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BEWARE THE SIDE EFFECTS:
CAPITAL CONTROLS, TRADE AND MISALLOCATION

Eugenia Andreasen
Sofía Bauducco
Evangelina Dardati
Enrique G. Mendoza

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ABSTRACT

Capital controls are an effective credit-management tool but they have serious side effects. Analyzing a dynamic Melitz-OLG model in which firms face credit constraints, we find that capital controls worsen misallocation and hurt exports. Misallocation worsens through static effects that lower capital-labor ratios and raise firm prices. In addition, changes in saving incentives induce dynamic effects and changes in wages, aggregate demand and the real exchange rate cause general equilibrium effects. A quantitative analysis calibrated to Chile's capital controls of the 1990s yields a sizable worsening in misallocation, with stronger effects on firms that are exporters, more productive, or far from their optimal scales. Exports and the share of exporting firms fall sharply. Rebating the revenue that capital controls may generate or using loan-to-value regulation instead of capital controls results in sharply weaker effects, but slightly tighter capital controls strengthens them significantly. A set of empirical tests applied to Chilean firm-level data provide robust support for the model's key predictions.

Eugenia Andreasen
Universidad de Chile
eandreasen@fen.uchile.cl

Sofía Bauducco
Central Bank of Chile
sbauducco@bcentral.cl

Evangelina Dardati
Universidad Diego Portales
edardati@gmail.com

Enrique G. Mendoza
University of Pennsylvania
Department of Economics
and NBER
egme@sas.upenn.edu

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1 Introduction

Views on capital controls have shifted widely. They were considered bad policy from the time the Bretton Woods System collapsed in 1971 to the mid-1990s. They began to gain favor after the 1990s emerging markets Sudden Stops as a tool to prevent credit booms and contain surges in capital inflows, and became a widely-accepted macroprudential policy tool after the 2008 Global Financial Crisis. This turnaround was partly supported by research showing that macroprudential capital controls can address pecuniary externalities that cause overborrowing and sudden stops (see Bianchi and Mendoza (2020) for a literature review). Most research on capital controls, though, focuses on how they affect financial intermediaries, the balance of payments, and macroeconomic dynamics and typically uses representative-agent settings.

This paper takes a new direction by examining the "side effects" of capital controls. In particular, we emphasize their heterogeneous impact across firms and the resulting aggregate effects. This approach is motivated by empirical evidence showing that capital controls affect firms differently depending on size, financial dependence, external trade, and capital intensity (e.g., Alfaro et al. (2017), Forbes (2007), Andreasen et al. (2024)). Thus, the data suggest that an active transmission mechanism links capital controls to firm dynamics and firm heterogeneity, but to date little is known about this mechanism and its implications.[1]

We study two related questions: What are the effects of capital controls on macroeconomic aggregates and capital misallocation across firms? Do the latter vary with firm characteristics (e.g., are they stronger for more productive firms or exporters, do they reduce the share of firms that export)? To answer these questions, we develop a dynamic Melitz model with Blanchard-Yaari overlapping generations of entrepreneurs who face borrowing constraints. Entrepreneurs produce differentiated intermediate goods and sell them to domestic final-good producers and, if they choose to export, to foreign buyers. They differ in their initial productivity draw, capital stock, age, debt, and export status. Capital controls are modeled as a tax-equivalent levy on foreign borrowing that raises the interest rate on debt and compound the effects of the existing borrowing constraints.

We examine first how capital misallocation (i.e., dispersion in marginal revenue products of capital, MRPK) differs across environments with and without borrowing constraints and/or capital controls. Without both, there is no misallocation, but the world opportunity cost of capital that pins

[1]Some of the research on macroprudential capital controls warns of investment distortions akin to those of capital taxes, but still using representative-agent models (see Bianchi and Mendoza (2020) and Darracq-Paries et al. (2019)).

down MRPK is inefficient because monopolistic competition distorts prices. Borrowing constraints without capital controls (denoted the NCC regime) cause misallocation through the standard mechanism in the literature: credit-constrained firms operate below their long-run optimal scale of capital (i.e., they display an "optimal scale gap"), which results in higher MRPKs for more constrained firms. Importantly, in this setting misallocation shrinks monotonically as a firm grows.

The environment in which capital controls are added to borrowing constraints (denoted the CC regime) introduces new sources of misallocation that change non-monotonically as firms grow, in a manner analogous to a distortionary, size-dependent industrial policy (e.g., Guner et al. (2008)). Three effects are at work. First, *static effects* (for a given net worth and unchanged aggregate variables) create a "misallocation zone" in which misallocation first widens with net worth and then shrinks. Firms with little net worth remain as credit constrained as without capital controls and those at their optimal scale remain at the same scale, so that both are outside the misallocation zone and unaffected by these static effects. But firms in the middle are affected because capital controls allow them to borrow only at an interest rate larger than the world interest rate. Some of these firms operate at the pseudo-steady-state of capital consistent with the opportunity cost inclusive of the tax on foreign borrowing, and larger firms self-finance their growth because capital controls prevent them from borrowing at the lower world interest rate. Capital controls make both of these firms reduce their capital stock and capital-labor ratios and increase their prices, thus raising their MRPKs. Second, *dynamic effects* arise from two sources: changes in saving incentives as firm-specific marginal returns on saving change (depending on the tightness of the credit limits imposed by borrowing constraints and capital controls) and delays in firms' entry into export markets, which reduce exports and the share of exporting firms. Third, *general equilibrium* effects induced by changes in the wage rate and the price and output of final goods.

While static effects unambiguously increase MRPKs at a given level of net worth for firms in the misallocation zone, dynamic effects are ambiguous because the returns on saving switch from lower than without capital controls when the firm has little net worth to higher when net worth is large enough. Similarly, general equilibrium effects are ambiguous depending on the direction in which aggregate variables move. For instance, a drop in the price of final goods reduces MRPK and stimulates investment, because it reduces the effective opportunity cost of investment, and it favors exporters because it induces a real depreciation. Thus, the net effect of capital controls on misallocation and aggregate outcomes is theoretically ambiguous, which motivates our aim to examine the model's quantitative predictions.

We also analyze the socially optimal allocations of a planner who faces the economy's borrowing constraint at the aggregate level–namely, pledging the aggregate capital stock as collateral. This planner allocates initial capital injections so as to move all firms to their optimal scales immediately, and thus equates marginal returns on capital and intertemporal marginal rates of substitution (IMRS) in consumption across entrepreneurs. Using these results, we characterize the inefficiencies present in the decentralized equilibrium as firm-specific wedges relative to the efficient MRPK, and explain that the planner can decentralize the efficient outcome using taxes on debt (capital controls), profits, and transfers that vary with age and productivity.

We assess the model's quantitative predictions by comparing aggregate variables and misallocation in the stationary equilibria of the NCC and CC regimes, using a calibration based on the Chilean *encaje*—an unremunerated reserve requirement on capital inflows introduced in 1991 and removed in 1998. Calibrated to match key moments from Chilean firm-level data, the model approximates well the firm-size distributions observed before and after the *encaje*.

The model predicts that capital controls have sizable negative effects on investment, consumption, the credit-to-value-added ratio, exports, and the share of exporters. Misallocation (the mean deviation of MRPKs relative to their long-run level), rises by 0.53 percentage points (pp) for the economy as a whole, and significantly more for exporters than non-exporters, and for firms with large v. small optimal scale gaps or high v. low productivity. Real wages and profits fall about 0.7%, and the output and price of final goods fall by 0.82% and 0.32%, respectively. These drops trigger strong general equilibrium effects that moderate sharply the effects of capital controls.

Three counterfactual experiments shed light on key determinants of the above baseline results. First, we examine the effects of capital controls under alternative rules for rebating the revenue generated by debt taxes, while acknowledging that in practice capital controls generally lack rebate mechanisms. Rebates have distributional implications that matter for the effects of capital controls on misallocation. One rule simply rebates to each entrepreneur their own debt tax bill, and hence only provides rebates for firms that borrow. This mitigates the adverse effects on some aggregate variables but causes misallocation to increase more overall and across the groupings we study (exporters v. nonexporters, high v. low productivity, and large v. small optimal scale gaps). This occurs because the rebates allow the younger firms that carry larger debts, and thus receive larger rebates, to transit faster into the misallocation area, whereas older firms in the self-finance zone of the misallocation area do not receive transfers.

Since the planner moves all firms to their optimal scale immediately after birth, we consider three other rebate rules that provide rebates only to newborn firms. These rules yield mixed results for the effects of capital controls on aggregate variables but misallocation effects are less severe, and in two cases misallocation actually falls overall and for some of the groups we study. In particular, a rule rebating all tax revenue to newborn firms of the productivity level with the largest mass in the age-productivity distribution who never become exporters (with smaller optimal scales than exporters), moves these firms close to their optimal scale and their misallocation falls by -5.1pp. Aggregate misallocation falls by -1.5pp while misallocation for firms with the other productivity levels remains about the same as in the baseline.

The second counterfactual experiment examines loan-to-value (LTV) regulation as an alternative policy to reduce credit by reducing the fraction of capital pledgeable as collateral to yield the same drop in the credit-to-value-added ratio as in the capital controls baseline. LTV regulation proves to be far superior, because it has sharply weaker effects on aggregate variables and misallocation. Aggregate misallocation rises about 30% less than with capital controls. This occurs because, like the rebates, LTV regulation has different distributional implications. In particular, it spreads the burden of the credit reduction more evenly, reducing credit to firms barely affected by capital controls (those at the borrowing constraint) and raising it to firms that were most affected.

The third counterfactual considers a higher borrowing tax rate of 6%, instead of the 1.75% calibrated to the Chilean *encaje* in our baseline calibration. We do this because, as we document later in the paper, long-run averages of optimal macroprudential capital controls range from 3% to 12% in simulated models, and they are used frequently and fluctuate relatively little (about half as much as GDP). The higher tax yields much larger effects on aggregate variables and misallocation, which increases by 2.15pp. Additionally, the distribution and magnitude of misallocation across firms are notably affected due to stronger general equilibrium effects and the interaction with the firm-age distribution during aggregation.

In the last Section, we use Chilean firm-level data from a large database of manufacturing establishments to assess the empirical relevance of the model in two ways. First, we construct empirical counterparts to the model's misallocation measures by grouping firms in the same way (exporter status, productivity, and optimal scale gaps), and compare the changes in misallocation across periods with and without capital controls in the data with those predicted by the model. We find that the magnitude and heterogeneity of changes in misallocation align well with the model's results. Second, we run panel regressions to test the model's key predictions. We find statistically significant evidence of heterogeneous effects of capital controls indicating that misallocation worsened more for exporters, high-productivity firms and firms with large optimal scale gaps, as the model predicts. These results are robust to various checks, including balanced versus unbalanced panels, capital stock imputations, using total sales to calculate misallocation, winsorizing outliers, alternative exporter definitions, and including interactions with macro control variables.

The rest of the paper is organized as follows: Section 2 compares our work with the related literature. Section 3 presents the model. Section 4 derives its implications for misallocation. Section 5 discusses the quantitative results. Section 6 conducts the empirical analysis. Section 7 concludes.

2 Related Literature

Our paper is related to the literature on misallocation and financial frictions that uses heterogeneous-firms models to examine how policies and firm characteristics generate misallocation (e.g., Hsieh and Klenow (2009), Guner et al. (2008)). Several studies focus on closed-economy models with financial frictions under perfect competition, including Buera et al. (2011), Midrigan and Xu (2014), and Buera and Moll (2015). In these models, credit frictions generate distortions and induce misallocation. Our work differs in that we examine an open-economy model, which links MRPKs to world opportunity costs, assume monopolistic competition and model the firms' life cycle, both of which amplify the effects of financial frictions on MRPKs.

Cavalcanti et al. (2021) propose a model that relaxes the assumption that firms face a borrowing constraint at a common financing cost. They obtain dispersion in credit spreads due to lenders' market power and intermediation costs that fall with a firm's assets and productivity, and find larger real effects than with the common financing cost. In our model, financing costs are also firm-dependent, albeit in a simpler way, because capital controls increase the interest rate for borrowing but not for saving, and effective financing costs vary with the tightness with which credit constraints and capital controls affect firms. We obtain a similar result indicating larger real effects than in a regime with borrowing constraints but no capital controls.

An important branch of this literature uses open-economy models to examine the effects of financial integration modeled as access to borrowing at a lower world real interest rate. Gopinath et al. (2017) study a model with infinitely-lived firms and monopolistic competition in partial equilibrium. Productivity shocks and capital adjustment costs, combined with a size-dependent borrowing constraint increasing and convex in capital, yield the result that capital inflows triggered by the interest-rate drop are misallocated towards high net-worth firms that may be less productive. Firms accumulate precautionary savings and those with more capital can borrow more and speed up convergence to their new optimal scale, but poorer firms may draw higher productivity. They find empirical evidence supporting this result in data for Southern European countries in the 2000s. Our setup also features monopolistic competition, but modeling the firms' life-cycle and using a standard credit constraint linear in capital.[2] Still, our model is consistent with their main finding in that it predicts that, with the borrowing constraint but without capital controls and in partial equilibrium, a lower interest rate worsens misallocation unambiguously. This occurs because the misallocation zone widens as the borrowing constraint makes firms take longer to reach their new, higher optimal scales implied by the lower interest rate.[3]

The focus of our analysis is not a fall in the interest rate but an asymmetric increase that affects firms only when borrowing, representing capital controls. Interestingly, this asymmetry introduces endogenous non-monotonic size-dependence in the distortions induced by the combination of credit constraints and capital controls. A newborn firm hits first the borrowing constraint, then outgrows it and repays its debt, and then self-finances its growth to reach its optimal scale. Firms of different age cohorts and net worth are at different stages, with the result that capital controls increase misallocation in an economy that already had the borrowing constraint. Hence, financial integration (i.e., the removal of capital controls) would *reduce* misallocation.

Asriyan et al. (2021) study a general equilibrium model with infinitely-lived heterogeneous entrepreneurs, financial frictions and an imperfectly-elastic supply of capital. They find that the effect of a lower interest rate on aggregate output is ambiguous. It may fall if a pecuniary externality generated by the elasticity of capital props up investment of less productive firms by enough to crowd out that of more productive firms. Their model is different from ours, but the two highlight the importance of general equilibrium effects, in their case via a pecuniary externality on the cost of capital, in our case via changes in aggregate demand, the price of final goods and wages. Theoretically, the effect of the *higher* interest rate implied by capital controls on aggregate output is also ambiguous, but in our calibrated solutions we find that output falls.

This paper is also related to the analysis of capital controls in an economy with financial constraints by Andreasen et al. (2024). Using Chilean manufacturing data, they find that exporters in more capital-intensive sectors are more negatively affected by capital controls, while the converse is

[2]We also abstract from precautionary savings, because of the risk-of-death insurance of the Blanchard-Yaari OLG setup and the productivity shocks are only drawn at birth, but we introduce endogenous trade participation and allow for general equilibrium effects, both of which are found to be quantitatively relevant.

[3]In general equilibrium, changes in wages, the price of final goods and their aggregate demand can alter this result.

true for non-exporting firms. Moreover, capital controls reduce aggregate production but increase TFP. This paper differs in that it studies the effects of capital controls on misallocation, analyzes the resulting efficiency wedges of the decentralized equilibrium, and explores the implications of altering the distributional incidence of capital controls.

Another strand of the literature relevant to our analysis studies how the interaction of trade and financial frictions affects misallocation. Brooks and Dovis (2020) show that misallocation across exporters and non-exporters reduces the gains from trade liberalization with the standard borrowing constraint linked to existing capital but not with one linked to future profits. They find evidence consistent with the latter using Colombian data. Our model and theirs are similar in that both feature a dynamic Melitz OLG setup and endogenous trade participation, but we examine the effects of capital controls instead of a trade reform, and in an economy that already has a (standard) borrowing constraint. Leibovici (2021) examines the industry-level and aggregate effects of financial development on trade shares (ratios of exports to domestic sales). He uses a rich multi-sector model with infinitely-lived entrepreneurs exposed to idiosyncratic productivity shocks who choose to operate in various tradable or nontradable industries. Differences in capital intensity induce differences in financial dependence. A cut in the fraction of capital pledgeable as collateral reallocates trade shares to less capital-intensive industries. Our analysis has a simpler sectoral setup and abstracts from recurrent productivity shocks, but we model the firms' life cycle and examine capital controls as a financial friction additional to the borrowing constraint. Still, both studies find that exporters are larger and more credit constrained than non-exporters, tighter financial frictions reduce sharply the share of firms that export but the aggregate trade share hardly changes. Finlay (2021) also proposes a model with infinitely-lived firms in which exporters are more credit constrained than non-exporters. Tightening credit constraints for exporters lowers aggregate productivity because they are more productive. Similarly, in our model, exporters are more credit constrained, because their optimal scales are larger, but tightening credit constraints using capital controls has non-monotonic effects across exporters and non-exporters depending on productivity. Also, in our setup the life-cycle dynamics of the firms drives the aggregate effects.

