# Entrepreneurship, Financial Frictions and Optimal Policy *

(Very preliminary and Incomplete)

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April 2023

(Preliminary and Incomplete)

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**Abstract**

The presence of financially constrained entrepreneurs generates an heterogeneity in returns to capital which in turn leads to a non-trivial distinction between capital and wealth taxes. We study the effects of partial reforms and optimal long-run taxation in a model that matches key U.S. economy moments on its pass-through sector and degree of inequality. Relative to the existing literature, we examine the implications of a wider set of tax instruments (including exemptions and inheritance taxes), inter-generational transmission of abilities and endogeneity of the occupational choice. We find that (i) a lower degree of inter-generational transmission of abilities weakens the welfare gains attainable through optimal policy (ii) allowing for a wider set of tax instruments, in particular an exemption on the wealth tax, leads to significant additional relative welfare gains (+30%) and shifts wealth taxation into positive territory (iii) the presence of the endogenous occupational choice dimension weakens motive to substitute capital for wealth taxation, given the extensive margin misallocation that it entails.

*I am grateful to Andrea Caggese and David Nagy for their constant guidance and support, and to Albert Marcet, Priit Jeenas, Edouard Schaal, Andrea Sy and Gianmarco Ruzzier for substantial comments that have improved this paper. I thank participants at CREi's Macro seminar for their insightful comments. All errors are my own.

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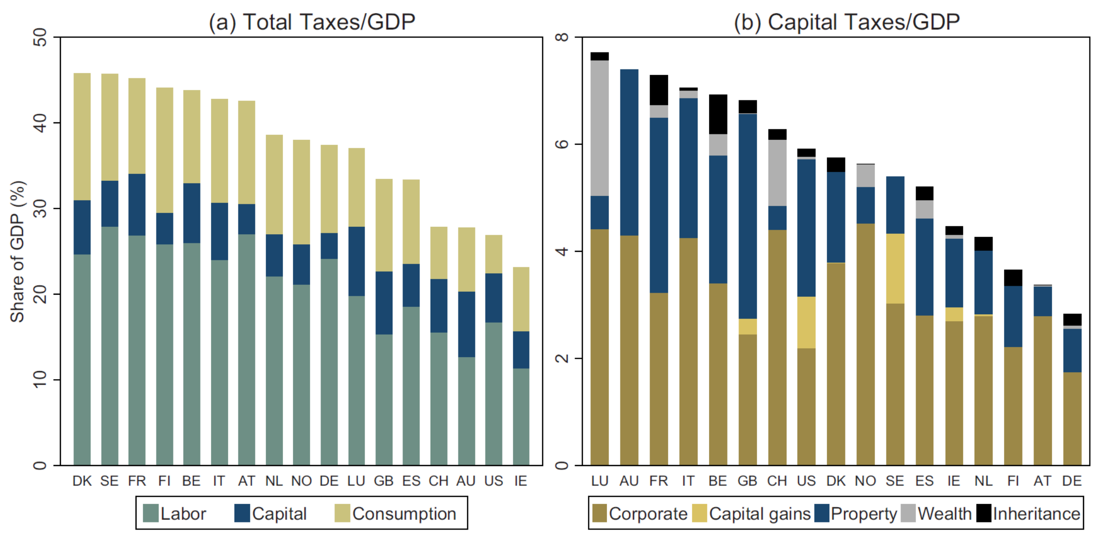
# 1 Introduction

Currently, most governments around the world finance themselves to a large extent through consumption and labour taxes (about 5% and 18% of GDP in the US), whilst capital taxes (the set of taxes including inheritance, wealth, corporate profits, capital gains and property taxes) represent a relatively small fraction at a combined 6% of GDP in the US. In addition to this, when focusing on the revenues obtained through the different capital taxes, the larger share comes from taxing the flow (e.g. profits) rather than the stock (e.g. property). Figure (1) shows precisely this.

Figure 1: Sources of Government Revenue, source: Bastani and Waldenström (2020).




**Notes:** Sources of government revenue by source. The left panel displays the taxes collected by the governments of several countries as a share of GDP for the labour, capital and consumption taxes. The right panel shows the decomposition of the capital tax class by sub-categories: corporate taxes, capital gains taxes, property taxes, wealth taxes and inheritance taxaes.

This arguably low taxation of the stock of wealth [1] is concurrent with an ever-increasing concentration of wealth. According to various estimates, wealth concentration (as measured by the holdings of the top 1% of the distribution) has increased significantly, from approximately 20% in the 80s to over 30% (FED) or 40% (Saez and Zucman, 2016) in the 2010s. Figure (2) depicts this evolution.

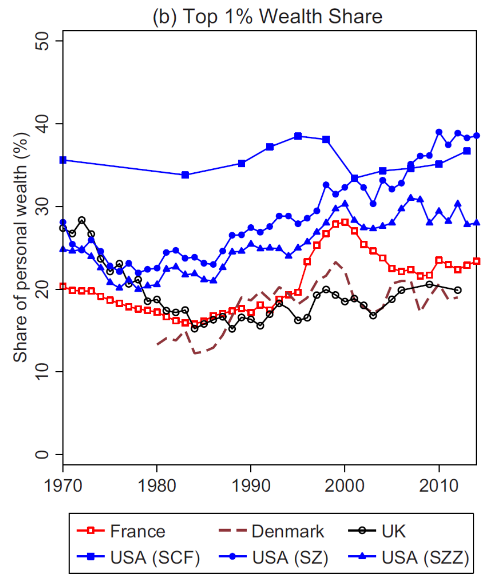
Given the composition of current government revenues and evolution of the concentration of wealth, a natural question that arises is whether there would be room for increasing wealth taxes (Piketty et al., 2013).[2] The classical view in economics, embodied in the work by Judd (1985) and Chamley (1986)[3] would suggest otherwise, arguing that positive long-run capital taxation would

[1] As compared to labour, consumption and the remainder of the set of capital taxes relative to the tax base.

[2] Henceforth, we shall refer to capital taxes as those on the returns to assets (*ra* in the generic model) and profits, and to wealth taxes as those on the stock of wealth.

[3] See Straub and Werning (2020) for a revisiting of the original results.

Figure 2: Wealth holdings, share top 1%, source: Bastani and Waldenström (2020).




**Notes:** Share of the wealth held by the top 1% of the distribution. The x-axis denotes the year and the y-axis is the share of wealth held by the top 1%. The legend specifies the country and/or source of this measure.

suppress the stock of capital, leading to lower wages and welfare in equilibrium. [4]

Our view on this begins with the observation that about 54-81% of the agents in the aforementioned top 1% of the wealth distribution are entrepreneurs. [5] Therefore, understanding wealth accumulation requires understanding entrepreneurship and private businesses. On this regard, a potential line of thought would indicate that if these agents have accumulated this degree of wealth it must be a result of efficiency.

There is, however, a substantial strand of the literature that also documents significant financial frictions for (primarily) small and young entrepreneurs. [6] The presence of such frictions implies that this mass of entrepreneurs is unable to access capital to the point of reaching optimal scale, leading to their marginal product of capital being higher than for their wealth-rich unconstrained counterparts. [7] This opens the door for a potential source of redistribution: the social planner could reallocate resources from wealth-rich unconstrained entrepreneurs with lower returns to wealth-poor constrained entrepreneurs, leading potentially to both (i) efficiency gains and (ii) welfare gains. The instrument for such reallocation could well be a wealth tax. [8]

[4] A recent strand of the literature however (Conesa et al. (2009), Guvenen et al. (2022), Boar and Midrigan (2022a)) has found results that go against this view.

[5] This figure is taken from Cagetti and De Nardi (2006), who construct measures for entrepreneurs under different definitions employing SCF data.

[6] See Holtz-Eakin et al. (1994), Banerjee and Blickle (2021), Georgellis et al. (2005) for example.

[7] Conditional on productivity.

[8] This mechanism of allocative efficiency through wealth taxation is precisely the "use it or lose it" mechanism proposed in Guvenen et al. (2023). Following their example, suppose the government had to finance itself with an amount of five euros and there were two agents in the economy, an efficient $e$ businessman/woman with profits of twenty euros and its inefficient $i$ counterpart with zero profits, and each with a wealth of a hundred euros. Under

While recent literature has begun addressing the topic of optimal policy in the presence of financially constrained entrepreneurs ((Boar and Midrigan, 2022b), (Guvenen et al., 2022), (Guvenen et al., 2023)), three important margins remain unexplored. First is the degree of the intergenerational transmission of entrepreneurial abilities. [9] Whether the offspring of successful entrepreneurs who have accumulated significant wealth are able to operate at the same scale or their skills show regression towards the mean could have important policy implications. Second, we investigate the role played by having a wider set of tax instruments at the disposal of the social planner. In particular, we augment the set to include inheritance taxes and exemptions on inheritances and wealth taxes. In addition, we perform the global optimization exercise over all taxes jointly, which remains computationally challenging. Third, we incorporate an explicit endogenous occupational choice. This is of importance as it regulates the extensive margin of misallocation in response to policies. Lastly, we study revenue-neutral partial reforms wherein a given tax is increased to subsidize a decrease of another. This provides key insights for the subsequent optimal policy analysis.

To that end, we construct a DSGE model featuring (i) endogenous occupational choice (ii) life-cycle structure (iii) a corporate and entrepreneurial sector and (iv) a government that levies taxes through a variety of tax instruments. The model reproduces the moments related to the pass-through (entrepreneurial) sector and inequality in the U.S. and enables the study of partial reforms and optimal long-run taxation.

