Business Cycle Effects on Stock Market Listing and Managerial Efficiency

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Abstract
The importance of outside monitoring to mitigate managerial inefficiency due to agency costs has had a long history in the literature. By contrast, the aggregate implications of the decision to list on financial markets and establish the required monitoring has not been examined. This paper begins to fill this gap by analyzing the aggregate implications of equity listing decisions by managers. In our model, firm managers are heterogeneously skilled in production of differentiated goods, but operate inefficiently in the absence of outside monitoring. Listing ameliorates managerial inefficiencies, but implies that firms incur monitoring costs. The presence of the managerial inefficiency and monitoring costs reduces output available for consumption by households. Only managers whose productivity is sufficiently high choose to list, because the benefits of listing offset the costs. The model implies that equity finance is pro-cyclical: When the economy expands, more entrepreneurs list, and those who were already listing choose to sell more equity. The importance of outside monitoring in improving managerial efficiency in the aggregate economy depends upon the cross-sectional size distribution of firms, product substitutability, the level of underlying efficiency, and listing costs.

1 Introduction
Agency costs are an important source of managerial inefficiency and therefore firm profitability. This view has been developed in a large literature stemming from the early work of Jensen and Meckling (1976). This literature has demonstrated the pivotal role of corporate monitoring and governance to ensure the optimal level of profitability and, thereby, shareholder value.1 Recent US-based empirical studies have demonstrated the importance for firm profitability of corporate

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1For a survey, see Shleifer and Vishny (1997).
governance measures and, thereby, potentially entrenched managers.\textsuperscript{2} In international studies, researchers have found that the stocks of companies that list on foreign equity markets with more stringent disclosure requirements enjoy an increase in price, a finding that is often viewed as an outcome of committing to closer scrutiny.\textsuperscript{3} A common thread in this extensive research is the disciplining function on managers arising from outside ownership.

Despite the wealth of research on managerial inefficiency and firm profitability, relatively little research has considered the aggregate implications of these relationships. In this paper, we begin to fill this void. In our model, managers are heterogeneously skilled in production of differentiated goods, but operate inefficiently in the absence of outside monitoring. Managers have a choice: to be sole owners or to list their firm on a stock exchange. If they are the sole owners of their own firm, they avoid monitoring and can appropriate the entire profit from the company, but remain inefficient. However, if they choose to sell shares of their company on the equity market, they must pay the costs of undergoing monitoring, but they can commit to reduce their inefficiency. Managers endogenously fall into three categories. First, managers of low productivity firms do not list. These firms remain private property of the respective entrepreneurs because the costs associated with public ownership more than offset the private benefits to owners. Second, managers of sufficiently productive firms sell some equity, but they retain a significant ownership share. Finally, managers of high productivity firms sell the maximum amount of equity ownership.

We then study the aggregate implications of these listing and equity sales, finding three interesting implications. First, the model implies that equity finance is pro-cyclical, consistent with the empirical literature.\textsuperscript{4} Intuitively, as the aggregate economy becomes more productive, individual firms also become more productive. As a result, the benefit of issuing equity increases relative to the costs. More entrepreneurs choose to sell equity in their firms, and those who were already listed prior to the economy’s expansion choose to sell more equity. Second, we show that managerial inefficiency and monitoring costs generate a dead-weight loss on aggregate consumption, as it reduces dividend payments available for household spending. By contrast, listing and the associated monitoring has a pro-cyclical effect on profits of firms owned by households. As more firms are listed and undergo more market scrutiny, the decline in managerial inefficiency can more than offset the higher reporting costs required for monitoring. As a result, the dividends available for aggregate consumption increases on the margin. This result suggests a different relationship between financial development and growth than is often discussed in the literature.\textsuperscript{5} Third, since managers tend to choose more outside monitoring when the gains are particularly high, the effects of aggregate shocks on managerial inefficiency are dampened in cases when underlying distortions are highest. For example, when the underlying managerial inefficiency is high or when the listing costs are low, more firms choose to receive outside monitoring in steady state and thereby react less to aggregate shocks.

\textsuperscript{2}See, for example, Gompers, Ishii, and Metrick (2003) and Core, Guay, and Rusticus (2006).
\textsuperscript{3}See the survey in Karolyi (2006).
\textsuperscript{4}See for example Covas and Den Haan (forthcoming).
\textsuperscript{5}See for example Levine and Zervos (1998).
Our paper represents one of the few studies of the interaction between corporate monitoring and aggregate fluctuations. Phillipon (2006) examines the impact of aggregate shocks on firms with different levels of governance. For this purpose, Phillipon builds a model in which managers may over-invest in labor and capital and therefore create an inefficiency in output. Shareholders may monitor these managers at a cost. Badly governed firms are monitored less and are therefore more sensitive to aggregate shocks than well governed firms. The study uses a cross-section of empirical measures of corporate governance in firms over the business cycle and finds that the results corroborate the model. While this paper provides important insights into the role of corporate governance and the sensitivity of firms to aggregate shocks over the business cycles, it does not examine the managerial decision to list nor the macroeconomic implications of this decision. Another related paper is Covas and Den Haan (forthcoming) which considers the effects of the debt versus equity decision over the business cycle. However, it does not address the decision of whether to seek outside monitoring, the key decision in this paper.