Finally, our paper also relates to the empirical literature on the firm-level effects of capital controls. Bekaert et al. (2011) show that easing capital controls positively affects capital stock growth and TFP. Larraín and Stumpner (2017), focusing on Eastern European countries, find that financial openness increases aggregate productivity via a more efficient allocation of capital across firms. Varela (2017) studies the 2001 financial liberalization in Hungary and shows that it can lead firms to invest in technology adoption and thereby increase aggregate TFP. Alfaro et al. (2017) find a decline in cumulative abnormal returns for Brazilian firms following the imposition of capital controls in 2008-2009, and that this effect is stronger for smaller, non-exporting and more financially dependent firms. Some papers study the Chilean case. Oberfield (2013) examines allocative efficiency and TFP during the 1982 financial crisis. He finds that within-industry TFP either remained constant or improved in 1982, while a drop in between-industry allocative efficiency accounts for a third of the fall in TFP. Chen and Irarrázabal (2015) provide suggestive evidence that financial development might be an important factor explaining the fall in misallocation driving growth in output and productivity in Chile between 1983 and 1996. Forbes (2007) finds that smaller firms experienced significant financial constraints, which decreased with firm size. Our paper contributes to this literature by examining the effects of the Chilean *encaje* on misallocation using a large panel dataset of manufacturing establishments and showing that misallocation increased relatively more for high-productivity and exporting firms and for firms further away from their optimal scale.

3 Model

We propose a model in which overlapping generations of entrepreneurs sell differentiated varieties of intermediate goods to domestic and foreign final-goods producers in monopolistically-competitive markets. Entrepreneurs can make an irreversible choice to become exporters by paying an entry cost. Their access to foreign financing is limited by a borrowing constraint and, if present, capital controls. The borrowing constraint induces dispersion in MRPKs via the standard mechanism from the literature (i.e., constrained firms grow their net worth gradually with MRPKs that are monotonically larger the further away firms are from their optimal scale). Capital controls add another financial friction, but with a mechanism that changes MRPKs non-linearly as firms grow, as we explain in the next Section. These financial frictions interact with the entry cost to export, because firms must accumulate enough assets for them to find it optimal to become exporters.

3.1 Final-goods sector

A representative final-goods producer purchases differentiated intermediate inputs from domestic and foreign firms and combines them using a constant-elasticity-of-substitution (CES) technology. The elasticity of substitution across inputs is denoted by $\sigma > 1$. Let the set $[0, 1]$ index the continuum of domestic entrepreneurs, and define $\{p_{h,t}(i)\}_{i\in[0,1]}$ and p_m as the prices charged by domestic and foreign entrepreneurs, respectively. The final-goods producer chooses the optimal bundle of domestic inputs, $\{y_{h,t}(i)\}_{i\in[0,1]}$, and imported input, $y_{m,t}$, to maximize profits, taking prices as given and subject to the CES technology:

$$\max_{y_{h,t}(i), y_{m,t}} p_t y_t - \int_0^1 p_{h,t}(i) y_{h,t}(i)\, di - p_m y_{m,t}$$

$$\text{s.t.} \qquad y_t = \left[\int_0^1 y_{h,t}(i)^{\frac{\sigma-1}{\sigma}}\, di + y_{m,t}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

where p_t is the CES price index of final goods, $p_t = [\int_0^1 p_{h,t}(i)^{1-\sigma}\, di + p_m^{1-\sigma}]^{1/(1-\sigma)}$. This problem yields standard demand functions for domestic inputs:

$$y_{h,t}(i) = \left(\frac{p_{h,t}(i)}{p} \right)^{-\sigma} y_t. \tag{2}$$

These are the demand functions that entrepreneurs internalize in their optimization problems. By analogy, we assume that they face the following demand from foreign buyers:

$$y_{f,t}(i) = \left(\frac{p_{f,t}(i)}{p^*} \right)^{-\sigma} y^*, \tag{3}$$

where $p_{f,t}(i)$ is the price entrepreneur i charges abroad, and p^* and y^* are the exogenous price and production of foreign final goods, respectively. Hence, the real exchange rate is given by p_t/p^*.

3.2 Intermediate-goods sector

Each individual entrepreneur supplies a unit of labor inelastically and has iso-elastic preferences:

$$\sum_{t=0}^{\infty} (\beta(1-\rho))^t \frac{c_t^{1-\gamma}}{1-\gamma}, \tag{4}$$

where c is consumption, $1/\gamma$ is the elasticity of intertemporal substitution, β is the subjective discount factor, and $1-\rho$ is the probability of survival. Each period, a fraction ρ of entrepreneurs dies and is replaced by newborns. To abstract from death risk in the optimization problem, we adopt the standard Blanchard-Yaari formulation: entrepreneurs use insurance contracts so that, upon their death, all savings and capital are transferred to existing entrepreneurs. Surviving entrepreneurs receive an extra $\frac{\rho}{1-\rho}$, so that their net worth rises by the coefficient $\frac{1}{1-\rho}$.

At the beginning of each period, entrepreneurs decide whether to remain non-exporters

($e_t = 0$) or become exporters ($e_t = 1$). The latter choice is irreversible, while non-exporters retain the option to switch in the future.[4] Entrepreneurs who choose $e = 1$ pay a one-time entry cost F in units of labor and start exporting the next period. Exporting goods also incurs an "iceberg" trade cost that requires shipping ζ units for every unit sold abroad, with $\zeta > 1$.

Newborn entrepreneurs arrive with zero debt, draw idiosyncratic productivity z that remains constant until they die, and receive a transfer of capital from the government $\underline{k}(z)$ so they can start operations. Productivity follows a log-normal distribution with p.d.f. $f(z)$, mean μ_z, and standard deviation ω_z. Entrepreneurs produce inputs using capital k and labor n to operate a Cobb-Douglas technology with capital intensity $\alpha \in (0,1)$. The technological constraint requires:

$$y_{h,t} + e_t(\zeta y_{f,t}) = z k_t^{\alpha} n_t^{1-\alpha}. \tag{5}$$

Capital is in units of final goods and depreciates at rate δ. Investment is denoted x_t. Accounting for insurance payments, the law of motion for each entrepreneur's capital is:

$$k_{t+1} = \frac{1}{1-\rho}[(1-\delta)k_t + x_t]. \tag{6}$$

Entrepreneurs participate in a global market of one-period, risk-free discount bonds denominated in units of final goods. The world real interest rate is $R^* \equiv 1+r^*$. We model capital controls on inflows as a time- and state-invariant tax ($\tau \geq 0$) on external borrowing.[5] Entrepreneurs sell debt d_{t+1} to be repaid next period at a price $q(\tau)$ that depends on the presence of capital controls and the sign of their net position. The bond price schedule is:

$$q(\tau) = \begin{cases} \frac{1}{1+r^*} & \text{if } \tau = 0 \text{ or if } \tau > 0 \text{ and } d_{t+1} \leq 0 \\ \\ \frac{1}{1+r^*+\tau} & \text{if } \tau > 0 \text{ and } d_{t+1} > 0 \end{cases} \tag{7}$$

The world price $q^* \equiv 1/(1+r^*)$ applies either without capital controls ($\tau = 0$) or, if capital controls are present, when the entrepreneur is a net saver ($d_{t+1} \leq 0$). With capital controls, entrepreneurs

[4] This assumption is consistent with Chilean data showing that 71% of exporting firms continue exporting in the following period. For firms that have exported for three periods, this proportion increases to 93%.

[5] This assumption is motivated by two observations. First, in practice, capital controls remain in place for extended periods and adjust slowly to macroeconomic conditions, as was the case with the Chilean *encaje* we use in our quantitative analysis (see Appendix B and Acosta-Henao et al., 2025 and Fernández et al., 2015). Second, results from some of the studies on optimal capital controls show that they are active most of the time and fluctuate little over the business cycle (e.g., in Bianchi and Mendoza (2018), the optimal macroprudential debt tax is used with a long-run frequency of 94%, averages 3.6% and fluctuates about half as much as GDP).

that borrow $(d_{t+1} > 0)$ receive a lower price for the bonds they sell because of the debt tax τ.

Entrepreneurs also face a standard borrowing constraint: they cannot borrow more than a fraction $\theta \in [0,1]$ of the value of their end-of-period capital stock:

$$q(\tau)d_{t+1} \leq \theta k_{t+1}. \tag{8}$$

When capital controls are present, entrepreneurs also face the constraint $q^* d_{t+1} \leq 0$, because borrowing at the untaxed rate R^* is not allowed.

The entrepreneur's budget constraint is:

$$p_t c_t + p_t[(1-\rho)k_{t+1} - (1-\delta)k_t] + p_t d_t + w_t n_t + T_t = w_t + p_{h,t} y_{h,t} + e_t(p_{f,t} y_{f,t}) + p_t(1-\rho)q(\tau)d_{t+1}, \tag{9}$$

where w_t is the wage rate and T_t are lump-sum taxes. The left-hand side of this constraint shows that an entrepreneur uses disposable income to pay for consumption, investment, wages, outstanding debt and taxes. The right-hand-side shows that income is derived from wage income, domestic and foreign sales, and new debt issuance.[6]

Cash-on-hand is defined as the sum of wage income, profits from production, the residual value of existing capital minus debt repayment and taxes:

$$p_t m_t = w_t + \frac{p_{h,t}^{1-\sigma}}{p_t^{-\sigma}} y_t + e_t \frac{p_{f,t}^{1-\sigma}}{p^{*-\sigma}} y^* - w_t n_t + p_t(1-\delta)k_t - p_t d_t - T_t. \tag{10}$$

Using the definition of net worth, $a_{t+1} \equiv k_{t+1} - q(\tau)d_{t+1}$, we can rewrite the budget constraint as:

$$c_t = m_t - (1-\rho)a_{t+1}. \tag{11}$$

3.3 Recursive formulation of the entrepreneur's problem

We follow Buera and Moll (2015) in formulating the entrepreneurs' problem in recursive form using m as the main endogenous state variable and setting up the entrepreneur's individual optimization problem as a two-stage budgeting problem.[7] First, a static problem to maximize m' by choosing k', d', p_h', p_f' and n', for an arbitrary a' taking as given the aggregate variables (w, p, y)

[6] At equilibrium, total sales revenue $p_h y_h + p_f y_f$ can be expressed as $p_h z k^\alpha n^{1-\alpha}$. To derive this, substitute the demand functions for y_h and y_f, apply the equilibrium condition $p_f = \zeta p_h$, and simplify.

[7] In contrast with their setup, where perfect competition makes profits linear in net worth, monopolistic competition makes profits, debt, and capital non-linear in net worth in our model, and hence decision rules are also non-linear in m.

and the exogenous variables p^*, y^*.[8] Second, a dynamic problem choosing a' to maximize lifetime utility given an optimal decision rule $\tilde{m}'$ as a recursive function of a'.

An entrepreneur with a given z starts each period knowing if the previous period it chose $e = 0$, and hence remains a non-exporter in the current period, or $e = 1$, and thus became a "switcher" (i.e., a firm that starts exporting in the current period). Since exporting is an absorbing state, a firm with $e = 1$ remains an exporter next period (i.e., $e' = 1$). A firm that starts with $e = 0$ in the current period decides whether to become a switcher and start exporting in the next period ($e' = 1$) or remain a non-exporter ($e' = 0$). The value function of the entrepreneur is:

$$v(m, z, e; \tau) = e \cdot v^E(m, z, 1; \tau) + (1 - e) \cdot \left[\max_{e' \in \{0,1\}} \left\{ (1 - e') \cdot v^{NE}(m, z, 0; \tau) + e' \cdot v^E(m, z, 0; \tau) \right\} \right], \tag{12}$$

where $v^{NE}(m, z, 0; \tau)$ is the continuation value of remaining a non-exporter, and $v^E(m, z, e; \tau)$ is the value of being an exporter, which differs depending on whether the firm is a switcher ($e = 0$) or a continuing exporter ($e = 1$). In these value functions, z is invariant because entrepreneurs retain the productivity they draw at birth, and τ is also a fixed argument to denote that the functions vary differ with and without capital controls.

The continuation value for a non-exporter solves the second-stage problem:

$$v^{NE}(m, z, 0; \tau) = \max_{a'} \left[u\left(m - (1 - \rho)a'\right) + \beta(1 - \rho)v\left(\tilde{m}'(a', z, 0), z, 0; \tau\right) \right], \tag{13}$$

where the optimal cash-on-hand function solves the first-stage problem:

$$\tilde{m}'(a', z, 0; \tau) = \max_{k', d', p'_h, n'} \left[\frac{w + \frac{{p'_h}^{1-\sigma}}{p^{-\sigma}} y - wn' + p(1 - \delta)k' - pd' - T(z)}{p} \right] \tag{14}$$

$$\text{s.t.} \quad \left(\frac{p'_h}{p}\right)^{-\sigma} y = z{k'}^{\alpha}{n'}^{1-\alpha}, \qquad a' = k' - q(\tau)d', \qquad q(\tau)d' \leq \theta k', \qquad q^* d' \leq 0.$$

Recall that $q(\tau)$ varies with capital controls according to eq. (7). The function $v(\cdot)$ appears in the right-hand-side of (13) because the non-exporter retains the option to become an exporter in the future. Lump-sum taxes vary with z because we assume that the government sets them to pay for the capital endowments of newborn firms of each productivity type: $T(z) = p\rho\underline{k}(z)$. This avoids the income redistribution from low- to high-z entrepreneurs that would occur with a uniform tax.

[8] We use the standard convention of denoting with primes variables dated $t + 1$. Since we study only stationary equilibria, (w, p, y) are constant and hence we write them without dates for simplicity.

The value of being an exporter or a switcher is:

$$v^E(m,z,e;\tau)=\max_{a'}\left[u\left(m-(1-\rho)a'-\mathbb{1}_{\{e=0\}}\frac{wF}{p}\right)+\beta(1-\rho)v^E\left(\tilde{m}'(a',z,1),z,1;\tau\right)\right], \quad (15)$$

where:

$$\tilde{m}'(a',z,1;\tau)=\max_{k',d',p'_h,p'_f,n'}\left[\frac{w+\frac{p'^{1-\sigma}_h}{p^{-\sigma}}y+\frac{p'^{1-\sigma}_f}{p^{*-\sigma}}y^*-wn'+p(1-\delta)k'-pd'-T(z)}{p}\right] \quad (16)$$

$$\text{s.t.}\quad \left(\frac{p'_h}{p}\right)^{-\sigma}y+\zeta\left(\frac{p'_f}{p^*}\right)^{-\sigma}y^*=zk'^{\alpha}n'^{1-\alpha},\quad a'=k'-q(\tau)d',\quad q(\tau)d'\leq\theta k',\quad q^*d'\leq 0.$$

The indicator $\mathbb{1}_{\{e=0\}}$ applies to a switcher who must pay the one-time entry cost F to start exporting the next period. Once the firm becomes an exporter, $e=1$ in subsequent periods.[9]

We verify quantitatively that these value functions are increasing and concave in m for all z, and cross once with $v^E(m,z,0;\tau)$ crossing $v^{NE}(m,z,0;\tau)$ from below. Hence, for a given z, there is a threshold value of cash on hand $\hat{m}(z)$ at which the firm switches to become an exporter defined by $v^E(m,z,0;\tau)=v^{NE}(m,z,0;\tau)$. For a firm born at date $\nu=0$, there is an associated switching date $\hat{\nu}(\hat{m}(z))$ when it reaches the age at which it decides to become a switcher.[10]

Newborn entrepreneurs choose optimally their cash on hand after observing their z and receiving their capital injection from the government. Since they do not have inherited net worth nor debt, we can express the optimal cash-on-hand of a newborn entrepreneur, $\underline{m}(z)$, as:

$$\underline{m}(z)=[w+\underline{p}_h(z)z\underline{k}^{\alpha}\underline{n}(z)^{1-\alpha}-w\underline{n}(z)+p(1-\delta)\underline{k}(z)-T(z)]/p, \quad (17)$$

where $\underline{p}_h(z)$ and $\underline{n}(z)$ are the solutions that maximize m, taking as given $k=\underline{k}(z)$ and $d=0$, and subject to the technological constraint associated with the production of y_h. The distribution of $\underline{m}(z)$ is induced by $f(z)$. Moreover, applying the envelope theorem to this maximization problem yields $d\underline{m}(z)/dz=\underline{p}_h(z)\underline{k}^{\alpha}\underline{n}(z)^{1-\alpha}>0$. Hence, $\underline{m}(z)$ rises with z only via its first-order effect on production. Note also that newborn firms drawing a high enough z such that $v^E(m,z,0;\tau)\geq v^{NE}(m,z,0;\tau)$ become switchers from the start (i.e., $e'=1$), otherwise $e'=0$.

[9] The first-stage problem that determines $\tilde{m}'(a',z,1;\tau)$ is the same for switchers and established exporters, since switchers start exporting a period later. The current-period payoff differs because only switchers pay the entry cost.

[10] This is helpful for characterizing the equilibrium in terms of the firm-age distribution $\phi(\nu,z)$, as we explain later.

3.4 Stationary equilibrium

Our analysis compares stationary equilibria in the CC and NCC regimes. The model's Blanchard-Yaari OLG structure implies that the stationary firm-age distribution is $\phi(\nu, z) = \rho(1-\rho)^{\nu} f(z)$, and hence it is exogenous and independent of capital controls and borrowing constraints.[11] Although firms of the same age may differ in (m, z) across regimes, the share of firms by age and productivity is the same. We also use the firm-age distribution because the Chilean firm-level dataset we use for the calibration has information on the firms' assets, sales, employment and age, but not on their net worth and debt. Since the model has no risk, we assume $\beta R^* = 1$.