Our main findings are as follows. First, we find that in our calibration the "use it or lose it" mechanism (Guvenen et al., 2023) (increasing wealth taxes to subsidize capital taxes) leads to a efficiency gain but not a welfare gain for the agents in the economy. [10] Second, we find that allowing for a wider set of tax instruments leads to significant relative gains in aggregate welfare in our optimal policy exercises. In particular, allowing for an exemption on the wealth tax shifts the long-run wealth tax from negative to positive and to a relatively high rate. Moreover, this is not specific to the model with entrepreneurship as it carries over to the specification thereof without entrepreneurs. Third, a lower inter-generational transmission of abilities is found to lead to lower gains from re-distributive taxation relative to the benchmark with full inheritance of abilities. Intuitively, this happens as a lower persistence of the inter-generational transmission of abilities process leads in the steady state invariant distribution to less inequality in labour and capital incomes. This is again robust to not having entrepreneurs in the model. Lastly, we find that

capital taxation, the profits of $e$ would have to be taxed at 25%, whilst $i$ would be left untaxed. Under wealth taxation, however, both paying a wealth tax 2.5% would suffice to finance the government. Therefore, shifting from capital taxation to wealth taxation would (i) not distort the before-tax returns (ii) leave $e$ with a higher share of aggregate wealth. Although this is a static setting with no market for interpersonal financing, the intuition follows suit to the general model.

[9] In Guvenen et al. (2023) there is an extension considering a counterfactual with everyone beginning at the same productivity level. Here, we consider two opposite cases (full against no inheritance of abilities) and study its implications for policy by recalibrating the economy, with and without entrepreneurs.

[10] This is due to a variety of reasons, including (i) low degree of misallocation in the economy given the reasonable calibration using moments from the pass-through sector (ii) misallocation along the extensive margin stemming from the occupational choice being endogenous.

the dimension of endogenous occupational choice acts against the allocative efficiency force from the "use it or lose it" mechanism. The intuition for this is that decreasing capital taxes increases the returns to entrepreneurship along the entire abilities distribution, leading inefficient types to become entrepreneurs, and thus generating misallocation along the extensive margin.

**Related literature**

Our work is related to different strands of the literature. First, relative to the literature on optimal capital taxation, Judd (1985), Chamley (1986), Straub and Werning (2020), Conesa et al. (2009), Greulich et al. (2022)..., we extend the analysis to include entrepreneurship and consider capital, wealth and inheritance taxation jointly. In line with the more recent papers on this literature, we find positive long-run capital taxes as part of the optimal policy tuple of the social planner, and shed light on the implications for optimal policy on having a varying number of tax instruments available.

Second, regarding the literature on entrepreneurship and wealth concentration, Quadrini (2000), Cagetti and De Nardi (2006), Cagetti and De Nardi (2009)..., we study the implications of entrepreneurship for long-run optimal taxation as well as the implications of its inter-generational correlation. We find that understanding the source of wealth concentration is important, as in our baseline with entrepreneurs we find higher capital taxes than in the counterfactual without entrepreneurs (which requires a super-star labour ability state a la Castaneda et al. (2003)), mainly due to the motive to redistribute unequally held profits.

Third, as for the literature on entrepreneurship and financial frictions Holtz-Eakin et al. (1994), Banerjee and Blickle (2021), Georgellis et al. (2005)..., the focus here is on the implications of these financial frictions for optimal policy. Perhaps on a negative note, we find that when restricted to capital, labour and wealth taxes, the optimal long-run policy does not change (qualitatively) when including entrepreneurship in the model. This is mainly due to the low misallocation that the economy is subject to in our model to begin with given the choice for the targeted moments.

Lastly, in contrast to the closest literature on optimal capital taxation with entrepreneurs, Boar and Midrigan (2022b), Guvenen et al. (2023), we find, as discussed above, that allowing for a wider set of tax instruments, as well as the specific assumptions on the inter-generational persistence of abilities has significant implications for optimal policy and its associated welfare gains. In addition, we stress the importance of adding the margin of the endogenous occupational choice given its implications for misallocation (particularly along the extensive margin).

The rest of the draft is organized as follows. Section 2 presents the DSGE model. Section 3 discusses the calibration. Section 4 presents the results on (i) partial reforms (ii) optimal long-run policy. Lastly, section 5 concludes.

## 2 Model

We consider an infinite horizon dynastic model with two stages in life (young and old), two production sectors (entrepreneurial and corporate) and a government that levies taxes through a variety of instruments. This draft abstracts from aggregate uncertainty. We shall discuss each of the components of the model in detail.

**Households** The model is inhabited by a continuum of measure one of ex-ante identical households. The time period in the model is one year and agents go through two stages in life, young and old. Young people may become workers or entrepreneurs, and have a probability $p_y$ or remaining young. Meanwhile, Old people in this economy are either pensioners or can also become entrepreneurs, in which case they forgo their pension in that period. These types have a probability $p_o$ of remaining alive. Upon death, we assume that the offspring enters the model carrying the inherited assets and abilities.

Households in this economy derive utility from consumption and labour, $u(c, l)$ and discount the future at a fixed rate $\beta$.

Individuals in this economy must decide (i) how many assets to carry to the next period (bequests in the case of death) (ii) whether to become an entrepreneur or remain a worker/pensioner (iii) how many hours to supply in the labour market in the case of being a worker (iv) how much capital to invest the firm in the case of being an entrepreneur

**Technology** Each individual in the economy is endowed with idiosyncratic labour and entrepreneurial abilities, which we shall denote $x$ and $z$, respectively. These are exogenous, follow an auto-correlated process and are uncorrelated with one another. We will further assume that both processes follow an AR(1) process: [11]

$$y_t = \rho_y y_{t-1} + \epsilon_t \text{ s.t. } \epsilon_t \sim \mathcal{N}(0, \sigma_y)$$

Where $y$ denotes a generic variable, $\rho$ is the auto-correlation coefficient and $\sigma$ is the standard deviation of the error term.

The economy is made up of two sectors, the entrepreneurial and the corporate. Entrepreneurs produce according to the following decreasing returns to scale production function:

$$f(k, l) = e^z \left(k^\alpha l^{1-\alpha}\right)^v$$

Where $k$ denotes capital, $l$ labour, $z$ is the aforementioned idiosyncratic productivity of the entrepreneur and $v$ is the returns to scale parameter. Note that production takes place after $z$ is observed so there is no within-period uncertainty.

The corporate sector is standard and produces using capital and labour with a Cobb-Douglass production function:

$$f_c(k, l) = A k_c^\alpha l_c^{1-\alpha}$$

Where $k_c$ denotes the overall capital in the corporate sector and $l_c$ is the labour counterpart. $A$ stands for the productivity of the corporate sector and its main role will be to pin down its share

[11] These are then discretized into a Discrete Markovian Process using Tauchen (1986)'s method.

of production in equilibrium.

We assume that in both sectors capital depreciates at rate $\delta$. In addition, the corporate sector acts as a market clearing device. That is, $k_c$ and $l_c$ are equal to the residual of total capital and labour supply after subtracting the demand for these inputs by the entrepreneurial sector. Both sectors produce a homogeneous final good that is sold at unit price.

**Financial Markets** There exists a risk-free bond that is borrowed and lent intra-period at rate $r$. We impose the following structure on the financial market: (i) no borrowing for consumption is allowed, so that $a \geq 0$, where $a$ denotes the assets held by the household (ii) the borrowed funds may only be employed to finance entrepreneurial capital (iii) as mentioned above, production takes place after $z$ has been observed, so there no within period uncertainty in borrowing (iv) entrepreneurs are subject to borrowing constraints, which are assumed to take the following functional form:

$$k_{con} \leq \lambda a$$

Where $k_{con}$ denotes the maximum attainable capital under borrowing constraints, and $\lambda$ is the maximum leverage ratio of the entrepreneur over its wealth. Naturally, a value of $\lambda = 1$ will imply that there is financial autarky and entrepreneurs have to fully finance their investment through their wealth. A value of $\lambda \to \infty$ in turn would lead to the frictionless case where entrepreneurs have no borrowing constraints and optimal production scales can be achieved.

The presence of financial frictions will imply that productive entrepreneurs that have little wealth will not be able to produce at optimal scale, which implies that the marginal products of capital will not equalize among entrepreneurial firms, thus leading to heterogeneity in rates of return. This will be a key ingredient for our optimal policy analysis.

**Government** The government block in this economy is aimed at replicating the US tax system. We closely follow the literature and denote $\tau_k$ the tax on capital, $\tau_w$ the tax on wealth, $\tau_l$ the tax on labour, $\tau_c$ the tax on consumption and $\tau_I$ the tax on inheritances. We further assume that both wealth and inheritance taxation can be subject to an exemption level, below which no taxes are paid. The government levies these taxes to subsidize pension payments, a fixed level of government expenditure and debt payments. In our optimal policy exercise, we will allow the government to use lump-sum transfers, denoted by $T$, which will also enter into the expenditure side.

The capital tax is levied on the interest earned on assets $ra$ and entrepreneurial profits $\pi$. The wealth tax is paid at the beginning of the period over the total assets that the agent has, conditional on these being higher than the exemption level $(a > e_a)$. Labour taxes are paid over the supplied efficiency units of labour income $wlx$. As for consumption, taxes are paid over realized consumption, which will happen after the choice for optimal assets to carry to the next period has been made. Finally, inheritance taxes are paid upon death over the optimal choice for assets that the agent made for the following period $a'$, conditional on these being above the exemption level $(a' > e_I)$.

The budget constraint for the government is therefore:

$$\int(\tau_k(ra+\pi I_e)+\tau_w((a-e_w)I_{a>e_w})+\tau_l(wxlI_w+pI_p)+\tau_I((a'-e_I)I_{a'>e_I}I_d)+\tau_c(c)d\lambda) = pI_p+G+rD+T$$

Where $I_e$, $I_w$, $I_d$, $I_p$ are indicator functions for being an entrepreneur, worker, dead and a pensioner, respectively. $\lambda$ denotes the invariant distribution at the steady state of the economy over the state space. $p$ stands for the pension, which is assigned to pensioners $I_p$. The specific functional form will be discussed in the calibration section. $G$ is the fixed share of government expenditure over GDP, and $D$ is the debt ratio over GDP, which will be calibrated to match that of the US economy. Lastly, $T$ denotes the potential lump-sum transfers the government might choose to employ as part of the optimal tax policy.