The structure of the rest of the paper is as follows. Section 2 develops the listing decision of managers and shows that the group of listers versus non-listers depend upon an endogenous, firm-level productivity cut-off that varies with the aggregate economic cycle. In this section, we also develop the aggregate model. Section 3 completes the solution of the model and demonstrates additional macroeconomic implications of these corporate managerial decisions. Section 4 describes results from quantitatively evaluating the model. Concluding remarks follow in Section 5.

2 The Model

Several observations guide our analysis of managerial monitoring through financial market listing. First, the literature of stock market cross-listing has found that the equity price of a firm increases when listed in a market with more stringent disclosure requirements. Thus, while monitoring can take place through many channels, we choose to focus upon equity listing for the discussion below. However, many of the qualitative findings would continue to hold if the listing were in the form of other markets such as debt. Second, a common observation is that larger and more productive firms tend to be more likely to list on an exchange. Thus, our model should be able to reproduce this finding. Third, beginning with Jensen and Meckling (1976), the literature on managerial agency problems has focused upon the problem that managers may wish to divert resources away from profits. As a result, the firm profits available for shareholders is lower than the optimal efficient level.

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6 Studies that have looked at the effects of corporate governance on prices at listings include Doidge, Karolyi, and Stulz (2007) and Bailey, Karolyi, and Salva (2006).

7 For example, Stebunovs (2008) considers a model of bank debt in which banks effectively own equity in firms. Extending our model to this form of bank debt would generate similar results to those obtained in our equity-based model.

8 For evidence that firms tend to list when productivity is high, see for example Jain and Kini (1994), Pagano, Panneta & Zingales (1998), and Barh, Gulbrandsen & Schone (2005). Among other features, Chemmanur, He & Nandy (2007) find that listed firms tend to be larger.
To incorporate these three essential features into our analysis, we require a framework in which managers differ according to skill and, hence, productivity. Therefore, in our model we assume that managers have specific skills to produce a given variety of goods. The managers differ in their productivity and, hence, their firm’s size. The economy is populated by a unit mass of atomistic, identical households, who consume, supply labor, and hold shares in firms that are listed in the stock market, and a unit mass of monopolistically competitive manager-entrepreneurs. Each entrepreneur is also an equity holder in the firm that he/she manages. The firm produces a firm-specific good variety $\omega$. As inputs, the production process requires both labor and the unique managerial skill of the entrepreneur. The entrepreneur decides whether or not to share the ownership of the firm with households by selling shares in the stock market.\footnote{We assume that entrepreneurs have created their firms in the infinite past, and we abstract from endogenous firm entry to focus on the entrepreneurs’ decision whether or not to list firms in the stock market.} Entrepreneurs obtain income from their share of firm profits and selling firm shares (if they decide to do so). They use this income to finance consumption and, possibly, repurchases of shares in their firm. To highlight the roles played by managers and households, we assume that households can hold shares in all firms that are listed, but entrepreneurs cannot hold shares in firms other than their own.\footnote{Since some agents in the economy will have access to the equity market while others do not, our paper shares some similarities to the limited participation literature as in Alvarez, Atkeson, and Kehoe (2002, 2008) and Cole, Chien, and Lustig (2008).}

2.1 Households

Households differ from managers in that they supply labor and hold the equity in the economy. In particular, the representative household supplies $L$ units of labor inelastically in each period and maximizes $E_t \sum_{s=t}^{\infty} \beta^{s-t} U(C_t)$, where the period utility from consumption, $U(C_t)$ has the standard properties and $\beta \in (0, 1)$. We restrict utility to $U(C_t) = C_t^{1-\gamma}/(1-\gamma)$, $\gamma > 0$, where convenient below.

To allow for heterogeneity in production by managers, we assume the consumption basket $C_t$ in the utility function is a standard Dixit-Stiglitz aggregator of available varieties with elasticity of substitution $\theta > 1$:

$$C_t = \left( \int_0^1 c_t(\omega)^{\frac{\theta-1}{\theta}} d\omega \right)^{\frac{\theta}{\theta-1}}. \quad (1)$$

The household enters period $t$ with holdings $x_t(\omega)$ of shares in firm $\omega$ (where $x_t(\omega) \equiv 0$ if firm $\omega$ did not list in period $t-1$), receives its share of firm profits and the value of selling this equity position, and it receives labor income. The household then uses these resources to finance consumption and purchases of shares to be carried into period $t+1$. The household’s budget constraint is:

$$\int_0^1 (\pi_t(\omega) + v_t(\omega)) x_t(\omega) d\omega + w_t L \geq C_t + \int_0^1 v_t(\omega) x_{t+1}(\omega) d\omega, \quad (2)$$

where $\pi_t(\omega)$ denotes firm $\omega$’s time-$t$ profits, $v_t(\omega)$ is the share price, and $w_t$ is the real wage, all
in units of the consumption basket.\textsuperscript{11} Intertemporal optimization results in an Euler equation for holdings of shares in firms that list:

\begin{equation}
 v_t(\omega) = \beta E_t \left[ \frac{U''(C_{t+1})}{U'(C_t)} \left( \pi_{t+1}(\omega) + v_{t+1}(\omega) \right) \right].
\end{equation}

As is standard with Dixit-Stiglitz preferences, consumption is allocated to individual good varieties according to: \( c_t(\omega) = \rho_t(\omega)^{-\theta} C_t \), where \( \rho_t(\omega) \) is the price of good \( \omega \) in units of consumption.