For given $q(\tau)$, τ, p^* and y^*, the recursive stationary equilibrium consists of aggregate prices $\{w, p\}$, final goods output $\{y\}$, entrepreneurs' decision rules $\{c'(\nu, z), a'(\nu, z), n'(\nu, z), \tilde{m}'(\nu, z), p'_h(\nu, z), p'_f(\nu, z), y'_h(\nu, z), y'_f(\nu, z), d'(\nu, z), k'(\nu, z)\}$, lump-sum taxes $T(z)$, and value functions $v(\nu, z, e; \tau)$, $v^{NE}(\nu, z, 0; \tau)$, $v^{E}(\nu, z, e; \tau)$ such that:

1. Entrepreneurs' value functions and decision rules solve their optimization problems.

2. Decision rules for demand of intermediate goods and output of final goods solve the final-goods producer's problem.

3. The government budget constraint holds: $\sum_z p\rho\underline{k}(z) f(z) = \sum_z T(z) f(z)$ with $p\rho\underline{k}(z) = T(z)$.[12]

4. The labor market clears: $\sum_\nu \sum_z n(\nu, z)\phi(\nu, z) + F \sum_z \hat{\nu}(\hat{m}(z)) f(z) = 1$.

5. The market of final goods clears: $\sum_\nu \sum_z [c(\nu, z) + \rho\underline{k}(z) + x(\nu, z)]\phi(\nu, z) = y$, where $c(\nu, z) = m(\nu, z) - (1-\rho)a'(\nu, z) - \mathbb{1}_{\nu=\hat{\nu}(\hat{m}(z))} wF$ and $x(\nu, z) = (1-\rho)k'(\nu, z) - (1-\delta)k(\nu, z)$.

4 Capital Controls and Misallocation

This section derives the model's predictions for the effects of capital controls on misallocation. At the firm level, misallocation is defined as the deviation of a firm's MRPK from its long-run or

[11] Given the decision rules $a'(m, z; \tau)$ and $m'(a', z; \tau)$, the solutions obtained for the state space (m, z, e) map into (ν, z) by recursive substitution as follows: When a firm is born ($\nu = 0$), its choices are given by $a'(0, z) = a'(\underline{m}(z), z)$ and $m'(0, z) = m'(a'(0, z), z)$, respectively. Its choices at age 1 are therefore $a'(1, z) = a'(m'(0, z), z)$ and $m'(1, z) = m'(a'(1, z), z)$. Hence, for any age ν the firm's choices are $a'(\nu, z) = a'(m'(\nu-1, z), z)$ and $m(\nu, z) = m'(a'(\nu, z), z)$. For $0 \leq \nu < \hat{\nu}(\hat{m}(z))$ we use the non-exporter's decision rules, for $\nu = \hat{\nu}(\hat{m}(z))$ we use the switcher's, and for $\nu > \hat{\nu}(\hat{m}(z))$ we use the exporter's. Appendix C explains in detail the algorithm used to solve the model.

[12] The revenue generated by τ is discarded, in line with actual practice in the application of capital controls using quantitative restrictions, unremunerated reserve requirements, foreign exchange surrender requirements, etc. Later we examine quantitative experiments allowing the revenue to be rebated to entrepreneurs (see section 5.3.1).

optimal-scale level, $\overline{MRPK} \equiv p(r^* + \delta)$. As we show below, $\overline{MRPK}$ is also the efficient MRPK in a frictionless equilibrium.

4.1 Static effects

We begin by examining the exporters' first-stage "static" problem of maximizing $\tilde{m}'$ by choosing d', k', p'_h, p'_f for a given a' (i.e., problem (16)).[13] At this stage, we abstract from dynamic effects resulting from changes in the optimal choice of a' (i.e., the second-stage problem), and from general equilibrium effects due to changes in the aggregate variables (p, w, y).

The first-order conditions of the static problem in the CC regime are the following:

$$MRPN \equiv \frac{p'_h}{\varsigma}(1-\alpha)z(k')^{\alpha}(n')^{-\alpha} = w, \tag{18}$$

$$MRPK \equiv \frac{p'_h}{\varsigma}\alpha z(k')^{\alpha-1}(n')^{1-\alpha} = \mathbb{1}_{d'\leq 0}\left[p(r^*+\delta)+\mu\right] + \mathbb{1}_{d'>0}\left[p(r^*+\tau+\delta)+\eta(1-\theta)\right], \tag{19}$$

$$\left(\frac{p'_h}{p}\right)^{-\sigma} y + \zeta\left(\frac{p'_f}{p^*}\right)^{-\sigma} y^* = z{k'}^{\alpha}{n'}^{1-\alpha}, \tag{20}$$

$$p'_f = \zeta p'_h, \tag{21}$$

$$q(\tau)d' = k' - a'. \tag{22}$$

where $\varsigma = \sigma/(\sigma-1)$ is the markup of price over marginal cost, η is the multiplier on the borrowing constraint, and μ is the multiplier on the constraint that prevents borrowing at R^* under capital controls.[14] As shown in Appendix D, the left-hand-sides of (18) and (19) are the marginal revenue products of labor ($\frac{\partial(p_h y_h + p_f y_f)}{\partial n}$) and capital ($\frac{\partial(p_h y_h + p_f y_f)}{\partial k}$), respectively. In addition, the complementary slackness conditions $\eta(a' - (1-\theta)k') = 0$ and $\mu(a' - k') = 0$ must hold. These conditions imply that if $\eta > 0$, then $k'(a') = a'/(1-\theta)$, while if $\mu > 0$, then $k'(a') = a'$.

The above conditions highlight three key properties of the static problem. First, μ and η cannot be positive at the same time. A firm with the borrowing constraint binding borrows at the interest rate implied by the capital controls $(r^* + \tau)$, or equivalently sells bonds at a price $q(\tau) < q^*$, hence $\eta > 0$ and $\mu = 0$. A firm that does not borrow because it would like to borrow at r^* but finds $(r^* + \tau)$ too high, has $\eta = 0$ and $\mu > 0$. Second, the optimal choice of k' only depends on a' if either $\eta > 0$ or $\mu > 0$, otherwise Fisherian separation holds—that is, optimal k' is independent of a' and d'. Third, all firms have the same MRPN, which equals the wage rate. However, the wage

[13]The problem of non-exporters is similar, except there are no foreign sales and no price to set for them.

[14]The multipliers η and μ for maximizing $\tilde{m}'$ are related to those for maximizing lifetime utility in the standard optimization problem, $\tilde{\eta}$ and $\tilde{\mu}$, by the conditions $\eta = \tilde{\eta}\frac{p}{\tilde{\beta}u'(c')}$ and $\mu = \tilde{\mu}\frac{p}{\tilde{\beta}u'(c')}$, with $\tilde{\beta} \equiv \beta(1-\rho)$.

is different in the NCC and CC regimes and in the efficient equilibrium without credit frictions (i.e., MRPNs differ across regimes). Thus, there is labor misallocation across regimes—i.e., MRPN differs between them and both deviate from the efficient level, but there is no labor misallocation within each regime since all firms have the same MRPN. In contrast, MRPKs differ both across regimes and across firms within each regime, as we explain next.

The static effects of capital controls on misallocation are determined by condition (19). To understand the mechanism driving these effects and contrast it with the one at work in the literature on misallocation and credit constraints, we study its implications first without financial frictions, then introduce the borrowing constraint and capital controls separately, and finally add capital controls to the economy with the borrowing constraint.

4.1.1 No financial frictions

To remove all financial frictions, assume $\theta \to \infty$ so that the borrowing constraint never binds for any firm, and $\tau = 0$.[15] In this case, there is no misallocation, as the following proposition shows.

Proposition 1. ***No misallocation without financial frictions:*** *If $\theta \to \infty$ and $\tau = 0$ (no borrowing constraint and no capital controls), there is no misallocation (MRPK and MRPN are the same for all firms).*

Proof. If $\theta \to \infty$ and $\tau = 0$, the first-order conditions (18) and (19) reduce to:

$$MRPN_i = w \quad \text{and} \quad MRPK_i = p(r^* + \delta) \quad \forall i.$$

□

There is no misallocation (i.e., no factor reallocation across firms is desirable). If $\underline{k}_i < \bar{k}_i$, where $\bar{k}_i$ is the steady state of capital for firm i, a newborn firm jumps to its optimal scale immediately by borrowing as much as needed.

4.1.2 Borrowing constraints & capital controls separately

We examine next the regime without capital controls (NCC), where firms face borrowing constraints ($\theta > 0$) but no restrictions on capital inflows ($\tau = 0$). This case yields the standard results from the misallocation literature with credit constraints.

[15] $\theta \to \infty$ is sufficient but not necessary for the borrowing constraint to be irrelevant. The necessary condition for a firm of productivity z at birth is $\theta(z) > 1 - (\underline{k}(z)/\bar{k}(z))$, where $\bar{k}(z)$ is the firm's steady-state capital. Intuitively, with this θ even newborn firms can borrow enough to attain $\bar{k}(z)$ in the first period.

Proposition 2. ***Capital misallocation in the*** NCC ***regime****: For θ sufficiently low so that constraint (8) binds for entrepreneur i and $\tau = 0$ (binding borrowing constraint without capital controls), $MRPK_i > \overline{MRPK}$ and $k_i < \bar{k}_i$.*

Proof. The first-order conditions of the second-stage problem imply:

$$MRPK_i = p(r^* + \delta) + \eta_i(1 - \theta).$$

Firms with $k_i < \bar{k}_i$ need to borrow to invest. If the required debt exceeds $\theta\bar{k}_i$, jumping to the optimal scale at birth is unfeasible and, instead, they set investment as high as the constraint allows: $k_i'(a_i') = a_i'/(1-\theta)$. The constraint binds as long as $k_i < \bar{k}_i$, so $\eta_i > 0$ and $MRPK_i > \overline{MRPK}$.[16] □

For these firms, MRPK equals $p(r^* + \delta)$ plus the marginal cost of capital associated with the tightness of the credit constraint. This cost is given by the shadow value of the constraint η_i, which is in terms of marginal utility, multiplied by $(1 - \theta)$ (i.e., the opportunity cost of capital net of the benefit that an additional unit of capital provides as pledgeable collateral). Misallocation thus results from dispersion in the MRPKs of credit-constrained firms that operate below their optimal scale, with higher MRPKs for those that are more constrained. Importantly, for a firm of productivity z, the excess of MRPK over its steady-state level decreases monotonically as a' rises.

Consider next the case with capital controls but no borrowing constraints.

Proposition 3. ***Capital misallocation with capital controls but without borrowing constraints:*** *When $\theta \to \infty$ and $\tau > 0$ (no borrowing constraint with capital controls), if firm i would desire to borrow at R^* to reach its optimal scale, $MRPK_i > \overline{MRPK}$ and $k_i < \bar{k}_i$.*

Proof. If $\theta \to \infty$ and $\tau > 0$, capital controls prevent a firm i that would desire to borrow at R^* to reach $\bar{k}_i$ from borrowing. Hence, the first-order conditions of the second-stage problem imply:

$$MRPK_i = \mathbb{1}_{d_i > 0}[p(r^* + \tau + \delta)] + \mathbb{1}_{d_i \leq 0}\left[p(r^* + \delta) + \mu_i\right].$$

Firms with $k_i < \bar{k}_i$ face the capital controls and hence can only borrow at $(r^* + \tau)$. When they are born, they borrow so that $MRPK_i = p(r^* + \tau + \delta) > \overline{MRPK}$. This is akin to the optimality condition without financial frictions but at a higher interest rate. Hence, these firms jump to a *pseudo-steady-state* with a capital stock $\bar{k}_i^{cc}$ (which differs across them only because of their z_i). Fisherian separation holds and they share a common MRPK.

[16] As the analysis of dynamic effects will show, the firm's net worth grows gradually because the return on savings exceeds r^*, and hence it accumulates capital gradually.

Since $\beta(1 + r^* + \tau) > 1$, however, the dynamic effects studied later induce these firms to gradually pay down their debt and increase their net worth until $d_i = 0$. At this point, they are free from the capital controls and can save at r^*. But at r^* they would like to borrow to jump to $\bar{k}_i$. Hence, the constraint preventing borrowing at r^* binds ($\mu_i > 0$) and they start accumulating capital gradually, effectively as if they were under financial autarky.[17] MRPK's differ across firms in this category, with those more distant from $\bar{k}_i$ having higher MRPK. □

Capital controls distort capital decisions in two ways. First, all firms pay the same tax τ when borrowing, which increases the opportunity cost of funds equally for all firms in a way akin to the efficiency wedge of debt taxes in representative-agent models. Second, there is heterogeneity in the financial conditions of firms that those models miss: μ_i is larger for more debt-constrained firms (i.e., firms with lower a' that would have liked to borrow at r^* but not at $(r^* + \tau)$.

4.1.3 Capital controls and borrowing constraints

We now compare the CC and NCC regimes, both have borrowing constraints but only the former has capital controls. Since we are keeping p unchanged, the efficient MRPK remains $\overline{MRPK} = p(r^* + \delta)$, so changes in MRPKs caused by capital controls directly cause changes in misallocation.

Figure 1 illustrates how capital controls affect a firm's optimal capital choice k' as a function of net worth a', for given z and unchanged aggregate variables (p, w, y). The horizontal line $\bar{k}$ is the steady state of capital attained when the firm reaches its optimal scale, and is also the steady-state under free capital mobility. The line $\bar{k}^{cc}$ is the pseudo-steady state of capital reached under capital controls while the firm accumulates net worth to outgrow it. The 45-degree line ($k' = a'$) is the capital choice if the firm operates in financial autarky. The upward-sloping line $k' = a'/(1 - \theta)$ shows the capital choice when the borrowing constraint binds. Finally, the piecewise-linear curves show the firm's capital choice under the NCC regime (in yellow with two segments) and the CC regime (in red with four segments).

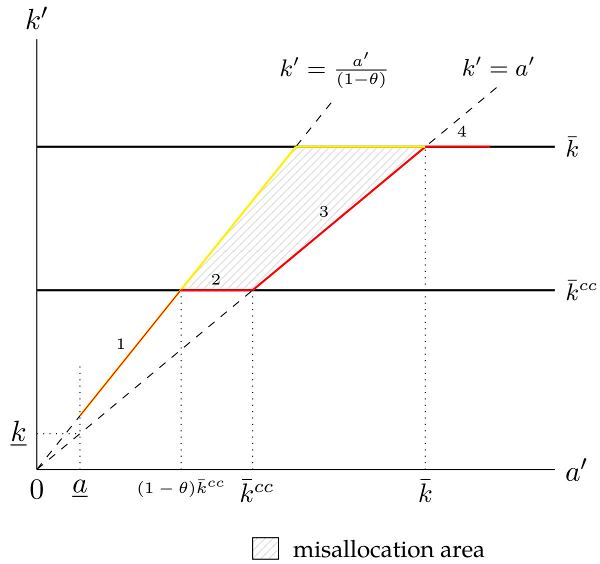
The firm's optimal capital choice k' in the CC regime falls into one of the four regions identified in Figure 1:[18]

1. ***Borrowing-Constrained Region:*** For $a' \in [\underline{k}, (1 - \theta)\bar{k}^{cc}]$, the outcome is like Proposition 2 but substituting $r^* + \tau$ for r^* and $\bar{k}^{cc}$ for $\bar{k}$. The firm would like to borrow at $(r^* + \tau)$ to reach $\bar{k}^{cc}$ but is

[17] We show below that the dynamic effects imply that the return on savings also exceeds r^* for these firms.

[18] For the numerical solution, it is important that in each region the system (18)-(22) has closed-form solutions for (k', d', p'_h, p'_f, n') given $(a', z; y, p, w)$ that do not depend on consumption. Hence, $\tilde{m}'(\cdot)$ is well defined.

Figure 1: Static Effects of Capital Controls
(first-stage optimal k' as a function of a' for given z)



Note: This figure depicts the impact of borrowing constraints and capital controls on a firm's choice of k' as a' varies. (1) Borrowing-Constrained Region: The borrowing constraint binds requiring $k'(a') = a'/(1-\theta)$. (2) Pseudo-Steady-State Region: The firm chooses and maintains the pseudo-steady-state of capital consistent with $r^* + \delta + \tau$, while gradually paying down its debt. (3) Autarky Region: The firm accumulates capital gradually through savings since capital controls prevent borrowing at r^* (i.e., a binding borrowing constraint at $d' = 0$). (4) Optimal-Scale Region: The firm has attained its optimal scale and is unaffected by capital controls.

credit-constrained and sets $k'(a') = a'/(1-\theta)$. Its MRPK is higher, and differs more from $\overline{MRPK}$, the further away it is from $\bar{k}^{cc}$. As we show later, firms in this region have incentives to save because they face a higher effective interest rate, so they increase a' and k' gradually until they reach $\bar{k}^{cc}$.

2. *Pseudo-Steady-State Region:* For $a' \in ((1-\theta)\bar{k}^{cc}, \bar{k}^{cc}]$, the outcome is related to Proposition 3. The firm has reached the pseudo-steady state $\bar{k}^{cc}$ consistent with $\tau > 0$, and since $(\beta R^* + \tau) > 1$, it has incentives to gradually repay its debt as shown below. MRPK is the same for all firms in this category, but it exceeds $\overline{MRPK}$.