**Individuals' decision problems** Agents in the economy have to make several decisions every period (i) occupational choice (ii) optimal assets (iii) optimal supply of labour (iv) optimal scale of production. We have four different types of agents in the economy, young workers, young entrepreneurs, old pensioners and old entrepreneurs. Each of them has their own particular maximization problem. We will closely look at the Bellman equations of each type of agent, starting with the young.

The state space for the young's problem (and every other type's) is given by their current holdings of assets, their idiosyncratic labour ability $x$ and their entrepreneurial ability $z$. At the beginning of the period a young agent has to choose whether to become a worker or an entrepreneur. The value function is therefore given by:

$$V^y(a,z,x) = \max\{V^w(a,z,x), V^{y,e}(a,z,x)\}$$

$V^y(a,z,x)$ is the upper envelope over the discrete set of occupational choices, and is the value function of being young. $V^w(a,z,x)$ and $V^{y,e}(a,z,x)$ are the value functions of being a worker and an entrepreneur, respectively. We shall now discuss each of them in further detail.

The value for being a worker is standard and given by the following Bellman equation:

$$V^w(a,z,x) = \max_{a',l} u(c,l) + \beta(p_y\mathbb{E}V^y(a',z',x') + (1-p_y)\mathbb{E}V^o(a',z',x'))$$

Subject to the budget constraint:

$$c = \frac{(1+r)(a) + wlx - \tau_w(a-e_w)I_{a>e_w} - \tau_l wlx - \tau_k ra - a' + T}{1+\tau_c}$$

And borrowing constraint:

$$a' \geq 0$$

Where $l$ is labour, the expectation operator $\mathbb{E}$ is with respect to the idiosyncratic productivities

$z, x$ and $V^o(a, z, x)$ is the value of being old, which we shall discuss later. As we can observe from the equations, the objective of the worker is to choose optimal assets for the next period and optimal labour supplied in the current period, subject to the borrowing constraint.

The value of being a young entrepreneur is in turn given by:

$$V^{y,e}(a, z, x) = \max_{a', k} u(c, l) + \beta(p_y \mathbb{E} V^y(a', z', x') + (1 - p_y)\mathbb{E} V^o(a', z', x'))$$

Subject to the budget constraint:

$$c = \frac{(1 + r)(a) + \pi - \tau_w(a - e_w)I_{a>e_w} - \tau_k(ra + \pi) + T - a'}{1 + \tau_c}$$

Where profits are given by:

$$\pi = z\left(k^\alpha l^{1-\alpha}\right)^v - (r + \delta)k - wl$$

And collateral borrowing constraints are:

$$k \leq \lambda a$$

The young entrepreneur must decide the optimal scale of production subject to the borrowing constraint. Since the profit maximization problem is static, one can obtain optimal capital $k^*$ and then obtain $\pi$ and solve for assets in a standard manner.

Having discussed the problem for the young, we now turn our focus to that of the elderly people. Their value function is given by:

$$V^o = \max\{V^p(a, z, x), V^{o,e}(a, z, x)\}$$

In this case the value is given by the upper envelope over becoming a pensioner or an old entrepreneur. Note that we assume that elderly people can, as their young counterparts, exit or enter entrepreneurship at every period.

In the case of becoming a pensioner, the value function will be given by:

$$V^p(a, z, x) = \max_{a'} u(c, l) + \beta(p_o \mathbb{E} V^o(a', z', x') + (1 - p_o)\mathbb{E}_d V^y(a' - \tau_I(a' - e_I)I_{a'>e_I}, z', x'))$$

Subject to the budget constraint:

$$c = \frac{(1 + r)(a) + p - \tau_w(a - e_w)I_{a>e_w} - \tau_l p - \tau_k ra - a' + T}{1 + \tau_c}$$

And borrowing constraint:

$$a' \geq 0$$

The problem for the pensioner is almost identical to that of the worker except for a couple of points: (i) note that the pensioner's income is now given by the pension $p$ rather than the income from working, $wlx$ (ii) note that now the probabilities corresponding to the life-cycle are $p_o$ and $1 - p_o$, which denote the probability of remaining alive and dying, respectively (iii) upon death, we see that the value function of the offspring is taken into consideration, and this is evaluated at the optimal choice for assets net of the inheritance tax (iv) The expectation operator $\mathbb{E}_d$ is now with respect to the process governing the inter-generational transmission of abilities.

Lastly, the problem for the old entrepreneur is given by:

$$V^{o,e}(a,z,x) = \max_{a',k} u(c,l) + \beta(p_o \mathbb{E}_d V^o(a',z',x') + (1-p_o)\mathbb{E}_d V^y(a' - \tau_I(a' - e_I)I_{a'>e_I}, z', x'))$$

Subject to the budget constraint:

$$c = \frac{(1+r)(a) + \pi - \tau_w(a - e_w)I_{a>e_w} - \tau_k(ra + \pi) + T - a'}{1+\tau_c}$$

Where profits are given by:

$$\pi = e^z \left(k^\alpha l^{1-\alpha}\right)^v - (r+\delta)k - wl$$

And the collateral borrowing constraint is:

$$k \leq \lambda(a)$$

Which is identical to the one of their young counterparts once accounting for the differences mentioned above.

## 3 Calibration

The model is calibrated to the US data. To study the implications of the intergenerational transmission of abilities and the role of entrepreneurship, four different calibrations are carried out: one with full inheritance of abilities and entrepreneurs, one with no inheritance of abilities and entrepreneurs, and the counterparts of these two without entrepreneurs. This section shall discuss in detail the choices for the parameters of the model and the imposed functional forms. Whenever specific values for the parameters are given, these will be the ones of the benchmark specification, the model with full inheritance of abilities and entrepreneurs.

**Demographics** The time period in the model is one year. For the probabilities governing the transition from young to old and from old to death, we follow Cagetti and De Nardi (2009). Young agents have a probability of $p_y = 97.8\%$ of remaining young and old agents have a probability of $p_o = 91\%$ of remaining alive. This guarantees that the expected working life duration is 45 years and expected retirement period is 11 years. It is assumed that when an old agent dies the offspring enters the economy inheriting the abilities either perfectly or independently, and assets (net of the inheritance tax).

**Preferences** The utility function is assumed to take the following functional form:

$$u(c,l) = \frac{c^{1-\sigma}}{1-\sigma} - \Phi\frac{l^{1+\gamma}}{1+\gamma}$$

Where $c$ denotes consumption and $l$ labour supply, which may only be supplied by workers. [12] The relative risk aversion parameter $\sigma$ is fixed at 2.5, a common value in the literature. The Frisch elasticity of labour supply $\gamma$ is set to 2, a common value in the macro literature. A $\frac{K}{Y}$ ratio of 3 is targeted, which requires $\beta = 0.9602$. Lastly, $\Phi$ is calibrated such that an average of 33% of the time is devoted to the labour market.

**Technology** The capital elasticity in production is set to $\alpha = 1/3$, a standard value in the literature. The returns to scale parameter in the entrepreneurial sector is set to $v = 0.679$, chosen to target a profit margin of 48% at the 90th percentile of entrepreneurial firms as reported in Zidar et al. (2017), who have acesss to an adminstrative dataset on pass-through firms. The productivity of the corporate sector $A$ is set such that the entrepreneurial sector produces 40% of GDP, as reported in Dyrda and Pugsley (2018). The depreciation rate is set at 6%.

**Tax System** As for the Tax System, the paper by Guvenen et al. (2023) is closely followed, due to its relevance in the literature and for ease of comparison of the results. In particular, we set the capital tax at $\tau_k = 25\%$, the labour tax at $\tau_l = 22.4\%$ and the consumption tax at $\tau_c = 7.5\%$. In addition to this, an inheritance tax is set so that 2% of the bequests pay the inheritance tax (as in Cagetti and De Nardi (2009)), which requires $\tau_I = 45.66\%$ and an exemption level of $e_I = 238.82$. [13] Although the assumption of flat taxes might seem restrictive, the literature has found that flat taxes with lump-sum transfers can achieve the bulk of welfare gains that are attainable with non-linear instruments (Boar and Midrigan, 2022a). The share of (wasteful) government expenditure G is calibration specific and is chosen such that it clears the budget constraint of the government in the calibration step. Lastly, the wealth tax $\tau_w$ and its exemption level $e_w$ are both set to zero in the benchmark economy (following the current US tax system). When studying optimal taxation, welfare will be maximized over each of these instruments over a continous domain.

**Labour and Entrepreneurial productivity** There are four parameters governing the idiosyncratic labour and entrepreneurial productivity processes, $\{\rho_z, \sigma_z, \rho_x, \sigma_x\}$. Although these parameters are jointly calibrated, a few comments are in place. First, the volatility of the entrepreneurial ability, $\sigma_z$, is chosen such that the $90/50p$ ratio of employment in pass-through firms is matched. Second, the $\rho_z$ is mainly responsible for targeting the MPK premium and leverage ratio of entrepreneurial firms. A higher auto-correlation implies that productive firms will be able to grow out of their borrowing constraint faster (Moll, 2014), thereby reducing the spread between the marginal product of capital and the user cost thereof, and also the debt-to-assets ratio. Third, the parameters on the labour ability $\{\rho_x, \sigma_x\}$ are mainly responsible for matching the Gini coefficient

[12] In particular, we assume that entrepreneurs and pensioners have a labour supply of zero.
[13] These calibrated rates are in line with the top marginal rate of 40%.

of wealth in the economy. Note that a higher auto-correlation $\rho_x$ will imply lower uncertainty on future income realizations, thereby weakening the savings motive of workers. The same applies to a lower value of $\sigma_x$. It is crucial to underline however that the extreme wealth concentration at the top percentiles in this class of models does not arise from the choice for $\{\rho_x, \sigma_x\}$ but rather from the interaction of financial frictions and entrepreneurial productivity (Cagetti and De Nardi, 2006). [14]

**Financial constraints** As explained above, a key ingredient for the presence of heterogeneity of returns in the economy is the presence of financial frictions, which prevent entrepreneurial firms from reaching their unconstrained level of production and therefore the equalization of returns. Here the parameter is set to match a capital-weighted debt-to-assets ratio of 35%, in line with Dyrda and Pugsley (2018). [15] This requires a value of $\lambda = 1.65$, well within the range of values estimated in the literature.