\subsection*{2.2 Managers and Firms}

To focus on the efficiency problem, we assume a simple role for the manager. Manager-entrepreneurs are born with an innate ability to produce a good of a given variety. The good cannot be produced without the manager and the manager consumes only his share of profits from the firm.\textsuperscript{12} As in Melitz (2003) and Ghironi and Melitz (2005), we assume that a firm producing variety \( \omega \), is associated with a firm-specific productivity \( z \), and hereafter we replace variety with productivity. This productivity is drawn from a continuous distribution \( G(z) \) with support \([z_{\min}, \infty)\). Output is produced with linear technology \( y_t(\omega) = Z_t z l_t(\omega) \), where \( l_t(\omega) \) is the amount of labor employed by the firm and where \( Z_t \) is a stochastic process generating aggregate productivity. In our quantitative model in Section 4, we assume that \( Z_t \) follows an AR(1) process in logs.

Although entrepreneurs have a different role in production, they consume the same bundle of products as the households given in equation (1). That is, entrepreneurs have the same period utility function as households so that they consume the same Dixit-Stiglitz aggregator of all goods as for households. We define the aggregate consumption bundle for entrepreneur \( z \) as \( C_t(z) \).

Managers depend upon the profit from their own firm and this profit in turn depends upon the efficiency of the managers relative to the natural profit of the variety produced. Given the preferences, the firm faces demand \( y_t^D(z) = \rho_t(z)^{-\theta} Y_t^A \), where \( Y_t^A \) is the economy’s total absorption of consumption output. Since labor is the only production input besides the entrepreneurs presence, "natural profits" are given by:

\begin{equation}
 \pi_t^V(z) \equiv \rho_t(z) y_t(z) - w_t l_t(z) = \frac{1}{\theta} \rho_t(z)^{1-\theta} Y_t^A.
\end{equation}

The first expression simply says that profits are revenues minus labor costs. The expression to the right of the second equal sign follows assuming Dixit-Stiglitz preferences.

While \( \pi_t^V(z) \) are the profits that would accrue to a firm with productivity \( z \) in a standard economy, the possibility that managers will divert profits from shareholders generates a distortion to available profits. To characterize this inefficiency, we assume there is a portion of natural profits that are diverted from pay-outs to shareholders. In principle, this diverted profit could be

\textsuperscript{11}We assume below that an individual firm’s profits depend on its ownership structure.

\textsuperscript{12}Many of our main conclusions below will continue to hold if we assume managers can also hold equity of other firms, but the classification of "household consumption" in our calibrated results require re-interpretation. See the discussion in Section 4 below.
consumed directly by managers. Alternatively, this profit could represent expenditures within the company that are inessential for efficient production (e.g., designer carpeting, company vacations). Below, we do not take a stand on the nature of the inefficiency; but take a reduced form approach to incorporate these standard stories.

To consider these effects, we follow related literature on agency costs by assuming that diverted profits are proportional to natural profits. For example, Phillipon (2006) assumes that managerial inefficiency is proportional to the production from labor and capital inputs. Albuquerque and Wang (2008) assume that a controlling shareholder may "steal" a proportion of firm output per period.13 In our model, we define the proportion distortion from managerial inefficiency as $\tau$. That is, $\tau$ represents the proportion of natural profits that are available to household after potential diversion by managers: $\tau \pi^V_t (z)$.

On the other hand, managers can choose to list their equity, be monitored by outside shareholders, and thereby mitigate their temptation to divert profits. To characterize the gain in efficiency of outside monitoring, we posit that the proportion $\tau$ of natural profits is a function of shares sold by managers to outsiders. Specifically, defining the shares of stocks sold by the manager of firm $z$ as $x_{t+1} (z)$, we define the share of natural profits available for dividends as a function $\tau (x_{t+1} (z))$. This function is continuous on $x_{t+1} (z) \in (0, 1)$ and monotonically increasing to capture the improvement in entrepreneurial/managerial efficiency from listing. That is, in order for listing to provide efficiency benefits, we require that the firm become more efficient with listing; i.e., $\tau' (x_{t+1} (z)) > 0$, $\tau'' (x_{t+1} (z)) < 0$. When entrepreneurs do not list, this proportion reaches a lower bound: $\tau (0) = \overline{\tau} \in (0, 1)$, and when entrepreneurs list their entire firm, $\tau (1) = 1$.