3. *Financial Autarky Region:* For $a' \in [\bar{k}^{cc}, \bar{k})$, the outcome is also related to Proposition 3. The firm has no debt and faces the interest rate R^*. At this rate, it would like to borrow to jump to $\bar{k}$ but it cannot because of capital controls, so it chooses $k' = a'$. MRPKs differ across firms in this category. They are higher for the more debt-constrained, and they all exceed $\overline{MRPK}$. These firms also have incentives to save because of a higher effective interest rate given by $R^* [1 + (\mu/p)]$. Thus, a' and k' rise gradually until reaching $\bar{k}$.

4. *Optimal Scale Region:* For $a' \geq \bar{k}$, the firm is at its optimal scale and $MRPK = \overline{MRPK}$. It does not need to borrow, and neither the borrowing constraint nor the capital controls affect it.

Comparing the decision rules in the NCC and CC regimes, Figure 1 shows that the static effects of capital controls imply (weakly) smaller k' for all firms in the CC regime.[19] Defining a firm's optimal scale gap as the percentage deviation of current capital from its optimal level, $OSG \equiv (\bar{k} - k)/\bar{k}$, it is evident that these gaps are also weakly larger under capital controls.

Lower k' under capital controls worsens misallocation because it increases $MRPKs$. This follows from three conditions derived from eqs. (18)-(22):

$$p'_h(a') = \left[\frac{[(p)^\sigma y + e(p^*)^\sigma \zeta^{1-\sigma} y^*]^\alpha}{z\,(k'(a'))^\alpha \left[\frac{1-\alpha}{w\varsigma}\right]^{1-\alpha}} \right]^{\frac{1}{1+\alpha(\sigma-1)}} \tag{23}$$

$$\frac{k'}{n'}\,(a') = \left[\frac{\varsigma}{(1-\alpha)z} \left(\frac{w}{p'_h(a',z)} \right) \right]^{1/\alpha} \tag{24}$$

$$MRPK(a') = \frac{\alpha z}{\varsigma} \frac{p'_h(a',z)}{\left[\frac{k'}{n'}\,(a',z)\right]^{1-\alpha}}. \tag{25}$$

For given $(a', z; y, p, w)$, the lower $k'(a')$ in the CC regime implies that firms charge higher $p'_h(a')$ (condition (23)) and this lowers $\frac{k'}{n'}\,(a')$ because it reduces the firm-specific real wage (condition (24)). These two effects increase $MRPK(a')$ (condition (25)). We denote the area of the trapezoid formed by the yellow and red lines in Figure 1 as the *misallocation area*. This is where the static effects of capital controls strictly reduce k' and increase $MRPK$ relative to $\overline{MRPK}$.

The trade status of firms matters for these results and for the analysis of Figure 1. Consider first a comparison between an exporter and a non-exporter of the same z. The exporter has higher $\overline{k}^{cc}$ and $\overline{k}$ than a non-exporter, because it sells at higher p'_h due to the effect of foreign demand (see condition (23)), and hence its misallocation area is larger (and it shifts up and to the right). This also implies a larger region 1 for the exporter, which in turn implies a longer transition through it.

Comparing exporters and non-exporters with the same productivity z can be misleading, because at equilibrium trade status is endogenous and correlated with productivity. Firms with low z never find it optimal to export, while those with high z typically export immediately upon entry. Since high-z firms also face larger misallocation areas—due both to higher productivity and the higher prices they charge as exporters—the model predicts that exporters are more likely to be high-z firms and to exhibit greater misallocation.

The static effects of capital controls on firms that switch into exporting during their transition to the optimal scale are more complex. The analysis must account for the region where the

[19] The interpretation of capital controls as size-dependent policies is evident in the similarity of this plot with the one Guner et al. (2008) derived for firm size restrictions represented as taxes on capital above a given level of k.

firm operated before switching and the one it enters after. Before exporting, foreign demand does not affect $p'_{h'}$, so the firm faces the same $\bar{k}^{cc}$ and $\bar{k}$ as a non-exporter. After switching, both increase to the exporter values. Thus, a switcher may move from region 2 or 3 as a non-exporter to region 1 or 2 as an exporter. If this occurs, and a' remains unchanged, the firm's misallocation may increase upon switching.[20] As we discuss later, dynamic effects further complicate this pattern.

A caveat of this analysis of static effects of capital controls is that it did not consider the existence of a domestic credit market. Appendix F extends the model in this direction. Entrepreneurs can trade domestic bonds b at a price q^b and interest rate $R^b = 1/q^b$. These bonds are in zero net supply so as to clear the market internally. Net worth and the borrowing constraint become $a' = k' - q(\tau)d' + q^b b'$ and $q(\tau)d' - q^b b' \leq \theta k'$, respectively. We obtain two key results: (1) If $R^b > R^* + \tau$, the results presented here hold: Firms that borrow always borrow from abroad so $b' = 0$ for all firms, and those that have attained $a' = \bar{k}^{cc}$ move into region 3 because there is no supply of domestic bonds and the marginal return on saving exceeds R^*.[21] (2) If $R^* < R^b \leq R^* + \tau$, capital controls move the economy to financial autarky, region 3 disappears but region 2 widens and firms never reach the optimal scale consistent with R^*, instead they remain at the steady-state of capital determined by R^b. Aggregate misallocation can be larger or smaller than in the model without domestic debt market depending on whether R^b is closer to $(R^* + \tau)$ or R^*.

4.2 Dynamic effects

We now turn to the analysis of dynamic effects resulting from changes in net worth a'. The general equilibrium effects that involve changes in (w, p, y) will be discussed in the quantitative section.

The dynamic effects capture differences across capital mobility regimes in the net-worth decision rule $a'(m, z)$ that solves the entrepreneur's second-stage optimization problem. These differences imply different locations along the horizontal axis of Figure 1 and hence different $k'(a'(m, z))$ choices. Applying the envelope theorem to problem (15) yields this Euler equation:

$$u'(c) = \beta u'(c') \frac{\delta \tilde{m}'(a', z; y', p, w)}{\delta a'}. \tag{26}$$

[20] If a firm switches from region 2 to 1, its MRPK rises by $(1-\theta)\eta^E$, where η^E is the Lagrange multiplier post-switch. If it switches from region 3 to 2, MRPK rises if $\tau > \mu^{NE}/p$, where μ^{NE} is the multiplier while the firm was a non-exporter.

[21] The results also hold if we assume that domestic bonds are taxed so that the after-tax return is R^*. This is reasonable because capital controls are a form of financial repression, which implies a wedge between saving and lending rates.

Differentiating (16) and simplifying using conditions (18)-(19), we find that:

$$\frac{d\tilde{m}'(a', z; y', p, w)}{da'} = \mathbb{1}_{d'>0}\left[R^* + \tau + \frac{\eta}{p}\right] + \mathbb{1}_{d'\leq 0}\left[R^* + \frac{\mu}{p}\right], \tag{27}$$

with the caveat that this derivative is not defined at the kinks of the $k'(a')$ function in Figure 1.

Combining the above two conditions yields the result that in both the CC and NCC regimes entrepreneurs with capital below $\bar{k}$ have the incentive to grow their net worth, because their individual marginal return on savings exceeds R^* (and $\beta R^* = 1$). We examine first how the return on savings changes in each region of the capital decision rule *within* the CC regime. Then we analyze the dynamic effects of capital controls by comparing *across* the CC and NCC regimes.

Region 1: Entrepreneurs borrow at $(R^* + \tau)$ and are credit-constrained. Since the optimality conditions of the first-stage problem hold too, we obtain:

$$\frac{u'(c)}{\beta u'(c')} = R^* + \tau + \frac{\eta}{p} = \left[\frac{MRPK'}{p} + 1 - \delta + \theta\frac{\eta}{p}\right], \tag{28}$$

where $u'(c)/\beta u'(c')$ is the IMRS and $R^* + \tau + \frac{\eta}{p}$ is the firm's return on savings. The return exceeds R^* in the CC regime because of both the debt tax and the tightness of the binding borrowing constraint. The latter varies across firms affecting more firms that are more constrained and thus have higher MRPK. Notice that the extent to which capital controls alter MRPK and their effect on the return on savings are linked: The firm's return on savings is larger the higher its MRPK.

Region 2: All firms in this region have capital $k' = \bar{k}^{cc}$ and debt $d' = (R^* + \tau)(\bar{k}^{cc} - a')$. The borrowing constraint is not binding and they gradually pay down their debt to zero because $\beta(R^* + \tau) > 1$. The dynamic effect is still at work because these entrepreneurs still desire to reallocate consumption into the future by growing their net worth.

Region 3: Entrepreneurs hit the no-borrowing constraint at R^*, and again since the optimality conditions of the first-stage problem hold, we obtain:

$$\frac{u'(c)}{\beta u'(c')} = R^* + \frac{\mu}{p} = \left[\frac{MRPK'}{p} + 1 - \delta\right]. \tag{29}$$

Hence, the return on savings exceeds R^* only because the capital-controls constraint preventing firms from borrowing at R^* binds ($\mu/p > 0$). This effect varies across firms affecting more those that are more constrained and thus have higher $MRPK$.

Region 4: Entrepreneurs that have reached their optimal scale are unaffected by capital controls and borrowing constraints and make optimal saving plans so as to equate their IMRS with the world interest rate R^*. Since $\beta R^* = 1$, their consumption and net worth are stationary.

It is worth noting that although r^* and τ are exogenous, the effective interest rates faced by individual firms in Regions 1 and 3 are endogenous. This is because they depend on the firm's η and μ (see eqs. (28)-(29)).

Now we characterize the dynamic effects of capital controls by comparing savings incentives across the regimes with and without capital controls. Consider first Region 1. This Region is the same in the NCC and CC regimes. In both cases, the entrepreneur's return on savings exceeds R^*, but it is important to note that the return is *lower* in the CC regime for a given a'.[22] The intuition is simple: without capital controls, firms in Region 1 would like to borrow at r^* to reach their optimal scale $\bar{k}$, but with capital controls they would like to borrow less at the higher rate $r^* + \tau$ since they only need to reach $\bar{k}^{cc}$. As a result, for the same age and productivity, firms in Region 1 accumulate capital more slowly with capital controls (i.e., have lower a') and thus have higher MRPKs and misallocation.

As firms arrive in Region 2, saving incentives are still weaker with capital controls but eventually in either Region 2 or 3 (but before reaching Region 4) they become stronger with capital controls.[23] Intuitively, Figure 1 shows that when a firm in the NCC regime reaches its optimal scale (with a return on savings of R^*) the same firm is still in Regions 2 or 3 in the CC regime (with a return on savings above R^*), and therefore somewhere within those two regions the firm's return on savings switches from higher in the NCC regime to higher in the CC regime.

The above results imply that the dynamic effects of capital controls on misallocation are ambiguous. For relatively younger firms, misallocation worsens because capital controls weaken saving incentives (and hence at the same age they have smaller k), but for sufficiently old firms the opposite is true.

[22]The proof is as follows: Consider for simplicity a nonexporter and ignore labor supply. Keeping p constant, firms in Region 1 with the same a' choose the same k' and have the same MRPK in both regimes. Then, condition (19) implies $(1-\theta)(\eta^{NCC} - \eta^{CC}) = p\tau > 0$, and condition (27) implies that the return on savings is bigger in the NCC regime by the amount $(\theta/p)(\eta^{NCC} - \eta^{CC})$.

[23]Firms in these regions are in the misallocation area where they choose smaller k' for given a' and $MRPK^{CC} > MRPK^{NCC}$. Using again conditions (19) and (27), we find that in region 2 $MRPK^{CC} > MRPK^{NCC}$ implies $\tau > (1-\theta)(\eta^{NCC}/p)$ but stronger saving incentives with capital controls require $\tau > \eta^{NCC}/p$. In region 3, $MRPK^{CC} > MRPK^{NCC}$ implies $\mu > (1-\theta)(\eta^{NCC}/p)$ but stronger saving incentives with capital controls require $\mu > \eta^{NCC}$. In both cases, saving incentives remain stronger in the NCC regime in the interval $[-\theta(\eta^{NCC}/p)$,0).

These dynamic effects alter the misallocation outcomes obtained from considering only the static effects. In Region 1, stronger saving incentives without capital controls imply higher misallocation with capital controls (instead of no effect). In Regions 2 or 3, the dynamic effects enlarge the static effects of capital controls on misallocation shown in the misallocation area of Figure 1, until firms hit the threshold where saving incentives become stronger with capital controls. Beyond that point, the dynamic effects weaken the static effects on misallocation, because firms of the same age and productivity grow their net worth faster under capital controls, and thus have more capital and less misallocation. It is even possible that for some firms the dynamic effects could be strong enough to offset the static effects. Hence, an entrepreneur of a given age and TFP may have saved sufficiently more with capital controls so that eqs. (23)-(25) yield higher MRPK *without* them.

4.3 Planner's problem & efficient allocations

We close this Section with a brief analysis of the normative implications of the model. A detailed treatment, including relevant proofs, is provided in Appendix E. We show that a social planner equalizes marginal returns across firms, even when facing an aggregate credit constraint. We then characterize the inefficiencies present in the decentralized equilibrium and discuss the set of optimal policies (including capital controls) that can decentralize the planner's allocation.

Consider first a social planner that does not face credit constraints. This planner eliminates misallocation, and the marginal revenue products it attains match those of the decentralized *competitive equilibrium* without financial frictions. These results are contained in this proposition:

Proposition 4. ***Efficiency of the Competitive Equilibrium:*** *If $\beta R^* = 1$, the MRPK and MRPN of the decentralized competitive equilibrium without financial frictions (as $\sigma \to \infty$ and intermediate goods become perfect substitutes) match the efficient real returns on capital and labor attained by a social planner free of financial frictions. Moreover, these marginal revenue products are time-invariant, constant across firms regardless of their age and productivity, and $MRPK_i = \overline{MRPK}$.*

Proof. See Appendix E. There, we also show that, if the planner and entrepreneurs have the same discount factors and $\beta R^* = 1$, the planner equalizes also consumption across all firms each period. □

This result implies that, without borrowing constraints, the decentralized *competitive* equilibrium not only equates MRPKs across all firms, but does so at the level that is socially optimal

$(\overline{MRPK})$. The same is true in the monopolistic-competition environment we focus on (see Proposition 1), but this economy is inefficient because the imperfect substitutability of input varieties and the firm's market power yields positive price markups.

We also study a planner who faces the collateral constraint but at the aggregate level (i.e., it can pledge as collateral the aggregate capital of the economy). We find that this planner still equalizes returns on capital and labor across firms (i.e., there is no misallocation). The planner sets the MRPK in units of final goods at $MRPKp_{\nu}^{SP}(z) = (1-\theta)\max\left(\frac{1-\hat{\beta}R^*}{\hat{\beta}}, 0\right) + r^* + \delta$, where $\hat{\beta}$ is the planner's subjective discount factor.

To analyze the inefficiencies in the decentralized economy of the NCC regime, we examine the gaps in marginal revenue products of capital and intertemporal marginal rates of substitution relative to the planner's efficient solutions. The gap in MRPKs (in units of final goods) for a firm of age ν and productivity z is:

$$MRPKp_{\nu}^{SP}(z) - MRPKp_{\nu}^{DE}(z) = (1-\theta)\max\left(\frac{1-\hat{\beta}R^*}{\hat{\beta}}, 0\right) - (1-\theta)\frac{\bar{\tilde{\eta}}_{\nu}^{DE}(z)}{\tilde{\beta}u'(\bar{c}_{\nu+1}^{DE}(z))}. \tag{30}$$

The first term in the right-hand-side of this expression is the planner's excess MRPKp relative to that of a planner without credit constraints ($r^* + \delta$). The second is the excess MRPKp of a firm in the decentralized equilibrium also relative to $r^* + \delta$, which varies with ν and z depending on the tightness of credit constraints (recall Prop. 2). Hence, misallocation in the stationary decentralized equilibrium is socially inefficient even when the planner faces a credit constraint. If the constraint is not binding at the planner's stationary equilibrium ($\hat{\beta}R^* = 1$), the above difference is negative for all firms below their optimal scale in the decentralized equilibrium (i.e., credit-constrained firms) and their MRPKp exceeds the efficient MRPKp, while for firms that have reached it their MRPKp matches the efficient one. If the planner is constrained ($\hat{\beta}R^* < 1$), some firms in the decentralized equilibrium sufficiently close to their optimal scales so that $\frac{\bar{\tilde{\eta}}_{\nu}^{DE}(z)}{\tilde{\beta}u'(\bar{c}_{\nu}^{DE}(z))} > \frac{1-\hat{\beta}R^*}{\hat{\beta}}$ have an MRPKp below the efficient one. This is because the planner faces the collateral constraint with the aggregate capital stock, which individual entrepreneurs do not internalize.

Given the above result, the gap in IMRS can be expressed as:

$$IMRS_{\nu}^{SP}(z) - IMRS_{\nu}^{DE}(z) = \frac{1}{1-\theta}\left(MRPKp_{\nu}^{SP}(z) - MRPKp_{\nu}^{DE}(z)\right) \tag{31}$$

The planner allocates income across entrepreneurs so as to attain a common IMRS for all of them, but individual IMRS in the decentralized equilibrium differ with ν and z depending on the tightness of firm-specific credit constraints. Thus, lifecycle saving plans in the decentralized equilibrium are also socially inefficient. This inefficiency and that in MRPKs are proportional to each other.