Tables (1), (2), (3) show the fixed and calibrated parameters and the targeted and untargeted moments, respectively.

Table 1: Model Parameters I, Fixed Parameters

| Parameter | | Value | Source |
|---|---|---|---|
| Capital Income Tax Rate | $\tau_k$ | 25% | Guvenen et al. (2023) |
| Labour Income Tax Rate | $\tau_l$ | 22.4% | Guvenen et al. (2023) |
| Consumption Tax Rate | $\tau_c$ | 7.5% | Guvenen et al. (2023) |
| Depreciation Rate | $\delta$ | 6% | Fixed |
| Share of Capital | $\alpha$ | 1/3 | Fixed |
| Probability remain young | $p_y$ | 97.8% | Cagetti and De Nardi (2009) |
| Probability remain old | $p_o$ | 91.1% | Cagetti and De Nardi (2009) |
| Risk Aversion Coefficient (CRRA) | $\sigma$ | 2.5 | Fixed |
| Frisch elasticity parameter | $\gamma$ | 2.0 | Fixed |
| Debt to GDP ratio | $D$ | 1.2 | Fixed, data |
| Public Expenditure as share of GDP (%) | G | Calibration Specific | Internal |

**Notes:** The table displays the fixed parameters in the model across all four different specifications. These parameters are fixed to typical values in the literature or directly taken from either Cagetti and De Nardi (2009) or Guvenen et al. (2023).

Turning the attention to the targeted moments, the model does a decent job at matching the selected moments across all four specifications of the model. A natural question that arises, if we are to take the predictions of the model seriously, is how it performs along other relevant dimensions that have not been directly targeted. Looking at the lower panel of table (3), a selection of relevant moments has been added along with their empirical values and the model generated

[14] In the version of the model without entrepreneurs, the extreme concentration of wealth is targeted following the strategy in Castaneda et al. (2003) of employing an additional "super-star" state for the labour productivity process.

[15] Note that in the frictionless economy this MPK premium would be zero, as firms would be able to attain their optimal scale where $k$ s.t. $\frac{\partial Y}{\partial k} = r + \delta$.

Table 2: Model Parameters II, Jointly Calibrated Parameters

| Def. | Parameter | Entre., full inh. | Entre., no inh | No Entre., full inh | No Entre., no inh |
|---|---|---|---|---|---|
| Discount factor | $\beta$ | 0.952 | 0.953 | 0.927 | 0.949 |
| Returns to Scale | $v$ | 67.9% | 67.75% | - | - |
| Leverage Ratio | $\lambda$ | 1.6578 | 1.69225 | - | - |
| Productivity Corporate sector | $A$ | 3.63 | 3.76 | 3.63 | 3.76 |
| Autocorrelation Entrepreneurial ability | $\rho_z$ | 96.2% | 96.46% | - | - |
| Standard deviation Entrepreneurial ability | $\sigma_z$ | 25.51% | 24.96% | - | - |
| Autocorrelation Labour ability | $\rho_x$ | 98.11% | 97.31% | 97.5% | 99% |
| Standard deviation Labour ability | $\sigma_x$ | 11.95% | 9.23% | 16.61% | 6.2% |
| Exemption level Inheritance Tax | $e_I$ | 238.827 | 260.155 | 184.722 | 95.439 |
| Inheritance Tax | $\tau_I$ | 45.66% | 45.45% | 29.2% | 45.31% |
| Disutility Labour | $\Phi$ | 1.81 | 1.71 | 2.7952 | 2.82 |
| Pr entry super-state | $p$ | - | - | 0.06% | 0.01% |
| Pr exit super-state | $q$ | - | - | 8.7% | 10.3% |

**Notes:** Internally calibrated parameters in the model by calibration specification: (i) model with entreprenerus and full inheritance of abilities, (ii) model with entreprenerus and no inheritance of abilities (iii) model without entrepreneurs and with full inheritance of abilities (iv) model without entrepreneurs and without inheritance of abilities. The first column provides the definition of the parameters in the second column. Columns (3) to (6) report the obtained parameters for each case. The procedure employs a SMM methodology with simulated annealing.

Table 3: Model Parameters III, Targeted and Untargeted Moments, by Calibrated Economy

| Targeted Moments | | | | | |
|---|---|---|---|---|---|
| Moment | Data | Entre., full inh. | Entre., no inh | No Entre., full inh | No Entre., no inh |
| Capital to Output Ratio | 3.00 | 2.997 | 2.993 | 3.017 | 2.998 |
| Employment 90/50p Ratio Pass-through firms | 7.83 | 7.78 | 8.09 | - | - |
| 90p Profit Margin Pass-through firms | 47.9% | 47.9% | 48.3% | - | - |
| Capital Weighted Debt-Assets Ratio | 34.58% | 35.7% | 34.8% | - | - |
| Share Inheritances Paying Tax | 2% | 2.09% | 2.04% | 2.3% | 2.02% |
| Inheritance Tax Revenue / GDP | 0.3% | 0.306% | 0.29% | 0.284% | 0.31% |
| Wealth Gini Coefficient | 83% | 81.11% | 82.2% | 82.5% | 81.3% |
| Production Share Pass-through Sector | 40% | 40.2% | 40.7% | - | - |
| Labour Supply | 0.33 | 0.336 | 0.335 | 0.332 | 0.335 |
| Untargeted Moments | | | | | |
| Moment | Data | Entre., full inh. | Entre., no inh | No Entre., full inh | No Entre., no inh |
| Share of Entrepreneurs | 7.6% | 6.11% | 5.85% | - | - |
| Capital-Weighted MPK premium | 3% | 2.44% | 2.3% | - | - |
| Total Tax Revenue / GDP | 29.5% | 27.79% | 28.1% | 28.3% | 29.52% |
| Capital Tax Revenue / Total Tax Revenue | 28% | 25.51% | 25.3% | 19.5% | 19.05% |
| Share top 10% Wealth | 68% | 69.7% | 72% | 70.4% | 62% |
| Share top 1% Entrepreneurs | 57% | 74.6% | 75% | - | - |
| Wealth Share top 1% | 32% | 17.9 % | 18.09% | 20.8% | 17.06% |
| Exit Rate (%) | ? | 10.3% | 11.7% | - | - |
| Entry Rate (%) | ? | 0.68% | 0.7% | - | - |
| Share Unconstrained E (%) | ? | 49.59% | 48.5% | - | - |

**Notes:** Performance of the model along the targeted and untargeted dimensions by specific calibration. The top panel displays the targeted moments while the bottom one does likewise for the untargeted. In each panel the data counterpart is provided on the second column and the model generated moments are provided in columns (3) to (6).

counterparts. A few comments are in place.

First, one may observe that the generated share of overall entrepreneurs is close to the data counterpart. [16]

Second, the degree of misallocation in the economy is captured through the capital-weigthed MPK premium, which measures the spread between the MPK at the entrepreneurial firms and the user cost of capital at the corporate sector, as in Gilchrist et al. (2014). Although the comparison is far from ideal (the original paper uses compustat public firms) this allows for a qualitative reading that the degree of misallocation in the model is not extreme. In fact, this case is strengthened by looking at the share of unconstrained entrepreneurs in the model, which is about 50% in both calibrations and is monotonically increasing as a function of the wealth distribution (in fact at the top 1% of the wealth distribution, nearly all of the entrepreneurs are unconstrained).

Third, although the model does well at matching the Gini coefficient of wealth, one could wonder how it fares in matching wealth concentration along the upper tail of the distribution. Here the results are mixed. Recall that in this class of models wealth concentration arises endogenously as a consequence of the financial frictions. When wealth is low, the maximum attainable stock of capital is very low, pushing the MPK at the entrepreneurial firms up. As the firms grow out of their borrowing constraints by accumulating past earnings, the MPK is equalized with the corporate sector and at some point become unconstrained. It is then that the endogenous wealth accumulation mechanism is weakened. This is in fact what is reflected on the wealth shares of the top 10% and 1% of the assets distribution. Although the model does well at matching the wealth concentration of the top 10%, it falls short at matching that of the top 1%, primarily due to this weakening of the financial frictions channel.

Lastly, and since the primary objective of the model is to address the question of optimal taxation, it is pivotal that it generates moments on the fiscal dimension that are close to the data. Following Guvenen et al. (2023), the Total Tax Revenue / GDP and Capital Tax Revenue / Total Tax Revenue moments are selected. The model is able to match these two moments quite closely, particularly in the model with entrepreneurs, given that the capital tax also collects revenues on profits, which are absent in the model without entrepreneurs.

# 4 Results

Having discussed the model and calibration, we now analyse the predictions of the model. First, we will study partial reforms starting at the benchmark SS to study the key trade-offs of the model. Second, once we gain an intuition on the underlying forces, we will look at the optimal taxation in this economy.

## 4.1 Partial Reforms

Studying optimal taxation requires understanding the key trade-offs between different tax instruments. For example, what is the effect of increasing wealth taxes to subsidize a reduction on

[16] This figure is taken from Cagetti and De Nardi (2006), who construct different definitions of entrepreneurship from the SCF data.

capital taxes? In this section we will study the response of the economy to such tax reforms, both in the model with and without entrepreneurs. The procedure is the following:

- Starting at the benchmark long-run SS, a tax $\tau_x$ is increased by $i$%.
- Then, for each $\tau_x$ and increase $i$, we find the corresponding rest of taxes $\tau_{-x}$ that balance the government budget constraint.
- Lastly, the semi-elasticity of the economy $\frac{\Delta log(X)}{\Delta \tau_x(i)}$ to the tax change is computed, where $X$ is an aggregate of interest.

