $\beta = 1$ the revenue maximizing tax is $t^* \approx 0.88$ and the cut-off productivity type is $\hat{\alpha} \approx 0.41$. Lowering the probability of success to $\pi = 0.2$ while raising β to $\beta = 1.1$ results in $t^* \approx 0.87$, and $\hat{\alpha} \approx 0.39$. Hence, even though the total tax base increases, the elasticity of the tax base rises sufficiently so that the optimal redistributive tax rate falls.

References

Abraham, A., Alvarez-Parra, F., Forstner, S. (2017). The effects of moral hazard on wage inequality in a frictional labor market. Mimeo, European University Institute, Florence.

Agrawal, D., Foremny, D. (2019). Relocation of the rich: Migration in response to top tax rate changes from Spanish reforms. *Review of Economics and Statistics* 101, 214-232.

Alvaredo, F., Chancel, L., Piketty, T., Saez, E., Zucman, G. (2017). Global inequality dynamics: New Findings from WID.world. *American Economic Review, Papers and Proceedings* 107, 404-409.

Atkinson, A., Piketty, T., Saez, E. (2011). Top incomes in the long run of history. *Journal of Economic Literature* 49, 3-71.

Autor, D., Dorn, D., Katz, L.F., Patterson, C., Van Reenen, J. (2017). Concentrating on the fall of the labor share. *American Economic Review: Papers and Proceedings* 107, 180-185.

Autor, D., Dorn, D., Katz, L.F., Patterson, C., Van Reenen, J. (2020). The fall of the labor share and the rise of superstar firms. *Quarterly Journal of Economics* 135, 645-709.

Bargain, O., Dolls, M., Immervoll, H., Neumann, D., Peichl, A., Pestel, N., Siegloch, S. (2015). Tax policy and income inequality in the United States, 1979-2007. *Economic Inquiry* 53, 1061-1085.

Battisti, M., Felbermayr, G., Peri, G., Poutvaara, P. (2018). Immigration, search and redistribution: A quantitative assessment of native welfare. *Journal of the European Economic Association* 16, 1137-1188.

Bayer, C., Kuhn, M. (2019). Which ladder to climb? Decomposing life cycle wage dynamics. CEPR Working Paper No. 13158. London.

Bell, B., Van Reenen, J. (2014). Bankers and their bonuses. *The Economic Journal* 124, F1-F21.

Bernard, A., Jensen, J.B., Redding, S., Schott, P. (2018). Global firms. *Journal of Economic Literature* 56, 565-619.

Bernard, A., Moxnes, A., Saito, Y. (2019). Production networks, geography, and firm performance. *Journal of Political Economy* 127, 639-688.

Bierbrauer, F., Brett, C., Weymark, J. (2013). Strategic nonlinear income tax competition with perfect labor mobility. *Games and Economic Behavior* 82, 292-311.

Boadway, R., Sato, M. (2015). Optimal income taxation with risky earnings: A synthesis. *Journal of Public Economic Theory* 17, 773-801.

Bourguignon, F., Spadaro, A. (2012). Tax–benefit revealed social preferences. *The Journal of Economic Inequality* 10, 75-108.

Bryson, A., Freeman, R., Lucifora, C., Pelizzari, M., Perotin, V. (2012). Paying for performance: incentive pay schemes and employees' financial participation. Centre for Economic Performance Discussion Paper No. 1112. London School of Economics.

Champagne, J., Kurmann, A. (2013). The great increase in relative wage volatility in the United States. *Journal of Monetary Economics* 60, 166-183.

Chang, Y., Park, Y. (2021). Optimal taxation with private insurance. *The Review of Economic Studies*, 88(6), 2766-2798.

Chaney, T. (2008). Distorted gravity: The intensive and extensive margins of international trade. *American Economic Review* 98, 1707-1721.

Chetty, R. (2006). A new method of estimating risk aversion. *American Economic Review* 96, 1821-1834.

Chetty, R. (2012). Bounds on elasticities with optimization frictions: A synthesis of micro and macro evidence on labor supply. *Econometrica* 80, 969-1018.