Appendix E also explains how the planner's allocation can be decentralized using a combination of debt taxes, profit subsidies, and lump-sum transfers. If the entrepreneurs' credit constraints do not bind in the decentralized equilibrium with the optimal policies in place (as we verified numerically for our calibration), the optimal debt and profit taxes are:

$$\tau_\nu(z) = \frac{1 - \hat{\beta} R^*}{\hat{\beta}} > 0 \quad \text{and} \quad \tau_\nu^k(z) = -\frac{\theta \tau_\nu(z)}{(1-\theta)\,\tau_\nu(z) + r^* + \delta} < 0. \tag{32}$$

Hence, the *optimal* debt tax is positive (i.e., the planner uses capital controls) and is invariant across age and productivity, which are properties we assumed for the ad-hoc debt tax in the model. The optimal profits tax is actually a subsidy, also constant across firms. In addition, decentralizing the planner's allocations requires a schedule of optimal lump-sum transfers that varies with ν and z. These policies can be viewed as aimed at these targets: The debt tax sets capital controls so as to support the planner's IMRS common across firms. The subsidy on profits supports the planner's MRPKp, also common across firms. Finally, the transfers redistribute income so as to replicate the planner's distribution of consumption across agents and to balance the government's budget constraint. But the three instruments need to be used jointly in order to attain all three targets.

5 Quantitative Analysis

In this Section, we evaluate the model's quantitative predictions. We focus on comparing the steady-state equilibria of the NCC and CC regimes.[24] We begin by calibrating the model to Chilean data and solving the NCC stationary equilibrium. Then, we solve the CC equilibrium with τ also calibrated to Chilean data, and study the differences across the two regimes in terms of aggregate variables and misallocation. Appendix C details the solution method.

[24]This approach abstracts from transition dynamics, which are examined by Andreasen et al. (2024) using a similar model. They find that capital controls trigger firm-level price adjustments that are smooth and relatively fast, suggesting that steady-state comparisons are a reasonable approximation.

5.1 Baseline calibration

We calibrate the NCC regime without capital controls so that the model's stationary equilibrium matches Chilean data targets for 1990-1991, before the *encaje* was introduced. A subset of the parameters $(\gamma, \beta, \sigma, \delta, \rho, r^*)$ are set to widely-used values or to estimates from the related literature. The coefficient of relative risk aversion and the subjective discount factor are set to standard values of $\gamma = 2$ and $\beta = 0.96$, respectively. Hence, $R^* = 1/\beta = 1.04167$. The rate of depreciation $\delta = 0.06$ is taken from Midrigan and Xu (2014). The elasticity of substitution across varieties $\sigma = 4$ is from Leibovici (2021), who calibrated his model to Chilean data and used this value based on estimates from Simonovska and Waugh (2014). The exit rate of firms is $\rho = 0.0735$ which is the average exit rate in the Chilean dataset described below over the 1990-2007 period.

We set the capital injection to newborn firms as a fraction κ of their steady-state capital: $\underline{k}(z) = \kappa\bar{k}(z)$.[25] In doing this, we take into account that $\bar{k}(z)$ rises with z and is also higher for exporters of the same z.[26] Also, in order to capture the empirical fact that exporters have better access to credit (e.g., Muuls (2015)), we set the fraction of capital that they can pledge as collateral higher than for non-exporters by the factor θ_f. In terms of Figure 1, this implies a larger misallocation area for exporters as the ray that defines region 1 shifts counterclockwise. We discretize the distribution $f(z)$ with a standard deviation ω_z over ten nodes, z_i for $i = 1, ..., 10$, using the Gaussian quadrature algorithm QWLOGN from Miranda and Fackler (2004).

The values of the parameters $\{\zeta, \omega_z, F, \theta_f, \theta^{NE}, \kappa, \alpha\}$ are determined by targeting seven data moments using an SMM algorithm. The data targets are: (1) the share of firms that export (0.18); (2) the ratio of sales between exporters and non-exporters (8.42); (3) the ratio of investment shares in value added between exporters and non-exporters (1.87); (4) aggregate exports as a share of total sales (0.21); (5) credit to the manufacturing sector as a share of manufacturing value added (0.33); (6) the aggregate capital stock relative to the wage bill (7.25); and (7) the ratio of sales of five- to one-year-old firms (1.24).[27]

The above targets are averages for the 1990–1991 period (the *encaje* was introduced in mid-1991 and hence, arguably, it did not influence those averages). All targets, except the ratio of credit to the manufacturing sector as a fraction of manufacturing value added, were calculated using Chile's *Encuesta Nacional Industrial Anual* (ENIA). The ENIA includes data on all manufacturing

[25]Note that $\underline{k}(z)$ and $\bar{k}(z)$ change with capital controls, since the stationary equilibrium of firms changes.

[26]In the Chilean data, the share of exporters increases significantly with firm size. Only 3% of firms in the lowest 25th percentile are exporters, while 30% and 54% of firms in the highest 75th and 95th percentiles, respectively, are exporters.

[27]This last ratio includes only firms that survive at least three years to mitigate noise from short-lived firms.

establishments with more than ten employees, comprising approximately 4,500 observations per year. It provides detailed information on characteristics such as total workers, payroll, domestic sales, exports, inputs, physical assets, and more. It does not, however, report credit data. To estimate the ratio of credit to the manufacturing sector as a fraction of manufacturing value added, we first calculate the ratio of manufacturing credit to total commercial credit for 2000–2005 using data from the Superintendencia de Bancos e Instituciones Financieras de Chile (these data are unavailable before 2000) and then linearly extrapolate the values for 1990–1991. Finally, we multiply these results by the ratio of the share of commercial credit in GDP (calculated using Central Bank of Chile data) to the share of manufacturing value added in GDP (reported by the World Bank).

The SMM algorithm assigns equal weight to each parameter and minimizes the squared differences between model moments and data targets. The resulting parameter values are presented in Table 1. Table C.2 in Appendix C compares the data targets with their model counterparts, showing that the calibration matches the moments to the second decimal.

In the CC regime with capital controls, we compute τ using the methodology proposed by De Gregorio et al. (2000) for a 12-month loan maturity, the 30% *encaje* that prevailed over 1992-1997, and the interest rate at the calibrated value of r^* (0.04167). This yields a debt-tax equivalent of $\tau = 0.0175$, representing a 42% increase in the borrowing rate. See Appendix A.1 for details.

To provide additional validation for the model calibration, we examine the extent to which the model's firm-size distribution matches the data. Table 2 shows the distribution of capital across Chilean firms by quintiles as of 1990 (before capital controls) and in 1997 (the last year the capital controls were in place) and in the model's stationary distributions for the NCC and CC regimes, respectively.[28] Figure 2 plots the Lorenz curves of the same distributions.

Table 2 and Figure 2 yield three interesting results. First, the model's firm-size distributions with and without capital controls approximate well their data counterparts. Second, these distributions display significant heterogeneity and concentration of capital ownership in the top quintile. Without (with) capital controls, the Gini coefficients are 0.741 (0.690) and 0.629 (0.627) in the data and in the model, respectively. Similarly, the fraction of capital held by each quintile of

[28]The firm-size distribution in the data is constructed using the *ENIA* dataset and the definitions of capital and optimal scale gap from Section 6. To make data and model comparable, we consider two time windows that correspond to the regimes with and without capital controls. Specifically, we define 1996–1998 as the period with capital controls, reflecting their actual presence from 1991 to 1998. As a benchmark for the regime without capital controls, we use the years 1990–1991 and 2000–2003. Additionally, firms with optimal scale gaps exceeding 0.66 are excluded, since newborn firms in the calibrated model receive a capital transfer of 34% of their optimal scale. Firms in the top 2.5% of the capital distribution are also excluded.

Table 1: Parameter Values in the NCC Calibration

Predetermined parameters				SMM calibration		
β	Discount factor	0.96	Standard	ζ	Iceberg trade cost	3.5591
γ	Risk aversion	2	Standard	ω_z	Productivity dispersion	0.4215
σ	Substitution elasticity	4	Leibovici (2021)	F	Sunk export entry cost	1.7094
δ	Depreciation rate	0.06	Midrigan and Xu (2014)	θ^{NE}	Non-exporters borrowing coefficient	0.0558
ρ	Death probability	0.0735	Chilean data	θ_f	Exporters borrowing factor	1.7808
				α	Capital intensity	0.4810
				κ	Fraction of steady-state capital as initial capital	0.3432

Table 2: Distribution of Capital by Quintiles

Quintile of firms	Data (1990) (1)	Model (NCC regime) (2)	Data (1997) (3)	Model (CC regime) (4)
0.2	0.0058	0.0153	0.0106	0.0154
0.4	0.0203	0.0468	0.0257	0.0470
0.6	0.0523	0.0934	0.0652	0.0947
0.8	0.1383	0.1737	0.1565	0.1734
1	0.7825	0.6709	0.7368	0.6694

firms in the data and in the model are very similar, with the lowest quintile holding less than 2% of aggregate capital, while the top quintile holds about 70%. Third, in both model and data the Gini coefficient is lower when capital controls are in place.

Interestingly, although the misallocation caused by capital controls reduces firm sizes, this does not change much how the (smaller) aggregate capital stock is distributed across firms. This is in part because the size of firms in each stationary distribution that are in Region 1 is similar and firms take some time to transit into Regions 2 and 3, where firms are smaller with capital controls.

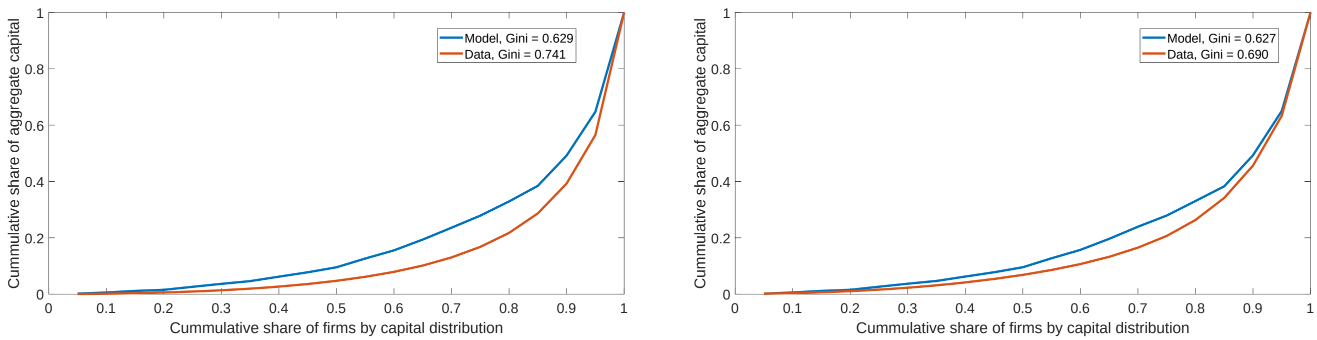
It is important to note also that endogenous trade participation plays a key role in the model's ability to match the observed firm-size distribution. This is because exporters are a small share of all firms (18%) but they are much larger than non-exporters. The distribution of capital across non-exporters is more equally distributed than across all firms, despite the fact that the productivity of these firms can differ sharply. The same is true for exporters.[29] Hence, it is the heterogeneity between exporters and non-exporters what enables the model to produce a distribution of capital across firms as unequally distributed as in the data.

[29] The Gini coefficients for non-exporters and exporters in the model are 0.44 and 0.37, respectively.

Figure 2: Lorenz Curves of the Firm Size Distribution - Data and Model

(a) NCC regime

(b) CC regime



5.2 Baseline results

We discuss here the quantitative results for the calibrated baseline model, focusing on the effects of capital controls on aggregate variables and misallocation.

5.2.1 Aggregate variables

Columns (1a) and (1b) of Table 3 compare the effects of capital controls on the steady-state values of aggregate variables in partial (Col (1a)) and general (Col. (1b)) equilibrium solutions. Each column shows percentage changes in the CC regime relative to the NCC regime.

These results yield two key findings. First, Col. (1b) shows that capital controls have large negative effects on all aggregate variables. This holds for macroeconomic aggregates (investment, consumption, final goods output, GDP, and credit as a share of value added), prices (wages, final goods prices, and real wages), and trade indicators (exports and the share of exporters). Second, general equilibrium (GE) effects dampen significantly the aggregate impact of capital controls. In partial equilibrium (PE), Col. (1a) shows that all aggregate variables fall by larger magnitudes, particularly exports, the share of exporters, and investment.

The above findings follow from the analysis of the previous Section. In partial equilibrium, capital controls have minimal impact on capital decisions in Regions 1 and 4.[30] Thus, the sharp investment drop (-16.1%) is due to strong static effects in Regions 2 and 3. The (ambiguous) dynamic effects are also at work, but the static effects dominate. In contrast, investment falls much less in general equilibrium (-1.56%), because the 0.32% drop in p reduces the opportunity cost of

[30]In Region 1 the results differ only because of the dynamic effect of stronger saving incentives without capital controls, and in 4 the optimal scales of capital are reached when MRPK equals $p(r^* + \delta)$, which is unchanged in partial equilibrium.

Table 3: Effects of Capital Controls on Aggregate Variables
(percent changes relative to NCC regime)

	CC (PE) (1a)	CC (GE) (1b)	LTV Reg. (2)	Higher τ (3)
Exports	-4.70%	-1.10%	-1.15%	-6.03%
Share of exporters	-11.09%	-6.19%	-1.43%	-6.19%
Domestic Sales	-0.93%	-0.91%	-0.26%	-1.51%
Investment	-16.08%	-1.56%	-1.17%	-6.40%
Consumption	-0.80%	-0.67%	-0.10%	-0.63%
Real Profits	-1.46%	-0.70%	-0.06%	-0.38%
Final goods output	—	-0.82%	-0.28%	-1.62%
Real GDP	—	-0.63%	-0.52%	-2.89%
Real wage	—	-0.78%	-0.55%	-3.04%
Wage	—	-1.10%	-0.48%	-2.61%
Price level (Real ex. rate)	—	-0.32%	0.07%	0.44%
Agg. credit/Value Added	$-6.36pp$	$-5.90pp$	$-5.90pp$	$-32.70pp$

Note: The change in the credit-value added ratio is shown as the difference in percentage points (*pp*). Real GDP corresponds to total value added, which is also the aggregate of the entrepreneurs' foreign and domestic sales.

investment for firms in all regions (see eq.(19)). This mitigates the drops in GDP, consumption, and domestic input sales. Furthermore, the 1.1% drop in wages stimulates demand for both labor and capital (given gross complementarity with Cobb-Douglas technology), although monopolistic competition partially offsets this effect, as lower p and y exert downward pressure on firm prices, reducing demand for capital and labor.

The decline in investment also affects exporters, leading to the larger drop in exports and the share of exporters in partial equilibrium. Since only firms with sufficiently high z are exporters, and only firms with intermediate values of z become exporters during their transition to optimal scale, exporters tend to be concentrated in regions 2 and 3 at stages where their $\phi(\nu, z)$ has significant weight in the aggregation. Hence, capital allocated to exporters falls sharply, causing a 4.7% drop in exports. Higher borrowing costs due to capital controls also discourage firms from entering the export market, causing a 11.1% reduction in the share of exporters. The general equilibrium effects noted above for the aggregate effects across all firms also operate here, moderating the drops in exports and the share of exporters (1.1% and 6.2%, respectively). There are also two other effects particular to exporters: First, the fall in p induces a real depreciation, making exports more competitive and hence more attractive. Second, the drop in w reduces the cost of becoming an exporter, further cushioning the drop in exports and the share of exporters.

It is also worth noting that the model does predict that capital controls are effective at reducing credit, by 6.4 pp and 5.9 pp in partial and general equilibrium, respectively. There are opposing forces explaining why these two results are similar: On the one hand, an increase in capital accumulation with a lower p gives more borrowing capacity to constrained firms, increasing aggregate credit. On the other hand, the regions where firms keep their debt constant (Region 2) or do not borrow (Region 3) are larger when p drops, reducing aggregate credit.