So far, we have described the benefits of listing. However, outside monitoring also comes at a cost which we term "reporting costs." For example, to list on a US stock exchange, firms must abide by SEC regulations and provide annual reports to shareholders. In our calibrations below, we treat the reporting costs as representing these more overt costs. Though not modeled explicitly, these costs can also represent the more subtle loss to the manager of giving up the ability to divert profits. To capture these costs associated with selling equity we define a function $f (x_{t+1} (z))$ that depends upon equity shares sold, $x_{t+1} (z)$. We assume that the function $f (x_{t+1} (z))$ is increasing in the number of shares sold, $f' (x_{t+1} (z)) > 0$ consistent with the idea that there are losses due to increased ownership. Similar to the profit distortion proportion $\tau$, we assume that the reporting cost function is monotone such that: $f (0) = 0$, $f (1) = f > 0$. The firm incurs no reporting cost if it sells no equity. It incurs reporting cost $f$ if it is completely owned by the public, and the reporting cost increases monotonically with the amount of equity sold. This assumption captures the idea that the more public the firm, the more stringent the information requirements it must satisfy and the higher the associated costs.

Combining the profit distortion proportion function and the listing costs, the profits available

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13 In turn, these authors build on the "stealing" technology described in Johnson, Boone, Breach, and Friedman (2000) and La Porta, Lopez-de-Silanes, Schleifer, and Vishny (2002).
to shareholders can be written:

$$\pi_t (x_{t+1} (z); z) \equiv \tau (x_{t+1} (z)) \pi^V_t (z) - f (x_{t+1} (z))$$  \hspace{1cm} (5)$$

As this equation shows, listing has two opposing effects on actual profits. First, listing more equity means increasing the proportion of natural profits manifested in actual profits through \(\tau (x_{t+1} (z))\), but more equity shares also means increasing the costs through \(f (x_{t+1} (z))\). We next describe the manager’s listing decision based upon this trade-off.

### 2.3 The Entrepreneur’s Listing and Equity Sale Problem

Every period \(t\), the original owner of the firm – entrepreneur \(z\) – makes a two-stage decision. In stage 1, he enters the period and observes the aggregate productivity shock, \(Z_t\). Based upon this information, he can infer his output demand, and, hence, his natural potential profits, \(\pi^V_t (z)\). Given this information, he decides whether to list and, if so, how much equity to issue. Based upon this decision, he earns profits according to equation (5) and pays out profits to existing shareholders as well as wages. In stage 2, the equity market opens and households decide how much to purchase of any newly issued stocks and how much to consume. At this stage, the manager sets the stock price so that households are willing to buy the newly issued shares. We next describe these two stages in more detail.

#### 2.3.1 Stage 1 Problem

As described above, a firm’s profit depend on the firm’s ownership structure. Time-\(t\) profits depend on whether or not the firm is listed in period \(t\), and on the amount of shares that are sold in that period, \(x_{t+1} (z)\). The manager recognizes the trade-offs between efficiency and costs and decides each period whether to list. Therefore, he decides on how much equity to sell by solving the following maximization problem:

$$\max_{x_{t+1}(z)} \pi_t (x_{t+1} (z); z),$$  \hspace{1cm} (6)$$

We assume that the entrepreneur never fully relinquishes the ownership of the firm, and we constrain \(x_{t+1} (z)\) to be in the interval \([0, \bar{x}]\), \(\bar{x} < 1\). We maintain this assumption for two reasons. First, as an empirical matter, entrepreneurs tend to hold at least some shares in their own firms, even after they go public. Second, for the purpose of our model, managers have an innate ability to produce their own goods and therefore they continue to make decisions about equity listings.\(^{14}\) The first-order condition for problem (6) thus implies:

$$\tau^f (x_{t+1} (z)) \pi^V_t (z) = f^f (x_{t+1} (z)).$$  \hspace{1cm} (7)$$

\(^{14}\)In our quantitative analysis below, we take \(\bar{x}\) to be arbitrarily close to one, an assumption that is consistent with most large non-financial firms in the United States.
The entrepreneur chooses to sell the amount of equity such that the marginal benefit of selling an additional unit of equity is equal to the marginal cost. Note that \( \pi^V_t(z) \) acts as a scaling factor for the marginal benefit of listing and selling equity.

Figure 1 illustrates the solution to this problem. Because of our assumptions on the function \( \tau(x_{t+1}(z)) \), the marginal benefit schedule \( MB(x_{t+1}(z)) = \tau'(x_{t+1}(z)) \pi^V_t(z) \) is a decreasing function of \( x_{t+1}(z) \). For ease of illustration, we assume that \( \tau'(x_{t+1}(z)) \) is linear over the relevant range of values of \( x_{t+1}(z) \). Similarly, for analytical convenience, we assume that listing costs are proportional to shares, given by the linear specification: \( f(x_{t+1}(z)) = \bar{T} x_{t+1}(z) \) where \( \bar{T} > 0 \). In this case, the marginal cost schedule is fixed at \( MC(x_{t+1}(z)) = \bar{T} \). Thus, the intersection of \( MB(z_h) \) for given firm \( z_h \) and \( \bar{T} \) determines the choice of listing at \( x_{t+1}(z_h) \) for this manager.