Chetty, R., Saez, E. (2010). Optimal taxation and social insurance with endogenous private insurance. *American Economic Journal: Economic Policy* 2, 85-114.

Cuñat, V., Guadalupe, M. (2009). Globalization and the provision of incentives inside the firm: The Effect of foreign competition. *Journal of Labor Economics* 27, 179-212.

Dasgupta, S., Li, X., Wang, A. (2018). Product market competition shocks, firm performance, and forced CEO turnover. *Review of Financial Studies* 31, 4187-4231.

Diamond, P.A., Saez, E. (2011). The case for a progressive tax: From basic research to policy recommendations. *Journal of Economic Perspectives* 25, 165-190.

Dixit, A., and Stiglitz, J. (1977). Monopolistic competition and optimum product diversity. *American Economic Review* 67, 297-308.

Doligalski, P., Ndiaye, A., Werquin, N. (2022). Redistribution with performance pay. Federal Reserve Bank of Chicago WP 2022-12.

Dorn, F., Fuest, C., Potrafke, N. (2022). Trade openness and income inequality: New empirical evidence. *Economic Inquiry* 60, 202-223.

Dreher, A., Gaston, N. (2008). Has globalization increased inequality? *Review of International Economics* 16, 516-536.

Eaton, J., Kortum, S. (2002). Technology, geography, and trade. *Econometrica* 70, 1741-1779.

Edmans, A., Gabaix, X. (2016). Executive compensation: A modern primer. *Journal of Economic Literature* 54, 1232-1287.

Edmans, A., Gabaix, X., Landier, A. (2009). A multiplicative model of optimal CEO incentives in market equilibrium. *Review of Financial Studies* 22, 4881-4917.

Egger, P., Nigal, S., Strecker, N. (2019). The taxing deed of globalization. *American Economic Review* 109, 353-390.

Fama, E. (1980). Agency problems and the theory of the firm. *Journal of Political Economy* 88, 288-307.

Frederiksen, A. (2013). Incentives and earnings growth. *Journal of Economic Behavior and Organization* 85, 97-107.

Freeman, R.B., Huang, W., Li, T. (2019). Non-linear incentives and worker productivity and earnings: Evidence from a quasi-experiment. NBER Working Paper No. 25507. Cambridge, Mass.

Freund, C., Pierola, M.D. (2015). Export superstars. *Review of Economics and Statistics* 97, 1023-1032.

Goldberg, P., Pavcnik, N. (2007). Distributional effects of globalization in developing countries. *Journal of Economic Literature* 45, 39–82.

Golosov, M., Tsyvinski, A. (2007). Optimal taxation with endogenous insurance markets. *Quarterly Journal of Economics* 122, 487-534.

Handley, K., Fariha, K., Ouyang, W. (2021). A long view of employment growth and firm dynamics in the United States: Importers vs. exporters vs. non-traders, US Census Working Paper CES-21-38.

Haufler, A., Perroni, C. (2020). Incentives, globalization, and redistribution. CESifo Working Paper No. 8450. Munich.

Heathcote, J., Storesletten, K., Violante, G. (2010). The macroeconomic implications of rising wage inequality in the United States. *Journal of Political Economy* 118, 681-722.

Heathcote, J., Storesletten, K., Violante, G. (2020). How should tax progressivity respond to rising income inequality? *Journal of the European Economic Association* 18, 2715-2754.

Holmstrom, B. (1999). Managerial incentive problems: Dynamic perspective. *Review of Economic Studies* 66, 169-182.

Hoynes, H., Luttmer, E. (2011). The insurance value of state tax-and-transfer programs. *Journal of Public Economics* 95, 1466-1484.

Immervoll, H., Richardson, L. (2011). Redistribution policy and inequality reduction in OECD countries. OECD Social, Employment and Migration Working Paper No. 122. Paris.

Jacobs, B., Jongen, E. L., Zoutman, F. T. (2017). Revealed social preferences of Dutch political parties. *Journal of Public Economics* 156, 81-100.

Janeba, E., Schulz, K. (2023). Nonlinear taxation and international mobility in general equilibrium. *Journal of Public Economics* 218, 104811.