5.2.2 Misallocation

To quantify the effects of capital controls on misallocation, we define mis_i^j as the misallocation of firm i with or without capital controls ($j = NCC, CC$), measured as the absolute deviation of the firm's log MRPK relative to the log of the long-run, efficient level ($\overline{MRPK}^j = p^j(r^* + \delta)$):

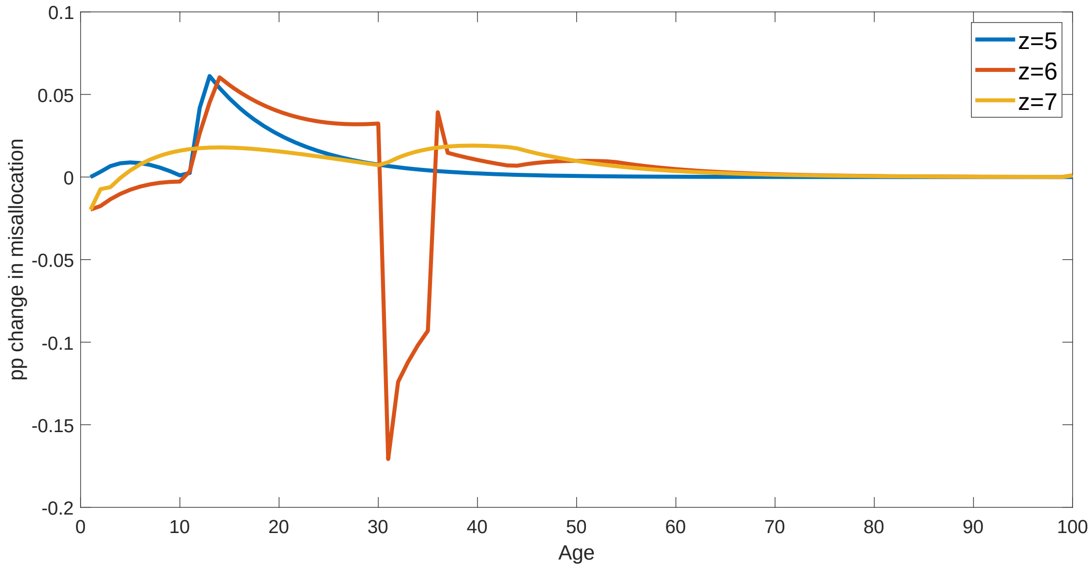
$$mis_i^j = \mid \log(MRPK_i^j) - \log(\overline{MRPK}^j) \mid . \tag{33}$$

Thus, mis_i^j represents the absolute percentage deviation from each regime's $\overline{MRPK}^j$. The corresponding aggregate measure is constructed as $MIS^j \equiv \sum_\nu \sum_z mis^j(\nu, z)\phi(\nu, z)$ for $j = NCC, CC$, which is the mean deviation of MRPKs relative to $\overline{MRPK}$. The firm-level and aggregate effects of capital controls on misallocation are then measured as $(mis_i^{CC} - mis_i^{NCC})$ and $(MIS^{CC} - MIS^{NCC})$, since these differences involve percentages, we describe them in percentage points.

Figure 3 shows the misallocation effects of capital controls for firms up to 100 years old and three values of z: (i) firms that always remain non-exporters ($z = 5$), (ii) firms that become exporters one period after entering the market ($z = 7$), and (iii) firms that start exporting during their transition to their optimal scale ($z = 6$). We chose these three because $z = \{5, 6\}$ are the most common in the calibrated TFP distribution $f(z)$, with 35% probability each, and $z = 7$ is the most common among firms that are always exporters (with a probability of 13.6%). Firms with $z < 5$ ($z > 7$) are also always non-exporters (exporters) and show similar qualitative patterns as firms with $z = 5$ ($z = 7$). The plots end at $\nu = 100$ because survival probability is negligible beyond this age. The misallocation effects are weighted by the fraction of surviving firms at each age, $\rho(1 - \rho)^\nu$, to account for the composition effect driven by the exponentially-decreasing survival probability, which is particularly relevant for middle-aged firms that show larger misallocation effects.

The patterns in Figure 3 are the net result of the static, dynamic, and general equilibrium effects. Firms transition through the four regions in Figure 1, with lower-productivity firms reach-

Figure 3: Effects of Capital Controls on Misallocation
(weighted by fraction of surviving firms)



Note: This chart plots $\rho(1-\rho)^{\nu}(mis(\nu,z)^{CC} - mis(\nu,z)^{NCC})$ using mis as defined in the text for a firm of age ν and productivity z, for $z = \{5,6,7\}$ and $\nu \in [0,100]$. Each value is weighted by the surviving fraction of firms of each age.

ing their smaller optimal scales at younger ages.[31] All firms start in Region 1 at birth, where capital controls have a small, ambiguous impact on misallocation, up to around age 10. Beyond this age, misallocation evolves differently across productivity levels. Nonexporters ($z = 5$) transit into Region 2, where capital controls cause misallocation to rise sharply, peaking above 0.05pp (weighted by survivors) before gradually falling as they move toward Region 3 and converging to zero in Region 4. Exporters ($z = 7$) take longer to reach Regions 2 and 3 (after ages 30 and 40, respectively), with misallocation effects peaking at lower levels but with similar qualitative patterns.

Switchers ($z = 6$) exhibit a distinct pattern. Early in Region 2, the effect of capital controls on their misallocation resembles that for nonexporters, but as they age further it remains high (around 0.04pp), instead of falling, until they reach the age at which they switch in the NCC regime (age 31). Capital controls cause these firms to delay the decision to switch to age 36, and therefore the misallocation effect between ages 31 and 36 is the difference between that of a nonexporter with capital controls and an exporter without them. Since misallocation is much smaller for the former, the misallocation effect drops by as much as 0.17pp. Once the firm switches to exporter under capital controls, the misallocation effect jumps back to around 0.04pp and then

[31]Recall that the four regions are: 1. Borrowing-Constrained, 2. Pseudo-Steady State, 3. Financial Autarky, and 4. Optimal Scale.

gradually declines to zero at the optimal scale.

Examining the optimal plans of switchers, with or without capital controls, we observe a gradual buildup of net worth before the switching age, followed by a sharp drop in investment and capital upon switching as entrepreneurs smooth the effect on consumption of paying the switching cost wF. This capital adjustment moves firms from non-exporters in Region 2 prior to switching back to Region 1 as switchers and then exporters. The smaller capital of the firms with $z = 6$ that switch at the younger age without capital controls increases their misallocation relative to the firms with the same z that have not switched with capital controls, and thus yields the large negative misallocation at age 31. Similarly, the sharp jump at age 36 stems from the capital drop when switching occurs under capital controls.

Table 4 reports aggregate measures of the misallocation effects of capital controls across all firms and groupings by exporter status, optimal scale gap, and productivity. Column(1a) presents the results under partial equilibrium (unchanged p, w, y) while Column(1b) shows general equilibrium results. Column (2) shows comparable data estimates to be discussed in Section 6.

Table 4: Effects of Capital Controls on Misallocation

	Model		Data	Counterfactuals	
	PE	GE		LTV Reg.	Higher τ
	(1a)	(1b)	(2)	(3)	(4)
All firms	$0.47pp$	$0.53pp$	$0.33pp$	$0.37pp$	$2.15pp$
Exporters	$1.33pp$	$1.30pp$	$0.47pp$	$1.07pp$	$5.55pp$
Non-exporters	$0.31pp$	$0.38pp$	$0.22pp$	$0.22pp$	$1.47pp$
OSG					
Large	$0.49pp$	$0.55pp$	$0.38pp$	$0.39pp$	$2.24pp$
Small	$0.23pp$	$0.24pp$	$0.25pp$	$0.05pp$	$0.28pp$
Productivity					
High	$0.75pp$	$0.72pp$	$0.57pp$	$0.90pp$	$5.00pp$
Low	$0.49pp$	$0.55pp$	$0.03pp$	$0.20pp$	$1.19pp$
1	$0.10pp$	$0.11pp$		$0.02pp$	$0.14pp$
2	$0.19pp$	$0.20pp$		$0.06pp$	$0.37pp$
3	$0.35pp$	$0.39pp$		$0.12pp$	$0.75pp$
4	$0.52pp$	$0.57pp$		$0.21pp$	$1.25pp$
5	$0.56pp$	$0.62pp$		$0.29pp$	$1.73pp$
6	$0.25pp$	$0.35pp$		$0.29pp$	$1.72pp$
7	$0.76pp$	$0.73pp$		$0.90pp$	$4.97pp$
8	$0.68pp$	$0.67pp$		$0.92pp$	$5.23pp$
9	$0.65pp$	$0.65pp$		$0.93pp$	$5.27pp$
10	$0.65pp$	$0.64pp$		$0.93pp$	$5.28pp$

Capital controls worsen aggregate misallocation slightly more in general equilibrium than in partial equilibrium, by $0.53pp$ instead of $0.47pp$. This is in contrast with the weaker adverse effects on aggregate variables in general equilibrium discussed earlier. To understand this result, consider how general equilibrium effects altering (p, w, y) affect the analysis of Figure 1. The reductions in the price of final goods and the real wage increase the values of $\bar{k}$ and $\bar{k}^{cc}$ that define Regions 2 and 4. The lower p because it reduces the opportunity cost of investment, and the lower w/p because it induces higher labor usage and the marginal product of capital is increasing in labor. Lower p also reduces the value of $\overline{MRPK}$, thereby increasing the misallocation of all firms, since it is measured as the deviation of their MRPKs from this value. On the other hand, the fall in y reduces aggregate demand and incentivizes firms to reduce $\bar{k}$ and $\bar{k}^{cc}$.[32] The effects of the drops in p and w/p dominate, and thus it follows from Figure 1 that higher $\bar{k}$ and $\bar{k}^{cc}$ lengthens Regions 1, 2 and 3 and the transition of firms through them, and therefore the misallocation area widens (the trapezoidal region shifts up and to the right as the $\bar{k}$ and $\bar{k}^{cc}$ lines move upward).

For firms within the larger misallocation area, capital controls worsen misallocation more in general equilibrium than in partial equilibrium, contributing to increase aggregate misallocation. Similarly, the lower $\overline{MRPK}$ worsens misallocation for all firms. But Region 1 also expands as $\bar{k}^{cc}$ rises, placing more firms in the region where static misallocation effects are absent and the dynamic effect is only slightly negative. Since the exponentially-decreasing age distribution has a larger mass of younger firms, with small misallocation effects in both partial and general equilibrium, the resulting composition effect implies that aggregate misallocation increases only slightly more in general equilibrium. The same logic explains the comparison of general and partial equilibrium results for the groups separated by exporter status, optimal scale gap and high-low productivity.

Consider next the groupings by exporter status, OSG, and productivity, aggregated using the corresponding conditional distributions. For exporter status, we classify firms based on their status in the CC regime. High-productivity firms are defined as those with $z \geq 7$, and low-productivity firms as those with $z \leq 4$. Firms with large (small) optimal scale gap are those with $OSG \geq 5\%$ ($OSG < 5\%$). Note that it follows from these definitions that the high-productivity group is the same as the exporters group but excluding switchers that have reached the age to become exporters. Similarly, the low-productivity group is the same as nonexporters except those with $z = 5$ and switchers young enough to still be nonexporters.

[32]The percent change in $\bar{k}$ between the CC and NCC regimes can be expressed as $ln(\bar{k}^{CC}) - ln(\bar{k}^{NCC}) = ln(\tilde{y}^{CC}) - ln(\tilde{y}^{NCC}) - (\sigma - 1)(1 - \alpha)[ln((w/p)^{CC}) - ln((w/p)^{NCC})]$, where $\tilde{y} = y + e\zeta^{1-\sigma}(p^*/p)^{\sigma} y^*$. Profits and profits net of taxes and inclusive of depreciated capital change by the same percentage because they are linear in $\bar{k}$.

Exporters bear the largest increases in misallocation caused by capital controls (1.30pp in general equilibrium). This is 2.3 times larger than the aggregate effect across all firms, and even 1.8 times larger than for high-productivity firms (0.72pp). Figure 3 explains why: The high-productivity result excludes the sizable misallocation effects of exporting firms with $z = 6$. The misallocation effect of capital controls on nonexporters is much smaller, at 0.38pp in general equilibrium—lower even than the 0.55pp of low-productivity firms. As Figure 3 shows, this reflects the fact that the nonexporter group includes firms with $z = 5$, as well as the subset of firms with $z = 6$ that are nonexporters in the CC regime but would be exporters in the NCC regime, for which misallocation drops sharply.

The non-monotonic pattern of misallocation effects of capital controls across productivity levels is another interesting feature of the baseline results. For z ranging from 1 to 5, (all non-exporters) misallocation rises sharply with z. It then dips at $z = 6$ and jumps again at $z = 7$, before flattening out slightly for higher values of z. This pattern reflects three forces. First, as we move from $z = 1$ to 5 we add more productive firms that face larger misallocation areas and reach them earlier in life, which gives them more weight in the age distribution. Second, the $z = 6$ group (switchers) includes the firms with the large negative misallocation effects that pull down the average for that group. Third, above $z = 7$ (exporters), misallocation effects are large but change little as z rises, because while exporters have larger misallocation areas they also have longer transitions, which gives them less weight in the age distribution.

The effect of capital controls on misallocation is also stronger for firms with large OSG, increasing by 0.55pp compared to 0.24pp for low-OSG firms. This pattern reflects the fact that firms far from their otimal scale are still in their growth phase and require continued access to external financing to reach it. As a result, they are more vulnerable to the tightening of capital flows induced by the controls.

Capital controls also affect significantly the distribution of income across entrepreneurs, and the worsened misallocation plays a key role. At the aggregate level, real wages and real profits fall -0.78% and -0.70%, respectively, but changes in income differ sharply within the various groups. The fall in w/p lowers labor income equally for everyone, but labor income is a smaller share of total income for firms of higher productivity, exporters or firms closer to their optimal scale, and changes in their capital income (i.e., profits) differ sharply. In particular, as shown in Table H.5 in Appendix H, profits fall less for firms with high v. low productivity (-0.02% v. -0.40%), and while they fall -0.74% for firms with large optimal scale gaps, they rise marginally for those with small ones. These distributional effects are also non-monotonic. Profits rise for the firms with the two lowest TFP levels, fall for firms with $z=3$ to $z=7$, and rise slightly for firms with $z \geq 8$.

To understand the above results, consider the effects of capital controls on a firm's profits that follow from these two conditions:

$$\frac{p^h(\tau,z)}{p} = \frac{\varsigma(r+\delta)^\alpha}{(1-\alpha)^{1-\alpha}\alpha^\alpha z}\left(\frac{w}{p}\right)^{1-\alpha}\left(\frac{MRPK(\tau,z)}{p(r^*+\delta)}\right)^\alpha \tag{34}$$

$$\frac{\pi(\tau,z)}{p} = \frac{y + e\frac{1}{\zeta^{\sigma-1}}\left(\frac{p^*}{p}\right)^\sigma y^*}{\left(\frac{p^h(\tau,z)}{p}\right)^{\sigma-1}}\left[1 - \frac{(1-\alpha)}{\varsigma}\right], \tag{35}$$

where $\pi/p \equiv [p^h y^h + p^f y^f - wn]/p$ are real profits. Condition (34) shows that a firm's relative price is a geometric weighted average of the real wage and the ratio of its MRPK relative to the efficient one (i.e., its misallocation), and condition (35) shows that a firm's profits are a decreasing function of its relative price.

For firms with the lowest z levels and/or young firms for which the misallocation effect of capital controls is small enough, the drop in w/p dominates, their relative prices drop and their profits rise. The general equilibrium effect reducing y pushes their profits in the opposite direction (see the numerator of eq. (35)), and the net result is the 0.40% drop in the capital income of the aggregate of low-z firms. In addition, since wage income is a larger fraction of their total income and w/p falls, it follows that the total income of these entrepreneurs also falls.

For firms with high z and/or middle-aged firms for which the misallocation effect is large enough, the higher misallocation dominates, their relative prices rise and their profits fall. Their profits are also negatively affected by the general-equilibrium drop in y, but this effect is smaller for high-z firms that are exporters than for nonexporters, and moreover the exporters' profits are propped up by the real depreciation induced by the drop in p, which explains the slight rise in profits for the highest productivity bins (the largest exporters).

5.3 Counterfactuals: tax rebates, LTV regulation & tighter capital controls.

We examine next three important counterfactual experiments: (1) rebates of the revenue of the debt tax; (2) LTV regulation (a cut in θ that yields the same drop in the credit-value added ratio as capital controls); and (3) tighter capital controls (a higher tax rate τ). Table H.6 in Appendix H provides the decomposition of partial and general equilibrium effects for the last two exercises.

5.3.1 Rebates of debt-tax revenue

The baseline results show that capital controls worsen misallocation, especially for exporters, high-productivity firms and firms that are far from their optimal scales. In contrast, we showed that a social planner removes all misallocation and equalizes MRPKs across entrepreneurs by moving all newborn firms to their socially-optimal scales. The planner also redistributes income to equate IMRS and allocate consumption proportionally across entrepreneurs of different ages, setting MRPK and IMRS proportional to each other. Since the other side of the misallocation caused by capital controls in the baseline results is an inefficient distribution of consumption and income, it is important to explore how the use of income-redistribution schemes could affect our results.

To explore this issue, we study the implications of alternative policies rebating the revenue from debt taxes. It is important to note, however, that as the review of existing practices in the use of capital controls provided in Appendix B shows, capital controls such as Chile's unremunerated reserve requirement and other commonly used instruments (e.g., quantitative restrictions, foreign exchange surrender requirements, multiple exchange rates) do not include rebates or other form of compensation for affected parties. Hence, the baseline results are more in line with these policies.