We will proceed in two steps. First, we will study the response of the main aggregate of interest the SWF, for all possible tax combinations. Second, we fill fix a given tax instrument and trace out the response of the real aggregates of the economy.

#### 4.1.1 Response of Aggregate Welfare

Since the ultimate goal of the social planner is to maximize long-run SS aggregate welfare, it is essential to understand how welfare responds to different tax trade-offs. Following Boar and Midrigan (2022b), to construct our aggregate measure of welfare we will proceed in two steps.

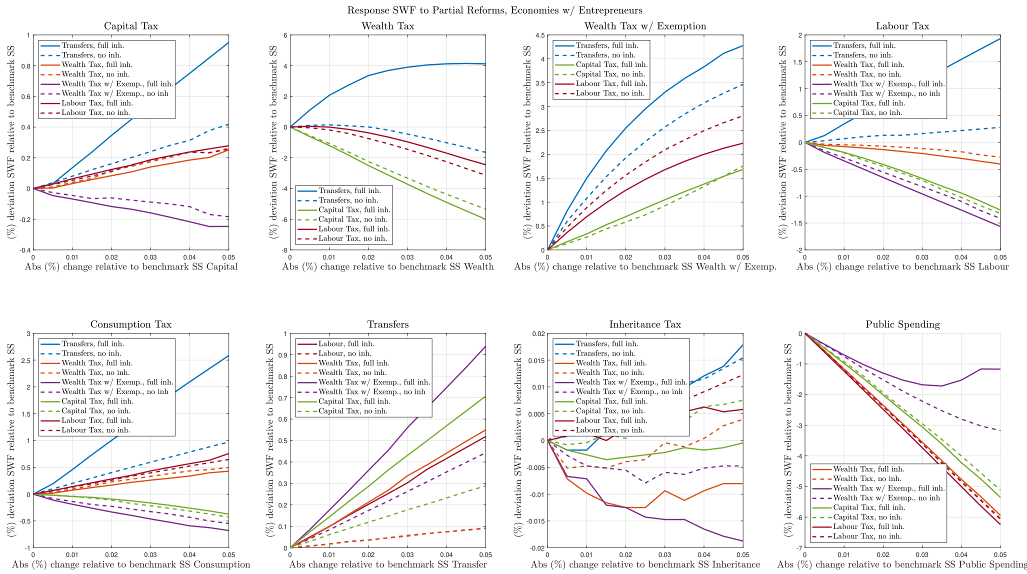
- First, for each household $i$ we define a consumption equivalence measure of welfare $V_i = \sum_{t=0}^{\infty} \beta^t \frac{\bar{c}_i^{1-\sigma}}{1-\sigma}$, where $V_i$ is the lifetime utility of the household. That is, $\bar{c}_i$ is the permanent consumption that would leave the agent indifferent (without working) with the SS.
- Second, we aggregate the obtained $\bar{c}_i$ according to $\left( \int \bar{c}_i^{1-\Delta} di \right)^{1-\Delta}$. This is our aggregate measure of welfare. $\Delta \geq 0$ is a parameter governing the preference for redistribution of the planner. For $\Delta = 0$, the planner is interested in maximizing average welfare. For $\Delta = \sigma$, the utilitarian planner's preferences are recovered.

For the purposes of this exercise we will keep $\Delta = \sigma$, as it is the standard benchmark in the literature. Figures (3) and (4) show the results of this policy counterfactual.

A few comments are in place regarding figure (3). First, we observe that regardless of the tax in question (moving along the panels), an increase in given tax to subsidize a lump-sum transfer increases long-run SS welfare, including capital and wealth taxes. This should come as no surprise in a model with a high calibrated degree of inequality and a social planner that has a preference for redistribution. However, we believe it points to the importance of carefully considering which tax instruments the government has under its disposal, as it will condition the trade-offs determining optimal policy. [17]

[17] This is a clear difference between Guvenen et al. (2023) and Boar and Midrigan (2022b), as the former consider the set $\{\tau_k, \tau_l, \tau_w\}$ and the latter $\{\tau_k, \tau_l, \tau_w, T\}$.

Figure 3: Response of the SWF to Revenue-neutral Partial Reforms starting at the SS




**Notes:** This figure shows the response of SWF (defined as the utilitarian welfare) for a set of partial reforms. In each panel, the x-axis indicates the tax that is increased in order to obtain additional revenues and subsidize a reduction of another tax at a time. Each line corresponds to one of these taxes in the specifications with entrepreneurs, with (solid) and without (dashed) inheritance of abilities. The y-axis indicates the (%) response of SWF relative to the benchmark SS. These are long-run exercises.

Second, as for the interaction between degree of the inheritance of abilities and the response of welfare, we can observe when looking at the trade-offs involving transfers and labour taxes that the welfare gains in the model with no inheritance of abilities is lower than the full inheritance counterpart. Intuitively, when abilities are drawn from the ergodic distribution upon death, the invariant distribution over the idiosyncratic productivities becomes less dispersed, so that on average agents are better off at the benchmark SS and the gains from redistribution are smaller. [18]

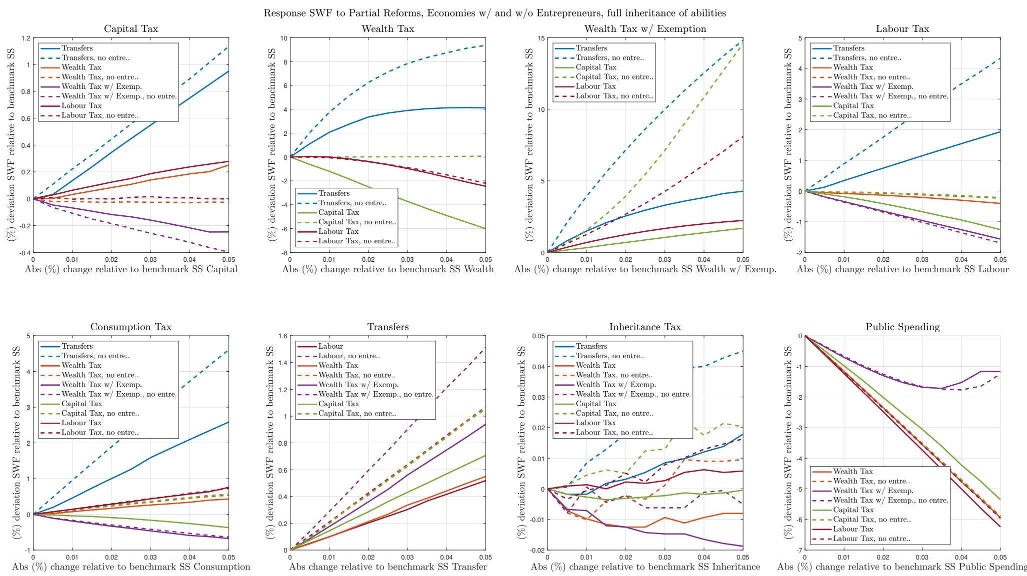
Third, and perhaps most notably, in our model there are no welfare gains [19] from the "use it or lose it mechanism". To see this, note that in the second panel, wherein the wealth tax is increased to subsidize a reduction on other taxes, both green lines (corresponding to the Capital Tax in the model with full inheritnace of abilities and no inheritance of abilities, respectively) indicate a negative response of aggregate welfare. The mechanism behind this will be explored in the next section.

[18]Consider the extreme case where agents live for one period only. In this case, if abilities were perfectly autocorrelated, a low-ability agent would be very likely to have a low-ability offspring. In contrast, if abilities were redrawn from the ergodic distribution, low-ability and high-ability agents would be as likely to have an offspring of a given ability, so that at the SS the distribution over abilities becomes less extreme.

[19]Note that welfare gains are endogneous on the specific pareto weights chosen for the SWF. This claim is done under the utilitarian SWF, which assigns equal weight to every agent. If pareto weights were chosen s.t. only entrepreneurs were considered, then the measure of welfare would increase.

Lastly, all the results on this and the next figures should be taken with a grain of salt insomuch as they are local properties around the benchmark SS of the economy. [20]

Figure 4: Response of SWF to Revenue-neutral Partial Reforms in the Calibrations With and Without Entrepreneurs, with Full Inheritance of Abilities




**Notes:** This figure shows the response of SWF (defined as the utilitarian welfare) for a set of partial reforms. In each panel, the x-axis indicates the tax that is increased in order to obtain additional revenues and subsidize a reduction of another tax at a time. Each line corresponds to one of these taxes in the specifications with entrepreneurs (solid) and without entrepreneurs (dashed), with full inheritance of abilities. The y-axis indicates the (%) response of SWF relative to the benchmark SS. These are long-run exercises.

Figure (4) is the counterpart of figure (3) in the case of the specifications of the model with entrepreneurs and no entrepreneurs (with full inheritance of abilities). Relative to the model with entrepreneurs, a few points are worth mentioning when comparing the economies with and without entrepreneurs.

First, we observe that in the model without entrepreneurs, we get the equivalence between wealth (without an exemption) and capital taxes. Since we can always find, given the homogeneity in the rate of return, a capital tax that does not alter the FOC for the agents for a given wealth tax (and vice-versa) we observe that in the model without entrepreneurs increasing the capital tax to decrease the wealth tax (first panel) or increasing the wealth tax to decrease the capital tax (second panel) generates no response in our measure of aggregate welfare. As we discussed in the previous figure, this is not the case in the model with entrepreneurs.