Figure 1 also depicts the solution for managers with other productivity levels. A lower productivity firm is shown with \( MB(z_l) \). For this manager, the benefits of listing are lower than the reporting costs.\(^{15} \) In this case, the firm decides not to list, i.e., \( x_{t+1}(z_l) = 0 \). As \( z \) increases, \( \pi^V_t(z) \) increases, shifting the \( MB \) schedule upward.\(^{16} \) The figure shows that there is a cutoff level of \( z \), denoted \( z^{list}_l \), such that \( \tau'(x_{t+1}(z^{list}_l)) \pi^V_t(z^{list}_l) = \bar{T} \) at \( x_{t+1}(z^{list}_l) = 0 \). This cutoff productivity defines the identity of the marginal non-lister. All firms with productivity \( z > z^{list}_l \) will list and sell a positive amount of equity to be held by the public in period \( t+1 \), determined by the intersection of the marginal benefit and marginal cost schedules. For instance, in Figure 1, the firm with productivity \( z_h > z^{list}_l \) sells the amount of equity \( x_{t+1}(z_h) \).

For firms with increasingly higher \( z \), the amount of equity sold also increases until it approaches the upper bound \( \bar{x} \). Therefore, the model implies a second cutoff firm-specific productivity level \( \bar{z}_l \) such that all firms with productivity \( z \geq \bar{z}_l \) list and sell the proportion \( \bar{x} \) of equity. Note that the listing cutoff productivity \( z^{list}_l \) and the upper bound cutoff \( \bar{z}_l \) are time-varying, since they are affected by cyclical conditions that contribute to determine the level of natural variable profits \( \pi^V_t(z) \).

A convenient functional form for the function \( \tau(x_{t+1}(z)) \) that is consistent with the requirements above and delivers the implications discussed in Figure 1 is:

\[
\tau(x_{t+1}(z)) = \tau + x_{t+1}(z) - \tau x_{t+1}(z)^2, \quad 0 < \tau < \frac{1}{2}.
\]

(8)

The marginal benefit schedule is then:

\[
MB(x_{t+1}(z)) = (1 - 2\tau x_{t+1}(z)) \pi^V_t(z).
\]

(9)

As depicted in Figure 1, increasing \( z \) shifts the schedule upwards and makes it steeper.

Solving for the productivity that implies marginal benefit equals marginal cost as in equation (7) using the MB form in equation (9) and the form for reporting costs, we obtain the listing cut-off.

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\(^{15}\) Thus, for Figure 1, we implicitly assume that the lower-bound firm productivity \( z_{min} \) is low enough to ensure \( MB(z_{min}) < \bar{T} \). We describe this constraint in more detail in the quantitative section below.

\(^{16}\) As illustrated in Figure 1, the marginal benefit curve also becomes steeper as productivity increases. While not necessary in general, the particular functional form we use below implies the curve steepens with \( z \).
Similarly, using the MB and reporting costs function, and solving the first-order condition equation (7) for the \( z \) that implies optimal shares are just equal to the upper bound, \( x_{t+1} = \bar{x} \), gives the upper-bound cut-off.

\[
\bar{z}_t = \frac{\theta}{\theta - 1} \left( \frac{\bar{x} + \theta \bar{F}}{Y_t^A} \right)^{\frac{1}{\pi - 1}}.
\]

(11)

The cutoff productivities for listing or selling the maximum allowed amount of equity are lower the higher aggregate output absorption \( Y_t^A \) and productivity \( Z_t \) (for given real wage). Intuitively, increases in demand or lower unit production costs boost natural variable profits, making it relatively more attractive to sell equity. Also, the effects of increasing or lowering the marginal cost of selling equity are straightforward. Since \( \theta > 1 \), a higher cost of listing \( \bar{F} \) requires a higher profit benefit to offset and therefore will increases both the listing cut-off \( \bar{z}^{list}_t \) and the maximum cut-off \( \bar{z}_t \). We return to these results below.

At this first stage decision, it is clear that our model delivers several plausible implications. First, low productivity firms do not list. They remain private property of the respective entrepreneurs because the costs associated with public ownership more than offset the benefits. Second, sufficiently productive firms list and sell a proportion of the firm determined by equating the marginal benefits and marginal costs of listing. Third, high productivity firms sell the maximum amount of equity allowed by the model requirement that the entrepreneur retain an ownership stake in the firm.

Figure 1 illustrates the effects of the heterogeneity of firms on the manager’s decision to sell equity for a given level of aggregate productivity \( Z_t \). More generally, however, the position of the marginal benefit schedule \( MB(x_{t+1}(z)) = \pi'(x_{t+1}(z)) \pi^V_t(z) \) is also affected by the other determinants of natural variable profits \( \pi^V_t(z) \). For instance, suppose there is an increase in aggregate absorption, \( Y_t^A \), or in aggregate productivity, \( Z_t \) for given real wage \( w_t \). Both these changes shift the marginal benefit schedule upward and make it steeper for any given firm \( z \). This increase induces some firms that were not listing prior to the change in aggregate demand or productivity to start listing and selling positive amounts of equity. In other words, consistent with the discussion above, the cutoff productivity for listing decreases. Higher aggregate demand or productivity induces firms that were already listing to sell more equity, inducing some of these firms to sell the maximum amount \( \bar{x} \) since the cutoff \( \bar{z}_t \) decreases. However, there will be little additional equity sale for firms that were already near \( \bar{x} \) before the expansion of the economy, and zero additional equity sale for the firms that were already selling \( \bar{x} \). These results are consistent with the evidence documented in Covas and den Haan (forthcoming) that equity sales are procyclical, but less so for the largest firms.\(^{17}\)