Tables 5 and 6 report the effects of four different rules for rebating debt-tax revenues on aggregate variables and misallocation, respectively. Since the tax is on the price of a discount bond, the tax paid by each firm is $\tau(1-\rho)pq^*q(\tau)d'(\nu,z)$ and total debt-tax revenue is $Rev = \sum_\nu \sum_z \tau(1-\rho)pq^*q(\tau)d'(\nu,z)\phi(\nu,z)$. Exercise TR1 simply adds lump-sum transfers returning to entrepreneurs the amount each paid in debt taxes. Exercises TR2-TR4 draw on the insight that a social planner moves all firms to their optimal scale at age $\nu = 1$, and hence use debt-tax rebates to provide larger capital transfers only to newborn firms. TR2 rebates debt-tax revenues generated by entrepreneurs of a given z of all ages as a larger capital transfer to newborns of the same z, that is, newborns of productivity z receive $\sum_\nu \tau(1-\rho)pq^*q(\tau)d'(\nu,z)\phi(\nu,z)$ as additional capital. TR3 distributes total debt-tax revenue as capital to newborn firms in the same proportions as the transfers they receive in a decentralization of a planner's problem with a binding aggregate credit constraint (DE^*). Newborns of a given z receive $\omega_n^{DE^*}(z)Rev$ as additional capital, where $\omega_n^{DE^*}(z) = TR_n^{DE^*}(z)/TR^{DE^*}$, $TR_n^{DE^*} = \sum_z TR_n^{DE^*}(z)\phi(0,z)$ and $TR_n^{DE^*}(z)$ are transfers to newborns of productivity z in the decentralized equilibrium.[33] TR4 rebates all the revenue to newborn firms of the productivity level with the largest mass in the age-productivity distribution, $z = 5$.

[33]To make this exercise comparable with the others, we solved the planner's problem setting $\hat{\beta} \approx \beta$. Since $\beta R^* = 1$, the planner's common MRPK is about the same as at the optimal scale of firms in the decentralized equilibrium $(r^* + \delta)$.

Table 5: Effects of Capital Controls on Aggregate Variables with Rebates.

	CC (GE) (1)	TR1 (2)	TR2 (3)	TR3 (4)	TR4 (5)
Exports	-1.10%	-0.34%	-1.73%	-1.93%	-2.30%
Share of exporters	-6.19%	3.22%	-8.92%	-8.08%	-8.08%
Domestic Sales	-0.91%	-0.50%	0.21%	0.14%	0.02%
Investment	-1.56%	-1.87%	-0.26%	-0.40%	-0.62%
Consumption	-0.67%	-0.31%	-0.09%	-0.15%	-0.22%
Real Profits	-0.70%	-0.38%	-0.39%	0.63%	2.19%
Final goods output	-0.82%	-0.58%	0.28%	0.21%	0.11%
Real GDP	-0.63%	-0.78%	0.07%	-0.01%	-0.11%
Real wage	-0.78%	-0.70%	-0.14%	-0.20%	-0.30%
Wage	-1.10%	-0.39%	-0.41%	-0.49%	-0.66%
Price level (Real ex. rate)	-0.32%	0.31%	-0.27%	-0.29%	-0.36%
Agg. credit/Value Added	$-5.90pp$	$-5.72pp$	$-5.96pp$	$-6.13pp$	$-6.27pp$

Note: Percent changes with respect to NCC regime. See the description in the text for the definitions of the rebates experiments TR1-TR4.

In exercise TR1, the rebates do not redistribute income directly by construction, since they return to each entrepreneur what they paid, but by altering misallocation they generate different distributions of income and consumption than without rebates. Comparing the effects of capital controls on aggregate variables and misallocation relative to the baseline without rebates (Cols. (1) and (2) of Tables 5 and 6), TR1 yields a clear trade-off: while the rebates mitigate the drops in final goods output and consumption and sharply weaken the adverse effects on exports and exporters, they also lead to larger drops in investment and exacerbate misallocation, particularly among firms that are more financially constrained (exporters and firms with high productivity or large OSG). The better outcomes for exports (a drop of -0.34% v. -1.10%) and the share of exporters (an increase of 3.22% v. a drop of -6.19%) occur because the rebates are particularly valuable to the highly-financially-dependent exporters, and because of the lower switching cost as w falls. The reduction in credit as a share of value added (5.72pp) is similar as without rebates.

Capital controls worsen misallocation more with TR1 rebates than in the CC baseline because they enlarge the mass of firms in the area where misallocation rises more with capital controls. Since TR1 rebates are only provided to firms with debt (i.e., firms in Regions 1 and 2) and they are larger for higher-productivity firms young enough to be in those regions, the borrowing constraints of firms in Region 1 are relaxed, allowing them to transition faster into the misallocation area in regions 2 and 3.[34] As a result, they experience larger misallocation effects from capital

[34]The rebates do not alter the static effects of capital controls, but the dynamic and general equilibrium effects change.

controls, and aggregate misallocation rises. Misallocation changes slightly for low-productivity firms ($z \leq 4$) and those with small OSG, which repay debt quickly and receive smaller rebates.

Table 6: Effects of Capital Controls on Misallocation with Rebates

	Model		Tax rebates		
	Baseline	TR1	TR2	TR3	TR4
	(1)	(2)	(3)	(4)	(5)
All firms	$0.53pp$	$0.74pp$	$0.22pp$	$-0.44pp$	$-1.46pp$
Exp. status					
Exporters	$1.30pp$	$1.47pp$	$0.43pp$	$0.82pp$	$1.33pp$
Non-exporters	$0.38pp$	$0.58pp$	$0.18pp$	$-0.68pp$	$-2.00pp$
OSG					
Large	$0.55pp$	$0.77pp$	$0.22pp$	$-0.47pp$	$-1.54pp$
Small	$0.24pp$	$0.24pp$	$0.23pp$	$0.14pp$	$0.17pp$
Productivity					
High	$0.72pp$	$0.81pp$	$-0.32pp$	$0.16pp$	$0.74pp$
Low	$0.55pp$	$0.54pp$	$0.48pp$	$-1.31pp$	$0.54pp$
1	$0.11pp$	$0.11pp$	$0.10pp$	$-0.27pp$	$0.10pp$
2	$0.20pp$	$0.20pp$	$0.18pp$	$-5.55pp$	$0.20pp$
3	$0.39pp$	$0.39pp$	$0.36pp$	$-2.62pp$	$0.38pp$
4	$0.57pp$	$0.56pp$	$0.49pp$	$-1.10pp$	$0.56pp$
5	$0.62pp$	$0.61pp$	$0.46pp$	$-0.46pp$	$-5.11pp$
6	$0.35pp$	$0.95pp$	$0.10pp$	$-0.29pp$	$0.31pp$
7	$0.73pp$	$0.82pp$	$-0.30pp$	$0.16pp$	$0.74pp$
8	$0.67pp$	$0.76pp$	$-0.42pp$	$0.14pp$	$0.67pp$
9	$0.65pp$	$0.73pp$	$-0.47pp$	$0.13pp$	$0.65pp$
10	$0.64pp$	$0.73pp$	$-0.48pp$	$0.13pp$	$0.64pp$

Note: See the description in the text for the definitions of the rebates experiments TR1-TR4.

Regarding experiments TR2-TR4, Cols. (3) to (5) of Table 5 show that, qualitatively, the three deliver similar changes in aggregate variables. In all cases, the real wage rate decreases by substantially less than in the baseline economy, because wealthier newborns demand higher consumption. This, together with the higher borrowing cost due to capital controls, delays the decision of firms to enter the foreign market and results in a lower share of exporters and a larger decline of exports than in the baseline CC regime without rebates (Col. (1)). As more productive firms remain non-exporters, domestic sales and final goods production increase.

Columns (3) to (5) of Table 6 show that, despite the relatively similar outcomes for aggregate variables, capital controls yield sharply different effects on misallocation under rules TR2-TR4, reflecting the allocative implications of each redistribution scheme. With TR2, newborn firms with higher productivity receive larger capital transfers than those with lower productivity, since firms with higher z of all ages need to carry more debt to reach higher optimal scales. The larger capital transfers allow entrepreneurs to begin their operations closer to their optimal scale, and thus the misallocation effect of capital controls is smaller than in the baseline CC regime (Col. (1)). This is true for aggregate misallocation as well as for all the firm groupings divided by exporter status, optimal scale gap and productivity. With TR2, capital controls actually *reduce* misallocation among high-productivity firms and firms with $z \geq 7$, contrary to increased misallocation without rebates, as these firms receive a larger share of debt-tax revenues.

TR3 distributes debt tax revenues more efficiently than TR1 and even TR2, in the sense that introducing capital controls now *reduces* aggregate misallocation (see Col. (4) of Table 6). This again reflects the re-distributional aspect of these transfers rule, now according to the planner's allocations of initial capital. Hence, TR3 assigns a greater share of debt-tax revenues as capital transfers to lower-productivity firms than under TR1 and TR2. Misallocation falls because the capital transfers represent a greater share of the optimal scale for these firms, enabling them to operate more efficiently. Indeed, newborn firms in the low-productivity group, in all productivity bins $z \leq 6$, with large OSG or non-exporters (which are low-productivity firms) all show lower misallocation when capital controls are introduced compared to the baseline.

Finally, rule TR4 rebates all debt-tax revenue to newborn firms with $z = 5$, which remain non-exporters in the long-run and thus have significantly lower optimal scales than firms with $z \geq 6$. Hence, the extra influx of capital brings them sufficiently close to their optimal scale and their misallocation falls $-5.11pp$ with capital controls. Firms of other productivities receive no rebates and yield about the same misallocation effects of capital controls as in the baseline case. However, since firms with $z = 5$ are relatively abundant (i.e., they have sizable mass in $\phi(\nu, z)$), their large reduction in misallocation leads to a drop in aggregate misallocation of $-1.46pp$.[35]

Illustrating the nature of the different redistribution arrangements under rules TR2-TR4, we see that while the three weaken the adverse effects of capital controls on misallocation, they distribute the effects across firms very differently. Using TR2, capital controls worsen misallocation more (less) than in the baseline for firms in the low-productivity (high-productivity) bins, but the opposite is true using TR3. TR4 barely changes results relative to the baseline for all firms

[35]Other rules providing rebates as capital to newborn firms of other z levels yield smaller reductions in misallocation. Rebates to newborn firms with $z \leq 4$ move those firms immediately to their optimal scales, since these scales are small, without spending all tax revenues. Misallocation is eliminated for these firms, but they are relatively few and close to their optimal scales so that their smaller misallocation is not large enough to significantly counteract the higher misallocation of others. Rebates to newborn firms with $z \geq 6$ result in small capital transfers compared to the firms' optimal scales, so the aggregate positive change in misallocation is lower than when rebates go to firms of lower z.

except those in the productivity bin receiving the rebates ($z = 5$), where capital controls reduce misallocation sharply. In all cases, including the baseline, capital controls have similarly distorting static effects (since they all share the same value of τ), but misallocation outcomes differ sharply because the distributive impact of the rebates alters the dynamic and general equilibrium effects.

It is important to note that misallocation under rules TR2-TR4 remains substantially worse than the constrained-efficient outcome. As explained earlier, the planner offsets individual collateral constraints by transferring capital to newborn firms so that they reach their optimal scales immediately after they are born and all firms have the same MRPK. Under the optimal mix of debt tax, profit subsidy and transfers, all the misallocation of the NCC regime ($mis^{NCC} = 0.19$ in our calibrated model) is removed, and hence the optimal policy mix, including optimal capital controls at rate τ, would reduce misallocation by $-19.1pp$, much more than under any of the rebates rules.[36]

5.3.2 LTV regulation

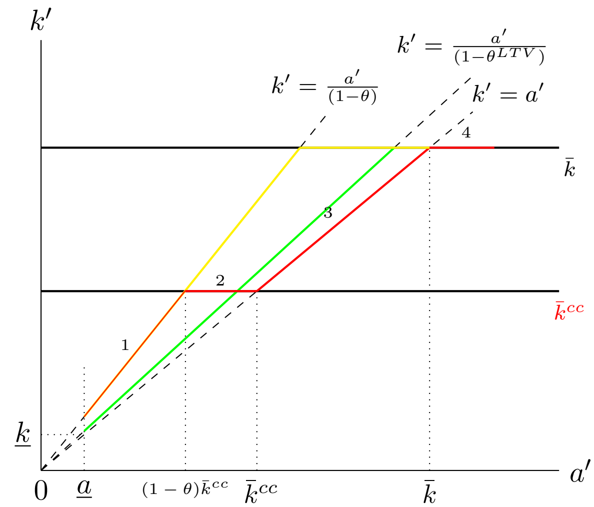
In this experiment, we examine the implications of reducing credit using loan-to-value regulation that lowers the fraction of capital pledgeable as collateral, instead of capital controls. We set $\tau = 0$ and reduce θ^{NE} to a value that reduces the credit-value added ratio by the same 5.9pp as in the CC regime, which requires $\theta^{LTV} = 0.0464$. Since θ_f is unchanged, θ^E is also reduced.

Figure 4 shows how the static effects of LTV regulation differ from those of capital controls. We add to Figure 1 a new ray that corresponds to the LTV regulation, $k' = \frac{a'}{1-\theta^{LTV}}$, flatter than the ray for the CC regime, $k' = \frac{a'}{1-\theta}$. The key result is that LTV regulation distributes more evenly the burden of the credit adjustment across firms, and hence it is also a policy that dampens the adverse effects of capital controls on misallocation and the distribution of income. Low-net-worth firms in Regions 1 and part of 2 borrow less due to the tighter borrowing constraints, and move to the flatter LTV ray. Firms with higher net worth in Region 2 and all firms in Region 3 borrow more. The value of θ^{LTV} is set such that the credit expansion of these firms offsets the reduction of the other firms to match the same aggregate credit drop of the CC regime. The misallocation area includes now firms in Region 1, but misallocation falls for firms in Region 3 and some in 2.

Column (3) of Table 3 shows that the aggregate effects of LTV regulation are weaker than those caused by capital controls: the real wage falls by only 0.55% (v. 0.78%), p is nearly unchanged (0.07% v. -0.32%), and output and consumption fall less (-0.28% and -0.10% v. -0.82% and -0.67%).

[36]The value of the optimal τ depends on how constrained is the social planner at its steady state, which in turn depends on the value of $\hat{\beta}$. With our calibration, the debt tax based on Chilean data of 1.75% is optimal if $\hat{\beta} = 0.944$ (keeping in mind that decentralizing the planner's equilibrium also requires the optimal subsidy on profits and transfers schedule).

Figure 4: Static Effects of LTV & Capital Controls
(second-stage optimal k' as a function of a')



Exports fall by a similar amount, but the share of exporters decreases much less (-1.43% v. -6.19%). Notably, capital and net profits at optimal scales rise more in the LTV regime, increasing by approximately 0.38% for non-exporters and 1.04% for exporters.

Column (2) of Table 4 shows that LTV regulation also worsens misallocation less than capital controls (by only 0.37pp instead of 0.53pp). Misallocation rises less for exporters, non-exporters, and firms with large and small optimal scale gaps. The breakdown by z reveals that misallocation increases less for firms with $z \leq 4$ but worsens for firms with $z \geq 7$, reflecting differential impacts across exporters and non-exporters. For exporters, the 1.07pp rise in misallocation is driven by the older cohorts of $z = 6$ firms that now become exporters, while younger, non-exporting cohorts experience reduced misallocation due to smaller optimal scale gaps.

In summary, these results suggest that LTV regulation is a superior tool for reducing credit. It results in smaller increases in both aggregate misallocation and misallocation across firm groups, while spreading the burden of credit reduction more evenly. However, high-productivity firms remain more constrained under LTV regulation, which increases their misallocation.

5.3.3 Tighter capital controls

Studying values of τ higher than the 1.75% calibrated to the 1990s Chilean *encaje* is important because estimates of average optimal debt taxes from the macroprudential policy literature are significantly higher, in the 3-to-12% range.[37] In this experiment, we increase the debt tax to $\tau = 6\%$.

Column (3) of Table 3 shows that the effects on aggregate variables worsen sharply. Output, investment, exports, the share of exporters, and real wages fall much more, and the price level rises 0.44% instead of falling -0.32%. In addition, the ratio of credit to value added falls by 32.7pp.

Column (4) of Table 4 shows a substantial increase in overall misallocation under tighter capital controls. The larger misallocation is observed across all firm categories, including exporters, non-exporters, firms with large optimal-scale gaps, and firms at all levels of z. The rationale behind these results follows again from Figure 1: As τ increases, $\bar{k}^{cc}(z)$ decreases, causing a contraction in Regions 1 and 2 that expands the misallocation area and thus worsens the static effects of capital controls. Moreover, the rise in p now triggers adverse general equilibrium effects (by increasing the opportunity cost of investment and making exports less competitive). The 2.15pp increase in aggregate misallocation including these effects is now larger than in partial equilibrium at 1.79pp (see Table H.6 in Appendix H).

6 Cross-Sectional Empirical Analysis

This Section provides empirical evidence showing that the Chilean *encaje* had effects consistent with the model's key predictions. In particular, misallocation increased more for more productive than less productive firms, exporters than non-exporters, and firms with larger than smaller optimal scale gaps. Moreover, the nonlinear effect indicating that misallocation changes relatively less with a firm's productivity for exporters than non-exporters is also present in the data.

6.1 Data

The variables needed for the empirical analysis are: a proxy for the capital controls, firm-level estimates of misallocation, and data to explore the relevant heterogeneity margins and to use as control variables. The empirical proxy for the Chilean *encaje* is constructed using the same debt-tax-equivalent methodology used for calibration, but applied year by year using actual annual values of the encaje rate and the international interest rate (see Appendix A). This results in a time-varying series of τ_t capturing the intensity of capital controls over time. This tax fluctuated around a peak of roughly 2.7% between 1994 and 1997 and averaged 1.98% over the eight years

[37] 3.6% in Bianchi and Mendoza (2018) using a model with land as collateral, 3% to 6% in Bianchi (2011) for different nontradable-GDP shares and borrowing coefficients, 5.1% in Bianchi et al. (2016) using a model with news shocks, 5% to 12% in Hernandez and Mendoza (2017) using a model with production and intermediate goods.

the policy was in place. The sharp and sudden increase in 1991 and removal in 1998 are crucial to identify the effects of capital controls.