A second point worth mentioning is that the response of aggregate welfare for the case of

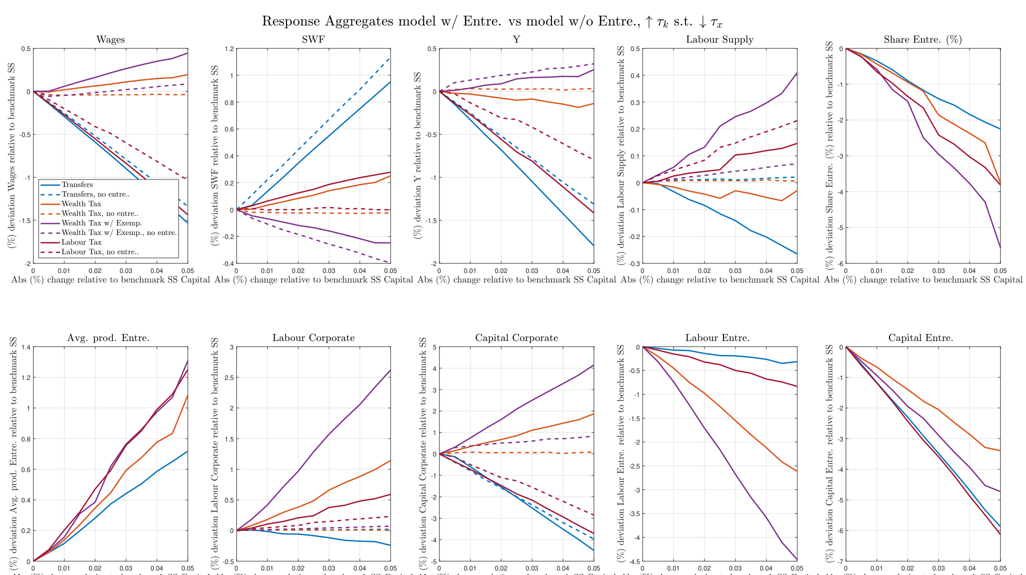
[20]For example, if we were to repeat the same partial reform analysis around a SS with optimally chosen labour and capital taxes, presumably the gains from increasing other taxes would be more moderate, as the capacity to collect additional revenues given the distortions would be reduced.

wealth taxation depends crucially on whether we have an exemption or not. Intuitively, an exemption [21] pushes the taxable base upwards on the wealth distribution, leaving the wealth accumulation policies of the large wealth-poor swathe of the population relatively undisturbed. Since the fraction of the population paying the wealth tax owns most of the wealth in the economy, the interest rate adjusts upwards to equate the supply and demand of capital, yielding higher returns to a large fraction of the population relative to the original SS. However, this holds both in the model with and without entrepreneurs, so it is not (as the "use it or lose it" mechanism) an idiosyncratic result of the model with entrepreneurs.

### 4.1.2 Response of Aggregates of Interest

In the previous section we discussed how aggregate welfare responds to partial reforms, in the model with and without entrepreneurs and under opposing assumptions on the inter-generational inheritance of abilities. The natural question that arises at this point is how these responses are generated in terms of the aggregates of the economy, a point we will endeavour to address in this section.

Figure 5: Response of Aggregates of Interest to Revenue-neutral Partial Reforms on Capital, models With and Without Entrepreneurs, with full Intergenerational Persistence of Abilities




**Notes:** This figure shows the response of a selection of aggregates for a set of partial reforms. In this exercise, the benchmark SS Capital Tax is increased progressively and its revenues employed to subsidize other taxes. Each line corresponds to one of these taxes in the specifications with entrepreneurs (solid) and without entrepreneurs (dashed), with full inheritance of abilities. The y-axis indicates the (%) response of each aggregate relative to the benchmark SS. These are long-run exercises.

[21] In this case we are using an exemption level s.t. only the top 10% at the benchmark SS wealth distribution pays the wealth tax.

Figure (5) shows the response of a selection of aggregates, in the model with entrepreneurs and without (under full inheritance of abilities) for a set of partial reforms wherein the capital tax is increased to subsidize a reduction in other taxes. For example, the first panel shows the response of wages when we increase the capital tax and employ these revenues to hand out lump-sum transfers (set of blue lines).

Turning the attention to the case of the economy without entrepreneurs first, we observe that the equivalence between capital and wealth taxes we observed in our measure of aggregate welfare carries over to the rest of the aggregates of the economy. If we focus on the dashed orange line, one may see that increasing the capital tax in the model without entrepreneurs to subsidize a reduction on the wealth tax s.t. the Gov. BC. holds generates no response in any of the aggregates.

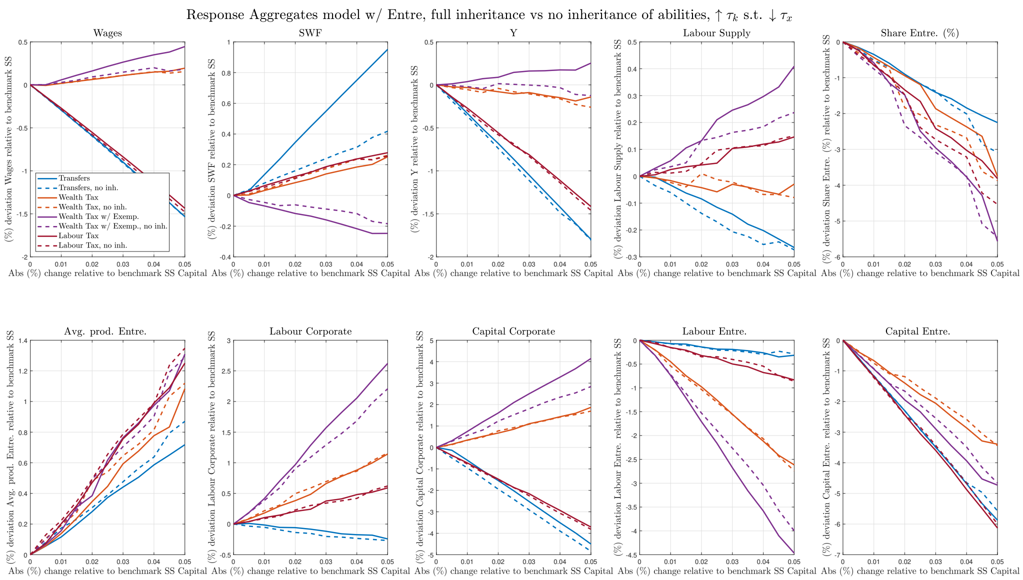
This is hardly the case in the model counterpart with entrepreneurs. In this case the heterogeneity in the rate of returns generates a non-negligible difference between capital and wealth taxation. However, as we discussed before, what we find is in clear contrast to Guvenen et al. (2023). While we observe a clear loss of efficiency due to the taxation of capital (solid orange line on the third panel), this substitution of the capital tax for a wealth tax leads to a positive response of aggregate welfare, which goes against the intuition of the "use it or lose it" mechanism. In our model, increasing the capital tax to subsidize a reduction on the wealth tax leads to an increase in the corporate sector's $\frac{K_c}{L_c}$ ratio. Since prices in this model are determined by this sector's MPK and MPL, wages increase in equilibrium, leading to an increase in utilitarian welfare (as the majority of the agents are young workers). This is not a sufficient condition for a increase in welfare however, as we can observe that in the case where we subsidize a reduction on the wealth tax with an exemption wages increase even more yet welfare declines. To the best of our understanding this is because interest rates decline further in the case of a wealth tax with an exemption, capital taxes are the same, and the reduction on the wealth tax only benefits the rich, pushing the distribution over assets downwards below the threshold. The bottom line is that studying the trade-offs between taxes requires an understanding of both the response of welfare at a given point on the state space as well as how the entire distribution over the state space shifts as a function of the policy change. [22]

An additional dimension that calls for attention in the model with entrepreneurs is the margin of the endogenous occupational choice. As can be seen in the fifth panel (row-wise) the share of entrepreneurs responds in a non-negligible manner to policy changes. The increase of the capital tax has the direct effect of decreasing the returns to entrepreneurship, as profits are taxed more heavily. At the same time, the sixth panel shows that average productivity of entrepreneurs increases as a direct effect of increasing capital taxes (in this sense capital taxes act as a cleansing force in the entrepreneurial sector). This mechanism has direct implications for optimal policy. Relative to a model where the mass of entrepreneurs is fixed, increasing wealth taxes to subsidize

[22] Guvenen et al. (2022) study this question theoretically. An important distinction however is that in their model workers are hand-to-mouth while in our model they accumulate wealth and there is endogenous occupational choice. Therefore, a policy that shifts the distribution over wealth downwards will decrease the expected value of becoming an entrepreneur.

a reduction of capital taxes involves the additional dimension of misallocation along the extensive margin.

Figure 6: Response of Aggregates of Interest to Revenue-neutral Partial Reforms, models With Entrepreneurs, by Varying degree of Intergenerational Ability Persistence




**Notes:** This figure shows the response of a selection of aggregates for a set of partial reforms. In this exercise, the benchmark SS Capital Tax is increased progressively and its revenues employed to subsidize other taxes. Each line corresponds to one of these taxes in the specifications with entrepreneurs and full inheritance of abilities (solid) and no inheritance of abilities (dashed). The y-axis indicates the (%) response of each aggregate relative to the benchmark SS. These are long-run exercises.

Closing this section on the response of the aggregates to the partial reforms, figure (6) shows the response of aggregates of interest in the model with entrepreneurs, with (full) and without inheritance of abilities. The main takeaway from this exercise is that the qualitative response (mainly, in terms of the sign) of aggregates does not vary significantly along this dimension. However, as mentioned above, the lesser dispersion along the abilities dimension in the invariant distribution associated to the SS with no inheritance of abilities decreases the inequality in (particularly) labour income, leading to more muted gains from lump-sum transfers or reducing labour taxes than in the full-inheritance counterpart.