\(^{17}\)In Figure 2, marginal benefit schedules before (after) the expansion of the economy are denoted with a subscript 0 (1).
Figure 2 illustrates these cyclical properties of listing and equity sales generated by increases in $Z_t$ to $Z_{t+1}$. First consider the decision by manager with productivity $z_h$. If aggregate productivity increases, then the natural profits will be higher implying a shift in the marginal benefit schedule to the right. As a result, this manager will issue more shares of equity from $x_t(z_h)$ to $x_{t+1}(z_h)$. Similarly, for managers such as $z_l$ who were previously unlisted, the increase in listing benefits from $MB_t(z_l)$ to $MB_{t+1}(z_l)$ generate a decision for the firm to list at $x_{t+1}(z_l)$. Finally, some firms with a high productivity, such as $z_{hh}$ now list the maximum amount of shares possible.

2.4 Stage 2 Problem

In stage 2, the entrepreneur, having decided whether to list and how much equity to sell, decides at what price to offer this equity. We denote the price set by the entrepreneur at time $t$ for the amount of equity $x_{t+1}(z)$ with $v_t(z)$.

In period $t$, the entrepreneur receives income in two components coming from dividends on retained shares and sales of equity:

$$(1 - x_t(z)) \pi_t(x_{t+1}(z); z) + v_t(z)x_{t+1}(z).$$

In other words, the entrepreneur receives his share of period-$t$ profits $(1 - x_t(z)) \pi_t(x_{t+1}(z); z)$, where $1 - x_t(z)$ is the share of equity that the entrepreneur kept as his own in period $t - 1$, and the value of selling the listed shares, $x_{t+1}(z)$ equal to $v_t(z)x_{t+1}(z)$. The entrepreneur uses this income to finance consumption and buy back the equity he had sold in period $t - 1$. This yields the budget constraint

$$(1 - x_t(z)) \pi_t(x_{t+1}(z); z) + v_t(z)x_{t+1}(z) \geq C_t(z) + v_t(z)x_t(z), \tag{12}$$

where $C_t(z)$ denotes the entrepreneur’s consumption of the consumption basket. Note that the entrepreneur budget constraint (12) nests all the possible scenarios of current and past listing decisions: For an entrepreneur who had not listed in period $t - 1$ and does not list in period $t$, equation (12) reduces to $\pi_t(0; z) \geq C_t(z)$. For an entrepreneur who had not listed in period $t - 1$ and chose to list in period $t$, $\pi_t(x_{t+1}(z); z) + v_t(z)x_{t+1}(z) \geq C_t(z)$. For an entrepreneur who had listed in $t - 1$ and decided to de-list in the current period, $(1 - x_t(z)) \pi_t(0; z) \geq C_t(z) + v_t(z)x_t(z)$. Finally, equation (12) with $x_t(z)$ and $x_{t+1}(z)$ different from zero applies to entrepreneurs who had listed in $t - 1$ and chose to continue listing in $t$.

The entrepreneur $z$ who engages in equity transactions sets the desired price for his firm’s equity at a price that will induce households to purchase his shares in equilibrium. Thus he sets the equity price as given by the Euler equation (3). Using the form of profits available for shareholders in equation (5), the household’s budget constraint in equation (2) can be re-cast by aggregating over
firm-specific productivities to yield:

\[ \int_{z_{\text{min}}}^{\infty} (\pi_t (x_{t+1} (z) ; z) + v_t (z)) x_t (z) \, dG (z) + \int_{z_{\text{min}}}^{\infty} v_t (z) x_{t+1} (z) \, dG (z). \quad (13) \]

The Euler equation for the representative household’s holding of equity in firm \( z \) can then be rewritten in terms of listings decisions as:

\[ v_t (z) = \beta E_t \left[ \frac{U' (C_{t+1})}{U' (C_t)} \left( \pi_{t+1} (x_{t+2} (z) ; z) + v_{t+1} (z) \right) \right]. \quad (14) \]

Thus, equity prices will depend upon aggregate fluctuations for two reasons. First, an increase in output increases natural profits as through the usual channel. Second, an increase in output induces more outside monitoring leading to more profits available for shareholders. This second channel is a novel outcome of our framework with managerial inefficiency.

### 2.5 Labor Market Equilibrium and Aggregate Output

To focus on the distortion to consumption by managerial inefficiency, we otherwise leave the production effects unchanged. Thus, we keep the economy on its production possibilities frontier and assume the labor market is undistorted. As in the Melitz (2003) model, the production function of individual firm \( z \) is linear in labor employed \( l_t (z) \). Thus, the output of firm \( z \) is: \( y_t (z) = Z_t z l_t (z) \). Recalling that the price of good \( z \) is given by \( \rho_t (z) \), aggregating of the output across firms gives total output or GDP as:

\[ Y_t = \int_{z_{\text{min}}}^{\infty} \rho_t (z) y_t (z) \, dG (z) = \int_{z_{\text{min}}}^{\infty} \rho_t (z) Z_t z l_t (z) \, dG (z) \quad (15) \]

Further, optimal price setting by the firm yields:

\[ \rho_t (z) = \frac{\theta}{\theta - 1} \frac{w_t}{Z_t z}. \quad (16) \]