Kleven, H., Landais, C., Saez, E., Schultz, E. (2014). Migration and wage effects of taxing top earners. Evidence from the foreigners' tax scheme in Denmark. *Quarterly Journal of Economics* 129, 333-378.

Kleven, H., Landais, C., Muñoz, M., Stantcheva, S. (2020). Taxation and migration: Evidence and policy implications. *Journal of Economic Perspectives* 34, 119-142.

Krueger, D., Perri, F. (2011). Public versus private risk sharing. *Journal of Economic Theory* 146, 920-956.

Landier, A., Plantin, G. (2017). Taxing the rich. *Review of Economic Studies* 84, 1186-1209.

Lazear, E.P. (2000). Performance pay and productivity. *American Economic Review* 90, 1346-1361.

Lehmann, E., Simula, L., Trannoy, A. (2014). Tax me if you can! Optimal non-linear income tax between competing governments. *Quarterly Journal of Economics* 129, 1995-2030.

Lemieux, T., MacLeod, W.B., Parent, D. (2009). Performance pay and wage inequality. *The Quarterly Journal of Economics* 124, 1-49.

Lockwood, B.B., Weinzierl, M. (2016). Positive and normative judgments implicit in US tax policy, and the costs of unequal growth and recessions. *Journal of Monetary Economics* 77, 30-47.

Ma, L., Ruzic, D. (2020). Globalization and top income shares. *Journal of International Economics* 125, 103312.

Melitz, M. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity, *Econometrica* 71, 1695-1725.

Nucci, F., Riggi, M. (2013). Performance pay and changes in US labor market dynamics. *Journal of Economic Dynamics and Control* 37, 2796-2813.

Piketty, T., Saez, E., Zucman, G. (2018). Distributional national accounts: Methods and estimates for the United States. *Quarterly Journal of Economics* 133, 553-609.

Potrafke, N. (2017). Partisan politics: the empirical evidence from OECD panel studies. *Journal of Comparative Economics* 45, 712-750.

Raith, M. (2003). Competition, risk, and managerial incentives. *American Economic Review* 93, 1425–36.

Rodrik, D. (1997). Has globalization gone too far? Institute for International Economics, Washington, D.C.

Rodrik, D. (1998). Why do more open economies have bigger governments? *Journal of Political Economy* 106, 997-1032.

Rubolino, E., Waldenström, D. (2019). Trends and gradients in top tax elasticities: Cross-country evidence. *International Tax and Public Finance* 26, 457-485.

Saez, E. (2001). Using elasticities to derive optimal income tax rates. *Review of Economic Studies* 68, 205-229.

Scheuer, F., Werning, I. (2017). The taxation of superstars. *Quarterly Journal of Economics* 132, 211-270.

Schmidt, K. (1997). Managerial incentives and product market competition. *Review of Economic Studies* 64, 191–213.

Sheshinski, E. (1972). The optimal linear income-tax, *Review of Economic Studies* 39, 297-302.

Simula, L., Trannoy, A. (2010). Optimal income tax under the threat of migration by top-income earners. *Journal of Public Economics* 94, 163-173.

Slemrod, J., Bakija, J. (2001). Growing inequality and decreased tax progressivity. In: K.A. Hassett and R.G. Hubbard (eds.), Inequality and Tax Policy, Chapter 6, 192-226. American Enterprise Institute, Washington, D.C.

Sliwka, D., Werner, P. (2017). Wage increases and the dynamics of reciprocity. *Journal of Labor Economics* 35, 299-344.

Song, J., Price, D.J., Guvenen, F., Bloom, N., von Wachter, T. (2019). Firming up inequality. *Quarterly Journal of Economics* 134, 1-50.

Splinter, D. (2020). U.S. tax progressivity and redistribution. *National Tax Journal* 73, 1005-1024.

Tóbias, A. (2016). Income redistribution in open economies. *Journal of Public Economics* 134, 19-34.

Varian, H. (1980). Redistributive taxation as social insurance. *Journal of Public Economics* 14, 49-68.

Wu, C. (2021). More unequal income but less progressive taxation. *Journal of Monetary Economics* 117, 949-968.