## 4.2 Optimal Policy

Having discussed the intuition behind the key tax policy trade-offs in the previous section, we are now ready to discuss optimal policy. We will consider the problem of a Ramsey social planner that seeks to maximize long-run SS welfare. [23] In particular, the problem of the Ramsey Social Planner

[23] Although studying long-run SS optimal taxation might seem restrictive, we interpret this as a conservative exercise on the desirability of capital, wealth and inheritance taxes. We are currently working on (i) computing optimal taxation

is:

$$\max_{\{\tau_k,\tau_l,\tau_w,e_w,\tau_I,e_I\}} \left(\int \bar{c}_i^{1-\Delta} di\right)^{1-\Delta}$$

Such that:

- The usual conditions for a Competitive Equilibrium hold.
- Transfers are such that the Government balances the Budget Constraint:

$$\int (\tau_k(ra+\pi I_e)+\tau_w((a-e_w)I_{a>e_w})+\tau_l(wxlI_w+pI_p)+\tau_I((a'-e_I)I_{a'>e_I}I_d)+\tau_c(c)d\lambda) = pI_p+G+rD+T$$

- Transfers are not allowed to be negative $T \geq 0$

That is, the objective of the social planner is to choose the capital tax $\tau_k$, labour tax $\tau_l$, wealth tax $\tau_w$, wealth exemption $e_w$, inheritance tax $\tau_I$ and inheritance exemption $e_I$ such that the measure of aggregate welfare $\left(\int \bar{c}_i^{1-\Delta} di\right)^{1-\Delta}$ is maximized. We assume that the Transfers balance in the background to clear the Gov. BC., and are restricted to be positive. [24] [25]

This is a large optimization problem, and in order to solve it we exploit the performance gains that GPUs (Graphics Processing Units) enable researchers to achieve, as documented previously in the literature (Fernández-Villaverde and Valencia, 2018). [26]

This optimization problem is tackled along several dimensions. Throughout, the baseline model will be the one with entrepreneurship and full inheritance of abilities. In order to understand the role of (i) inheritance of abilities (ii) presence of entrepreneurship (iii) endogenous occupational choice and (iv) preference for redistribution, $\Delta = \sigma$ vs $\Delta = 0$, the baseline model will be compared to the corresponding version where the relevant channel is present. Conditional on this, we will proceed incrementally, by adding additional tax instruments, so as to disentangle the welfare gains brought by each tax instrument under each scenario.

We begin our discussion by looking at the obtained results for optimal taxation in the model with entrepreneurship and full inheritance of abilities under both criteria for the SWF (Table 4). Before proceeding with the comparison however, we will first discuss the results for the baseline case, the model with entrepreneurship and full inheritance of abilities as we increase the set of available taxes.

First, when considering optimal labour and capital taxes only, the planner sets them at an optimal level of $\tau_k = 50.76\%$ and $\tau_l = 63.2\%$. This is in line with the recent literature finding

taking the transition path into account and (ii) getting the entire Pareto Improving Pareto Optimal frontier of policies as in Greulich et al. (2022).

[24] Allowing for negative transfers is possible but that could violate the restriction that $a' \geq 0$. Therefore, we impose that the solution is such that positive transfers are paid by the government.

[25] Note that whilst the planner maximizes over $\{\tau_k, \tau_l, \tau_w, e_w, \tau_I, e_I\}$ taking $T$ as the residual, the whole set of taxes under consideration is $\{\tau_k, \tau_l, \tau_w, e_w, \tau_I, e_I, T\}$.

[26] In particular, we write a fully native CUDA C++ code and run it on a RTX 3070, achieving speed-ups up to x7800 when compared to the closest possible implementation in MATLAB on a 10600K CPU.

Table 4: Optimal Policy I: Utilitarian vs Average Welfare, model With Entreperneurs and Full Inheritance of Abilities

| | Optimizing over (Transfer clears G. BC.) | | | | | | | Optimal Policy | Util. SWF |
|---|---|---|---|---|---|---|---|---|---|
| | Capital | Labour | Wealth | Wealth Exemp. | Cons. | Inheritance | Inheritance Exemp. | $(\tau_k, \tau_l, \tau_w, e_w, \tau_c, \tau_I, e_I)$ | % SS dev. |
| Utilitarian Welfare | | | | | | | | | |
| (1) | X | X | X | X | | X | X | $(0.06\%, 63.34\%, 14.9\%, 10.61, 7.5\%, 0\%, 0)$ | +18.9% |
| (2) | X | X | X | X | | | | $(10.2\%, 57.88\%, 14.8\%, 12.30, 7.5\%, 45.66\%, 238.827)$ | +18.9% |
| (3) | X | X | X | | | | | $(71.67\%, 68.73\%, -2.74\%, 0, 7.5\%, 45.66\%, 238.827)$ | +14.5% |
| (4) | X | X | | | | X | X | $(46.75\%, 66.2\%, 0\%, 0, 7.5\%, 30.97\%, 26.42)$ | +14.2% |
| (5) | X | X | | | | | | $(50.76\%, 63.2\%, 0\%, 0, 7.5\%, 45.66\%, 238.227)$ | +14.1% |
| Average Welfare | | | | | | | | | |
| (1) | X | X | X | X | | X | X | $(34.6\%, 62.3\%, -3.5\%, 0, 7.5\%, 0\%, 0)$ | +7.66% |
| (2) | X | X | X | X | | | | $(37.9\%, 63.62\%, -3.5\%, 0, 7.5\%, 47.34\%, 224.621)$ | +6.6% |
| (3) | X | X | X | | | | | $(38.16\%, 63.12\%, -3.5\%, 0, 7.5\%, 47.34\%, 224.621)$ | +6.6% |
| (4) | X | X | | | | X | X | $(21.1\%, 48.61\%, 0\%, 0, 7.5\%, 0\%, 0)$ | +1.48% |
| (5) | X | X | | | | | | $(19.2\%, 46.9\%, 0\%, 0, 7.5\%, 47.34\%, 224.621)$ | +1.3% |

**Notes:** Results from the optimal taxation exercise in the economy with entrepreneurs and full inheritance of abilities, by employed SWF. The utilitarian welfare has preference for redistribution $\Delta = \sigma$, while the average one has no preference for redistribution. The top panel indicates the results for Utilitarian Welfare while the second does it for Average Welfare. The central columns indicate which policy instruments are being optimized over by the Ramsey Social Planner. The second to last column indicates the optimal policy tuple for each case. The last column indicates the attained welfare improvement in the new policy steady state.

positive long-run capital taxes. This policy yields a welfare gain of 14.1%. Second, when adding inheritance taxes along with an exemption to the set of available tax instruments, the government sets now the tuple $\tau_k = 46.75\%, \tau_l = 66.2\%, \tau_I = 30.97\%$ and $e_I = 26.42$. The additional welfare gains from including inheritance taxation is a rather modest 0.1% on the aggregate. Turning to optimal joint capital, labour and wealth taxation the planner now implements the policy $(\tau_k = 71.67\%, \tau_l = 68.73\%, \tau_w = -2.74\%)$. This is in line with our previous results on partial reforms and goes against the intuition of the "use it or lose it" mechanism. As we saw in the previous section, increasing the wealth tax to subsidize a reduction of the capital tax leads in this model to a significant decline of the $\frac{K}{L}$ ratio in the corporate sector, reducing equilibrium wages and therefore welfare. We believe our results are more in line in this regard with Boar and Midrigan (2022b), who find the planner would rather redistribute the unequally distributed profits of the entrepreneurs than tax wealth. The welfare gains associated to such policy would yield an aggregate welfare improvement of 14.5%, a higher delta than inheritance taxation. The inclusion of a wealth exemption implies an optimal policy tuple $\tau_k = 10.2\%$, $\tau_l = 57.88\%$, $\tau_w = 14.8\%$, $e_w = 12.3$, a result that is in stark contrast to the case without an exemption. When an exemption is available, the planner redistributes by taxing the stock of wealth above a certain level, and the wealth tax reverses sign and is set at a high rate of $\tau_w = 14.8\%$. These high wealth taxes are then accompanied by reduced labour taxes and capital taxes (to the best of our understanding to keep the returns on assets from collapsing). Note that the inclusion of this tax instrument (an exemption on wealth taxation) leads to an aggregate welfare improvement of 18.9%, and entails the highest delta 4.8% on welfare relative to optimally set capital and labour taxes. Lastly, when allowed to use the full set of instruments the planner sets $\tau_k = 0.06\%$, $\tau_l = 63.34\%$, $\tau_w = 14.9\%$,

$e_w = 10.61$, and eliminates inheritance taxation. Relative to the case where inheritance taxation is used without wealth taxation (4) we see that the planner now eliminates this tax and in turn sets higher wealth taxes relative to (2). In terms of aggregate welfare however, adding inheritance taxation to already optimally set capital, labour, wealth and wealth exemption taxation leads to a negligible improvement.

Having discussed the results for utilitarian welfare, we now shift our focus to average welfare. Several points are worth mentioning. First, overall the degree of taxation is lower compared to the utilitarian counterpart. For example, in the case of optimal capital and labour taxes these are set at $\tau_k = 19.2\%$ and $\tau_l = 46.9\%$, significantly below the $\tau_k = 50.76\%$ and $\tau_l = 63.2\%$ found in the previous case. This is direct consequence of the lesser degree of preference for redistribution, particularly in the case of capital taxes, which are more distorting for the aggregate stock of capital in the economy. Second, in this case wealth taxes are set at the minimum possible level, $-3.5\%$, and capital taxes are kept lower than in the utilitarian counterpart (3), which suggests that the high capital taxes found before were indeed redistributing profits in the form of lump-sum transfers. Lastly, the result on wealth exemptions shifting the wealth tax from negative to positive at a relatively high rate disappears, which points to the importance of the preference for redistribution in the economy.