Substituting (16) into (15) implies that output can be written in terms of the wage rate and aggregate labor employed:

\[ Y_t = \frac{\theta}{\theta - 1} w_t \int_{z_{\text{min}}}^{\infty} l_t (z) \, dG (z). \quad (17) \]

To determine the labor demand, we equate the output demand by firm, \( y_t^D (z) = \rho_t (z)^{-\theta} Y_t^A \), to the production function by firm \( y_t (z) = Z_t z l_t (z) \). We then use the requirement that total output production must be equal to absorption in equilibrium \( (Y_t = Y_t^A) \) and substitute the result into equation (17). Using the definition of the average productivity

\[ \bar{z} \equiv \left( \int_{z_{\text{min}}}^{\infty} z^{\theta - 1} \, dz \right)^{\frac{1}{\theta - 1}}. \quad (18) \]
the output equation can be rewritten in terms of the equilibrium wage rate as:

\[ w_t = \frac{\theta - 1}{\theta} Z_t \tilde{z} \]  

(19)

Intuitively, monopoly power results in the fact that labor is paid a fraction \((\theta - 1)/\theta < 1\) of its overall productivity. Note that labor market clearing also implies \(L = \int_{z_{\min}}^{\infty} l_t(z) \, dG(z)\). Hence, total labor income in the economy is such that \(w_tL = (\theta - 1)Y_t/\theta\).

### 2.6 Aggregate Accounting

Given the labor market equilibrium and the budget constraints of the households and managers, we can now combine these relationships to derive the aggregate constraints of the economy. We begin by aggregating the entrepreneurial budget constraint in eqn (12) across firms to get:

\[
\int_{z_{\min}}^{\infty} (1 - x_t(z)) \pi_t(x_{t+1}(z); z) \, dG(z) + \int_{z_{\min}}^{\infty} v_t(z) x_{t+1}(z) \, dG(z) \\
= \int_{z_{\min}}^{\infty} C_t(z) \, dG(z) + \int_{z_{\min}}^{\infty} v_t(z) x_t(z) \, dG(z). 
\]

Next, we sum this aggregated constraint for managers to the aggregate household budget constraint in eqn (13) to obtain the aggregate resource constraint of the economy:

\[
\int_{z_{\min}}^{\infty} \pi_t(x_{t+1}(z); z) \, dG(z) + w_t L_t = \int_{z_{\min}}^{\infty} C_t(z) \, dG(z) + C_t. 
\]

(20)

The left-hand side of this equation is the economy’s total income: the sum of profit income, retained by entrepreneurs or distributed to shareholders, and labor income. Aggregate accounting requires total income to be equal to total consumption spending by entrepreneurs and households.

For notational convenience, we define aggregate entrepreneurial consumption as \(\tilde{C}_t = \int_{z_{\min}}^{\infty} C_t(z) \, dG(z)\).

Note that this variable combines consumption by entrepreneurs who list and those who do not. Therefore, aggregate entrepreneurial consumption can be decomposed at any point in time as:

\[
\tilde{C}_t = \int_{z_{\min}}^{\tilde{z}_{\text{list}}} C_t(z) \, dG(z) + \int_{z_{\min}}^{\infty} C_t(z) \, dG(z). 
\]

(21)

While managers and households consume aggregate profits, these profits are distorted by both managerial inefficiency and by reporting costs. Therefore, we can further decompose the aggregate resource constraint by aggregating these two distortions across firms.

As we have noted above, the managerial inefficiency by firm is given by \(1 - \tau(x_{t+1}(z))\) multiplied by the natural profit of firm \(z\), given by \(\pi_t^{\text{f}}(z)\). Using the solution for natural profits and aggregating across firms implies that the aggregate inefficiency is:
Similarly, if a firm lists profits available for consumption \( \pi_t(z) \) are lower than natural profits by the reporting costs. Aggregating these reporting costs across firms gives the GDP component of reporting as:

\[
\tilde{f}_t = \int_{z_{\text{min}}}^{\infty} f(x_{t+1}(z)) dG(z) = \int_{z_{\text{list}}}^{\infty} f(x_{t+1}(z)) dG(z).
\]  

(23)

Then decomposing profits into the natural profits and the deadweight loss from inefficiency in equation (22), and the cost of reporting in equation (23), and using aggregate profits and labor market equilibrium, we can rewrite equation (20) as\(^{18}\):

\[
Y_t = \tilde{C}_t + C_t + \tilde{\tau}_t + \tilde{f}_t = Y_t^A.
\]  

(24)

Equation (24) states that there are four sources of output absorption in our model economy: entrepreneurial consumption, household consumption, and two sources of distortions away from natural profits. The first distortion captured by \( \tilde{\tau}_t \) arises because profits available for consumption are below natural profits. And the second distortion captured by \( \tilde{f}_t \) derives from the monitoring cost for all listing firms \( f_R(x_{t+1}(z)) \). The expressions for \( \tilde{\tau}_t \) and \( \tilde{f}_t \) define the aggregated resources diverted due to profit inefficiency and monitoring costs, respectively. Absent inefficiencies in firm management (\( \tau(x_{t+1}(z)) = 0 \)) and monitoring costs (\( f(x_{t+1}(z)) = 0 \)), all output would be available for consumption by households and entrepreneurs.