We construct firm-level measures of capital and productivity using data from ENIA. Fixed capital (our proxy for k) is defined as the sum of a firm's vehicles, machinery, and buildings. For periods where capital data are missing but investment data are available, we impute the capital stock using the law of motion of capital. This approach assumes depreciation rates of 5%, 10%, and 20% for buildings, machinery, and vehicles, respectively, following Levinsohn and Petrin (2003). Nominal values are adjusted using the price of capital provided by ENIA. For the years 1990 to 1992, where no capital information is available, we impute all observations based on the same methodology. In cases where a firm has no capital data for any period, we apply the perpetual inventories method, which assumes that the capital stock is the cumulative sum of all past investments, adjusted for depreciation and price.[38]

We follow Wooldridge (2009) to measure productivity at the establishment level, deflating the relevant variables using 4-digit NAICS code deflators and the price of capital provided by ENIA.[39] Additionally, we use the wholesale price and fuel price indexes reported by the *Instituto Nacional de Estadística* (INE) to deflate electricity and fuel use, respectively. All firm-level variables used in the regressions are expressed in logs.

Misallocation is measured by first constructing MRPK estimates. Following Gopinath et al. (2017) and Hsieh and Klenow (2009), we combine the condition that defines MRPK in the model with the firm-level data. Rewriting condition (19), a firm's MRPK is:

$$MRPK = \frac{(\sigma - 1)}{\sigma}(p_h y_h + p_f y_f)\frac{\alpha}{k}. \tag{36}$$

Since in the model intermediate-good producers do not use intermediate goods themselves but in the data they do, our baseline specification proxies $(p_h y_h + p_f y_f)$ using the firm's value added, so the MRPK definitions in the model and the data are compatible. We also report results using total sales instead of value added to calculate MRPK and obtained similar results. Also in line with the previous section, misallocation for a firm i in industry j at date t is constructed as $mis_{ijt} = \mid log(MRPK_{ijt}) - log(\overline{MRPK_{jt}}) \mid$, with the yearly industry mean as a proxy for $\overline{MRPK_{jt}}$. We define industries at the 4-digit ISIC code.

[38] Since the capital deflator is unavailable prior to 1986, we exclude firms that only show data from this earlier period. We also conducted alternative tests using the consumer price index to deflate capital values so we could include these firms and obtained similar findings.

[39] The results are robust to computing TFP as in Levinsohn and Petrin (2003).

We also construct an empirical proxy for the optimal scale gap as the percentage gap between a firm's capital in period t and the average capital of firms older than 10 years in the same industry and year. Treating the latter as a proxy for the industry's steady-state firm size, OSG_{ijt} captures the firm's deviation from this benchmark.[40]

We use two complementary approaches to analyze the effects of capital controls on misallocation and assess the empirical relevance of the model's predictions. First, we compare the model's predicted changes in misallocation with those observed in the data, highlighting heterogeneity patterns across groups. Second, we estimate panel data regressions to test for the differential impact of capital controls on firms based on productivity, OSG, and export status.

6.2 Misallocation effects of capital controls in model & data

Columns (1b) and (2) of Table 4 compare the effects of capital controls on misallocation predicted by the model with their empirical counterparts. To compute the latter, we group firms based on observable characteristics and compare average misallocation across two time windows that correspond to the CC and NCC regimes.[41] Within each time window, we first compute the median misallocation for each group-year, and then average these medians across the years in the window. To define exporters, we use the firm's current export status. In line with the model assumption that firms are born with 34% of their steady-state capital, we restrict the sample to firms with $OSG_{i,j,t} \leq 66\%$. Moreover, as in the quantitative analysis, we define firms with low optimal scale gaps as those with $OSG_{i,j,t} \leq 5\%$. Finally, we classify firms as high or low productivity based on whether their productivity lies above or below the median of the distribution.

The empirical results aligm well with the model, producing somewhat larger estimates than the data but matching their qualitative ordering. For example, aggregate misallocation increases in both model and data, by 0.33pp in the data compared with 0.53pp in the model. Similarly, misallocation in the data increased more for exporters (0.47pp) than for non-exporters (0.22pp), in line with the ordering of the model estimates of 1.30pp and 0.38pp, respectively. Importantly, the data match the model's prediction that misallocation increases more sharply among high-productivity and high-OSG firms. In the data, misallocation rose 0.57pp for high-productivity firms compared to just 0.03pp for low-productivity firms. Likewise, high-OSG firms had a 0.38pp rise, while low-OSG firms only 0.25pp.

[40] Since OSG_{ijt} can be negative, we assign a value of zero in those cases.

[41] As noted earlier, we defined 1996–1998 as the period with capital controls, since capital controls were present from 1991 to 1998, and the years 1990–1991 and 2000–2003 as the period without capital controls.

6.3 Panel estimation results

The panel regressions study whether capital controls had differential effects on firm-level misallocation depending on the firms' TFP, optimal scale gap and exporter status. The main regression model is the following:

$$mis_{ijt} = \omega_1 CC_{t-1} * High\_TFP_{ijt} + \omega_2 CC_{t-1} * High\_OSG_{ijt} + \omega_3 CC_{t-1} * Exp_{ijt} + \omega_4 X_{ijt} + \omega_5 + A_i + B_t + \epsilon_{ijt}, \quad (37)$$

where CC_{t-1} denotes the tax-equivalent capital controls lagged by one period. $High\_TFP_{ijt}$ is a dummy equal to 1 for firms with TFP above the annual median. $High\_OSG_{ijt}$ is a dummy equal to 1 for firms in the top 25th percentile of the distribution of OSG in each year. We classify firms as exporters ($Exp_{ijt} = 1$) if they export in the current period.[42] While we used a threshold of $OSG_{i,j,t} \leq 5\%$ to define firms with a low optimal scale gap in the direct comparison of model and data results, we use a broader definition here to allow for sufficient variation for estimation (using the 5% cutoff would leave only 15% of firms in the high group and censor many observations at zero). X_{ijt} is a set of time-varying firm characteristics that includes the direct effect of TFP_{ijt}, OSG_{ijt} and Exp_{ijt}, as well as fixed capital and payroll. Table G.3 presents the summary statistics of all the variables included in the regression.[43] A_i is a vector of dummy variables at the firm level that account for fixed effects of the firm to control for time-invariant firm characteristics, and B_t is a vector of time dummy variables that account for unobservables at the aggregate level that could be correlated with CC_{t-1}, which could potentially bias the results. Note that these time fixed-effects absorb the direct effect of capital controls and the effect of any other aggregate time-varying change.[44] Although this strategy has the disadvantage of only allowing us to identify the heterogeneous effects at the firm level of capital controls, it also has the desirable feature of considerably reducing potential endogeneity problems due to omitted variables. Standard errors are clustered at the firm level.

Table 7 presents the regression results. Columns (1) to (3) show results for the full sample, while columns (4) to (6) show results for a balanced panel covering the period 1990-2003.

[42] The results are robust to using backward- and forward-looking definitions of exporters instead (see Appendix I).

[43] The only financial data available are interest expenditures, which are noisy and not significant in most regressions when normalized as $Int.Exp/FixedCapital_{ijt}$. The results remain robust if we include this variable.

[44] Hence, the empirical analysis and the quantitative experiments differ in that the former can only speak to firm-level effects of capital controls while the latter covers both firm-level and aggregate effects.

Consistent with the quantitative results, the key result in Col. (1) is that capital controls had a stronger effect on misallocation for firms with higher productivity, larger optimal scale gaps, and for exporters, compared to their counterparts. Specifically, if the direct effect of capital controls on misallocation was positive, misallocation increased more for these groups of firms.

Columns (2) and (3) of Table 7 examine whether the data support the non-linearity predicted by the model regarding the difference in misallocation effects as productivity varies between exporters and non-exporters. The regression results show that the impact of capital controls on misallocation increases more with productivity and optimal scale gaps for non-exporters compared to exporters. Moreover, for exporters, the interaction with optimal scale gap is not statistically significant, and the interaction with TFP is only marginally significant at the 10% level. These heterogeneous patterns are consistent with the effects found in Table 4 and highlight the different roles of productivity and OSG in driving misallocation depending on a firm's export status.

Table 7: Heterogeneous Effects of the Chilean *Encaje*: TFP, OSG and Export Status

VARIABLES	(1) All firms	(2) All firms Exporters	(3) All firms Non-Exporters	(4) Balanced Panel	(5) Balanced Panel Exporters	(6) Balanced Panel Non-Exporters
CC*High TFP	0.143***	0.057*	0.164***	0.167***	0.153***	0.176***
	(0.014)	(0.032)	(0.015)	(0.023)	(0.047)	(0.027)
CC*Exp	0.146***			0.129***		
	(0.018)			(0.028)		
CC*High OSG	0.040**	-0.047	0.096***	-0.003	-0.094*	0.048*
	(0.017)	(0.032)	(0.020)	(0.024)	(0.050)	(0.027)
High TFP	-0.776***	-0.804***	-0.767***	-0.716***	-0.787***	-0.711***
	(0.023)	(0.050)	(0.027)	(0.042)	(0.089)	(0.047)
Exporters	-0.242***			-0.272***		
	(0.031)			(0.055)		
Fixed Capital	0.265***	0.355***	0.253***	0.425***	0.580***	0.418***
	(0.016)	(0.037)	(0.018)	(0.033)	(0.069)	(0.035)
High OSG	-0.368***	-0.067	-0.501***	-0.176***	0.150	-0.297***
	(0.033)	(0.064)	(0.040)	(0.056)	(0.120)	(0.063)
Payroll	-0.349***	-0.336***	-0.346***	-0.318***	-0.281***	-0.344***
	(0.018)	(0.038)	(0.021)	(0.037)	(0.070)	(0.042)
Observations	90,055	17,694	71,514	22,192	5,420	16,635
R-squared	0.598	0.624	0.613	0.577	0.610	0.600
Firm FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Note: This table examines the interaction effects of capital controls with $High\_TFP$, $High\_OSG$, and Exp on misallocation, defined as the absolute value of the difference between the firm's MRPK and the industry average MRPK. Columns (1) to (3) assess the full sample of firms, differentiating between exporters and non-exporters in columns (2) and (3), respectively. Columns (4) to (6) analyze a balanced panel from 1990 to 2003, which is further split into exporters and non-exporters in columns (5) and (6). All regressions include firm- and time-fixed effects, with robust standard errors clustered at the firm level. The T statistics are provided in parentheses. The significance levels are indicated as ***, ** and *, corresponding to the levels 1%, 5%, and 10%, respectively.

Results from the balanced panel (columns 4 to 6) are qualitatively similar, suggesting that the findings are not driven by firm entry or exit. The main difference lies in the interaction between capital controls and $High\_OSG$: in the balanced panel, where firms age but no new firms enter, OSG tends to decline over time, weakening the impact of this variable. As a result, the coefficient on $CC \times High\_OSG$ for non-exporters loses significance (column 6) relative to the full sample (column 3). For exporters, the interaction turns negative and becomes significant at the 10% level. When aggregating across both groups, the overall interaction becomes insignificant (column 4). In contrast, the interaction with $High\_TFP$ strengthens and becomes more precisely estimated for exporters, with significance increasing from 10% to 1%.

To ensure that our results are not driven by the capital data imputation process we described, in Table 8 we also estimate our regressions for a subsample of firms where capital is imputed using only the law of motion of capital but not using the perpetual inventory method (columns 1 to 3) and for another subsample where no imputation at all is considered (columns 4 to 6). The results show that while these subsamples have fewer observations by construction, the results are consistent with those from our baseline case.

Table 8: Heterogeneous Effects of the Chilean *Encaje*:
Different Capital Imputation Methods

VARIABLES	(1) Capital Law Only	(2) Capital Law Only Exporters	(3) Capital Law Only Non-Exporters	(4) No imputation	(5) No imputation Exporters	(6) No imputation Non-Exporters
CC*High TFP	0.144***	0.057*	0.165***	0.148***	0.048	0.186***
	(0.014)	(0.032)	(0.015)	(0.021)	(0.040)	(0.025)
CC*Exp	0.146***			0.173***		
	(0.018)			(0.025)		
CC*High OSG	0.040**	-0.048	0.096***	0.046**	-0.047	0.117***
	(0.017)	(0.032)	(0.020)	(0.023)	(0.040)	(0.029)
Observations	89,553	17,627	71,101	37,856	10,760	26,557
R-squared	0.598	0.624	0.613	0.656	0.678	0.669
Firm FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES

Note: In Cols. (1)-(3), capital is imputed using the law of motion of capital without the perpetual inventories method. In Cols. (4)-(6), no imputation is applied. All regressions include firm- and time-fixed effects, with robust standard errors clustered at the firm level. T statistics are reported in parentheses. Significance levels denoted as ***, **, and *, correspond to 1%, 5%, and 10% levels, respectively.

In additional regressions reported in Appendix I, we show that the results are also robust to several important modifications: (i) using total sales instead of value added to measure misallocation; (ii) winsorizing the top and bottom 1% observations of our database with respect to alternative dimensions–i.e., dependent variable, controls, and sectors' productivity; (iii) excluding firms born around the Russian crisis; (iv) introducing alternative classifications of exporters, i.e., backward- and forward-looking; (v) considering a binary measure of capital controls; and (vi) introducing the interaction of alternative macroeconomic controls with our firms' characteristics.

7 Conclusions

This paper examines the effects of capital controls on aggregate variables and misallocation through the lens of a dynamic Melitz-OLG model with borrowing constraints. In the model, capital controls affect misallocation via three effects: *Static effects*, operating for given net worth and unchanged wages and price and output of final goods, worsen misallocation by creating a misallocation zone where a subset of firms have either costlier or more constrained access to credit. These firms reduce their capital-labor ratios and raise prices, thus increasing their MRPKs. *Dynamic effects* that depend on how saving incentives respond to changes in firm-specific marginal returns on saving (e.g., if net worth grows faster because returns are higher with capital controls, firms spend less time in the misallocation zone). *General equilibrium effects* that depend on changes in wages, and the price and output of final goods (e.g., a lower price reduces the opportunity cost of investment and causes a real depreciation that incentivizes exports). In contrast, a social planner who faces a binding credit constraint at the aggregate level removes all misallocation and distributes income and consumption optimally using a mix of transfers and taxes on debt and profits.

The static effects of capital controls differ from the standard effects of credit constraints in that they are non-monotonic in net worth: Firms with low net worth and firms with enough net worth to operate at their optimal scale are unaffected, but the effects grow large and then shrink for firms in between. This occurs because capital controls induce endogenous, non-monotonic size-dependence on how financial frictions distort the firms' decisions.

We evaluate the model's quantitative implications by comparing stationary equilibria with and without capital controls using the episode of the Chilean *encaje* (an unremunerated reserve requirement imposed between 1991 and 1998) as a natural experiment. The model predicts that aggregate misallocation worsens by about 0.53pp, with much larger effects on exporters (1.30pp) and firms with high productivity or large optimal scale gaps. Investment, exports, and the share of firms that are exporters also fall sharply. Profits, real wages, and the price and output of final goods also drop, inducing strong general equilibrium effects that mitigate significantly the effects of capital controls obtained in partial equilibrium. The pattern with which capital controls affects misallocation across the firms' age and productivity is in line with the non-monotonic pattern of the static effects, increasing first gradually and then rapidly as firms age and then falling gradually until they vanish as firms reach their optimal scale. Firms that become exporters as they transit to their optimal scale go through periods in which their misallocation falls sharply, because capital controls delay the date when they start exporting, and hence before that date the firms remain non-exporters under capital controls with lower misallocation than as exporters without them.

Counterfactual experiments with various rules to rebate the revenue generated by capital controls as debt taxes highlight the distributional implications behind our results. A simple rule rebating to each entrepreneur what they paid in taxes weakens the effects of capital controls on macro aggregates but yields larger misallocation effects, because it concentrates the rebates on credit-constrained firms that are marginally affected by capital controls, moving some of them to the misallocation zone. Alternative rules that provide rebates only to newborn firms perform better, and some can yield lower misallocation with capital controls. Another counterfactual experiment shows that LTV regulation designed to reduce credit as much as with capital controls has much weaker adverse effects on macro aggregates and misallocation. This is because LTV regulation distributes more evenly the burden of reducing credit across firms than under capital controls, assigning a larger share to credit-constrained firms and a smaller share to other firms. A third experiment shows that a higher debt tax rate set within the range predicted by the literature on macroprudential capital controls yields significantly larger misallocation effects.

We complement the quantitative analysis with a cross-sectional empirical analysis using a large dataset of Chilean firms to test the relevance of the quantitative findings. We find strong and robust statistical evidence indicating that, as the model predicts, the Chilean *encaje* increased misallocation more for more productive firms, for exporters and for firms with larger optimal scale gaps. The data also support the model's prediction indicating that the effect of capital controls on misallocation as productivity increases is markedly stronger for exporters than non-exporters.

Our findings have implications beyond capital controls. The model's theoretical predictions apply to the broader question of the effects of financial repression (i.e., gaps between borrowing and lending rates), capital income taxes and size-dependent industrial policies. The analysis also sheds light on the misallocation, trade and real-exchange-rate implications of financial openness.

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