Table 5: Optimal Policy II: model With Entrepreneurs, Full and No Inheritance of Abilities

| | Optimizing over (Transfer clears G. BC.) | | | | | | | Optimal Policy | Util. SWF |
|---|---|---|---|---|---|---|---|---|---|
| | Capital | Labour | Wealth | Wealth Exemp. | Cons. | Inheritance | Inheritance Exemp. | $(\tau_k, \tau_l, \tau_w, e_w, \tau_c, \tau_I, e_I)$ | % SS dev. |
| Full Inheritance | | | | | | | | | |
| (2) | X | X | X | X | | | | $(10.2\%, 57.88\%, 14.8\%, 12.30, 7.5\%, 45.66\%, 238.827)$ | $+18.9\%$ |
| (3) | X | X | X | | | | | $(71.67\%, 68.73\%, -2.74\%, 0, 7.5\%, 45.66\%, 238.827)$ | $+14.5\%$ |
| (4) | X | X | | | | X | X | $(46.75\%, 66.2\%, 0\%, 0, 7.5\%, 30.97\%, 26.42)$ | $+14.2\%$ |
| (5) | X | X | | | | | | $(50.76\%, 63.2\%, 0\%, 0, 7.5\%, 45.66\%, 238.227)$ | $+14.1\%$ |
| No Inheritance | | | | | | | | | |
| (2) | X | X | X | X | | | | $(2.99\%, 43.23\%, 14.38\%, 14.41, 7.5\%, 45.45\%, 260.155)$ | $+4.9\%$ |
| (3) | X | X | X | | | | | $(69.47\%, 50.5\%, -2.7\%, 0, 7.5\%, 45.5\%, 260.155)$ | $+2.7\%$ |
| (4) | X | X | | | | X | X | $(44.36\%, 41.96\%, 0\%, 0, 7.5\%, 28.7\%, 13.48)$ | $+1.77\%$ |
| (5) | X | X | | | | | | $(43.9\%, 38.51\%, 0\%, 0, 7.5\%, 45.45\%, 260.155)$ | $+1.69\%$ |

**Notes:** Results from the optimal taxation exercise in the economy with entrepreneurs, by degree of intergenerational transmission of abilities. The utilitarian welfare has preference for redistribution $\Delta = \sigma$. The top panel indicates the results for the full inheritance case while the bottom one does so for the no inheritance case. The central columns indicate which policy instruments are being optimized over by the Ramsey Social Planner. The second to last column indicates the optimal policy tuple for each case. The last column indicates the attained welfare improvement in the new policy steady state.

Having discussed the implications for optimal policy stemming from differing tastes for redistribution, we now look at how opposing processes for the inter-generational transmission of abilities shape optimal taxation. First, when looking at (5), capital taxes 50.76% are now at a higher rate than labour taxes 38.51%, the latter being in fact lower than in the case with full inheritance of abilities. As we discussed before, intuitively drawing abilities from the ergodic distribution upon death/birth leads to a lesser degree of inequality along the abilities dimension at the SS invariant distribution. Therefore, it should come as no surprise that there is less room for redistribution and that the gains thereof are a lower 1.69%. In fact, capital taxes are set at a higher rate than labour taxes, which suggests that capital income (mainly profits) are more unequally distributed than labour income. Second, when adding inheritance taxation to the set of available instruments, the planner chooses in this case a higher degree of inheritance taxation (bearing in mind the lower exemption level). To the best of our understanding, in aggregate terms, those holding a large share of wealth are old entrepreneurs who were productive in the past. With no inheritance of abilities, it is likely that the offspring of these agents has a low ability as an entrepreneur, which will require a lower level of assets to obtain optimal scale. Therefore, we would expect that inheritance taxation is less distortive in a world with no inheritance of abilities. In any case, the additional gains from this tax instrument are again modest, a 0.08%. Third, optimal capital, labour and wealth taxation is similar to the case with full inheritance of abilities, the aforementioned motive for lower labour taxation notwithstanding. The same applies to the case where wealth exemptions are available. It is worth noting, however, that the relative increase in welfare from wealth exemptions is higher in the model with no inheritance of abilities.

Table 6: Optimal Policy III: model With Entrepreneurs against No Entrepreneurs, with Full Inheritance of Abilities

| | Optimizing over (Transfer clears G. BC.) | | | | | | | Optimal Policy | Util. SWF |
|---|---|---|---|---|---|---|---|---|---|
| | Capital | Labour | Wealth | Wealth Exemp. | Cons. | Inheritance | Inheritance Exemp. | $(\tau_k, \tau_l, \tau_w, e_w, \tau_c, \tau_I, e_I)$ | % SS dev. |
| With Entrepreneurs | | | | | | | | | |
| (2) | X | X | X | X | | | | $(10.2\%, 57.88\%, 14.8\%, 12.30, 7.5\%, 45.66\%, 238.827)$ | $+18.9\%$ |
| (3) | X | X | X | | | | | $(71.67\%, 68.73\%, -2.74\%, 0, 7.5\%, 45.66\%, 238.827)$ | $+14.5\%$ |
| (4) | X | X | | | | X | X | $(46.75\%, 66.2\%, 0\%, 0, 7.5\%, 30.97\%, 26.42)$ | $+14.2\%$ |
| (5) | X | X | | | | | | $(50.76\%, 63.2\%, 0\%, 0, 7.5\%, 45.66\%, 238.227)$ | $+14.1\%$ |
| Without Entrepreneurs | | | | | | | | | |
| (2) | X | X | X | X | | | | $(-4.1\%, 74.9\%, 10.09\%, 14.28, 7.5\%, 29.23\%, 184.722)$ | $+53.03\%$ |
| (3) | X | X | X | | | | | $(45.9\%, 80.7\%, -2.8\%, 0, 7.5\%, 29.23\%, 184.722)$ | $+25.96\%$ |
| (4) | X | X | | | | X | X | $(21.37\%, 75.31\%, 0\%, 0, 7.5\%, 80\%, 8.81)$ | $+28.6\%$ |
| (5) | X | X | | | | | | $(19.78\%, 79.1\%, 0\%, 0, 7.5\%, 29.23\%, 184.722)$ | $+25.9\%$ |

**Notes:** Results from the optimal taxation exercise in the economy with and without entrepreneurs, with full inter-generational transmission of abilities. The utilitarian welfare has preference for redistribution $\Delta = \sigma$. The top panel indicates the results for the model with entrepreneurs while the bottom one does so for the model without entrepreneurs. The central columns indicate which policy instruments are being optimized over by the Ramsey Social Planner. The second to last column indicates the optimal policy tuple for each case. The last column indicates the attained welfare improvement in the new policy steady state.

Figure (6) shows the results for optimal taxation in the model with entrepreneurs and without, in the case of full inheritance of abilities and focusing on utilitarian welfare. Here again several points are in place. First, when looking at optimal capital and labour taxes, labour taxes are significantly higher and capital taxes significantly lower than in the case with entrepreneurs [27] This, to the best of our understanding, stems from the fact that in the model without entrepreneurs the Gini coefficient of wealth is generated by a super-star state for labour productivity, which implies greater inequality along labour income. At the same time, there are no profits in this version of the model, so that there is less room for redistribution along the capital income dimension, leading to lower capital taxes. Second, strikingly, in the model without entrepreneurs, optimal inheritance

[27] This is consistent with Boar and Midrigan (2022a), who also find higher optimal labour than capital taxes. Here capital taxes are substantially lower, partly reflecting the fact that the optimization is over the long-run SS rather than taking the transition into account.

taxes (4) jump to 80%, with a low exemption level. The stark difference relative to the model with entrepreneurs suggests that heterogeneity in returns has important implications for inheritance taxation. Intuitively, in the model without entrepreneurs everyone has the same skill as an investor, therefore we would expect a lower degree of distortions from any sort of capital taxation. Lastly, as we discussed in the previous section the welfare gains from taxing wealth with an exemption level was not idiosyncratic to the model with entrepreneurs, and in the model without entrepreneurs the planner also chooses a relatively high wealth tax accompanied by an exemption level.

## 5 Conclusion

As argued by Guvenen et al. (2023), the presence of entrepreneurship with financial frictions leads to the result on the equivalence between capital and wealth taxation breaking down. We study the question of optimal policy in a model that replicates the U.S. economy in its moments regarding the pass-through sector and degree of inequality. Relative to the existing literature, we study a wider set of tax instruments, including wealth exemptions and inheritance taxes, endogenize the occupational choice dimension and study the interaction between the processs for the intergenerational inheritance of abilities and optimal taxation. In addition, we study the trade-offs between the set of taxes by means of partial reforms.

We find the following results. First, relative to Guvenen et al. (2023), our partial reform and optimal policy exercises suggest that while the "use it or lose it" mechanism is efficiency enhancing in the model with entrepreneurs, it leads to a reduction in welfare, mainly through a decrease in wages that result from a reduction in the $\frac{K}{L}$ ratio in the corporate sector. Second, we find that adding a wealth exemption level to the set of available tax instruments for the planner shifts optimal wealth taxation from negative to positive, and at a relatively high rate. Intuitively, such policy (i) redistributes to the wealth-poor through lump-sum tranfers (ii) decreases the returns on savings for the wealth rich, which increases GE interest rates and leads to higher returns for the mass of agents below the exemption level. Third, we find that the endogenous occupational choice dimension acts as an opposing force to the "use it or lose it" mechanism. Increasing wealth taxes to subsidize a reduction on capital taxes increases the returns to entrepreneurship, which leads to a misallocation along the extensive margin. Lastly, a lower degree of inheritance of abilities leads to a more equal distribution at the SS invariant distribution of labour and capital income, which results in less room for welfare gains through redistributive taxation.

There a number of limitations that are worth noting however. To begin with, our current optimal taxation analysis focuses on the long-run steady state. It might well be the case however that the implied transition paths to these SS are very costly in terms of welfare for the vast majority of the agents in the economy. For this reason, our current priority is to expand the analysis to include the transition paths. In addition, we are currently employing a limited criteria for constructing aggregate welfare measures. In the future, we aim to study Pareto Improving Pareto

Optimal policies as in Greulich et al. (2022).

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