3 Assessing the Impact of Listing on Managerial Inefficiencies

We have developed the basic framework for analyzing the impact of listing on managerial waste above. In this section, we present the analytical solution of our model. We begin by solving for the steady state where aggregate productivity and the state variables are constant and then study the dynamics around this steady state.

3.1 The Steady State

In the steady state, aggregate productivity \( Z_t \) is assumed constant and equal to one. All endogenous variables are constant, and we denote their steady-state levels by dropping time subscripts. Since the labor supply is non-stochastic, we normalize this supply to equal one. Details of the solution for the steady state of the model are provided in Appendix C.

Using the equilibrium wage rate in equation (19) and the aggregate productivity in equation 

\(^{18}\)See the appendix for details.
it is straightforward to verify that $Z = L = 1$ implies:

$$w = \frac{\theta - 1}{\theta} \tilde{z} \quad \text{and} \quad Y = \tilde{z}. \quad (25)$$

Thus, steady-state wages and GDP are simply pinned down by the average firm productivity.

An important relationship in our analysis below is the effect of listing. The condition that the marginal benefit of listing equal the cost, $\tau'(x_{t+1}(z)) \pi_t^V(z) = f$, and the assumed functional form for $\tau(x_{t+1}(z))$ imply that the steady-state share of equity sold by the entrepreneur managing listed firm $z$ has the form:

$$x(z) = \frac{1}{2\tau}(1 - \frac{f}{\pi^V(z)}). \quad (26)$$

The larger $\tau$, the smaller the share of equity sold on the stock market. The intuition is straightforward: Larger $\tau$ implies that the firm is making actual profits closer to the natural level. Hence, the incentive to sell equity and bear the costs associated with listing is weaker. The share of equity sold is an increasing function of the firm’s natural profit and thus its relative productivity: The larger natural profits, the larger the marginal benefit of equity sale, making the entrepreneur more willing to bear the costs associated with selling a larger share of equity.\(^{19}\) Finally, the share of equity sold is decreasing in the marginal cost of equity sale $f$, a straightforward implication of the first-order condition.

Note from equation (26) that for equity shares to be in the feasible set, i.e. $x(z) \in (0, 1)$, we require conditions on the parameters. In particular, substituting the optimal goods price (16) into the natural profit equation (4) and using the equilibrium equilibrium level of output and wages from equation (25), the natural profit function in steady state is:

$$\pi^V(z) = \frac{1}{\theta} z^{\theta - 1} \tilde{z}^{-(\theta - 2)} \quad (27)$$

Rearranging the share of equity sold by each manager in (26) makes clear that for equity shares to be greater than or equal to zero, $x(z) \geq 0$, we require that:

$$\pi^V(z) \geq \overline{f} \quad (28)$$

Solving for the level of productivity where this condition holds with equality, determines the steady state listing cut-off. Substituting the steady state natural profits (27) into equation (28) and solving for $z$ implies this cut-off is:

$$z^{list} = \tilde{z}^{\frac{\theta - 2}{\theta - 1}} (\theta f) \frac{1}{\pi^V(z)} \quad (29)$$

Similarly, to ensure that equity sold in each firm is less than one, $x(z) \leq 1$, inspection of equation (33) shows that we need to require:

\(^{19}\)For given firm productivity $z$, the share of equity sold decreases with average productivity $\tilde{z}$ under the realistic assumption $\theta > 2$ because this reduces natural profits via its effect on the firm’s relative price (which more than offsets the effect on GDP and aggregate demand).
\[
\frac{\bar{f}}{1 - 2\tau} \geq \pi^V(z)
\]

This condition is likely to hold the higher is \(\bar{f}\), the closer is \(\tau\) to \(\frac{1}{2}\), and the lower is the firm’s productivity, \(z\). However, since the upper tail of the distribution of \(z\) is unbounded, we require an upper cut-off to keep highly productive managers from selling more than the total value of their firm.

Note that we can solve for this upper bound, \(\bar{z}\), as the productivity level that implies shares are equal to \(\bar{z} < 1\). For simplicity, we assume \(\bar{z}\) is arbitrarily close to one. Setting \(x(z) = 1\) in (26) and solving for \(z\) yields the cut-off productivity of firms for managers who want to sell less than all their firm equity. Using the solution for the listing cut-off in (29) and for natural profits in (27), this upper cut-off productivity can be rewritten:

\[
\bar{z} = \bar{z}_{\text{list}}(1 - 2\tau)^{-\left(\frac{1}{\tau\bar{f}}\right)}
\]

This relationship highlights the impact of the managerial inefficiency on the intermediate range of stock listings. First the upper bound is clearly always higher than \(\bar{z}_{\text{list}}\) because \((1 - 2\tau)^{-\left(\frac{1}{\tau\bar{f}}\right)} > 0\). Moreover, the closer \(\tau\) is to its upper limit of one-half, the greater the difference between the two cut-offs.

### 3.2 Dynamics

We now describe how these profits of firms deviate in response to aggregate shocks away from the steady state. Given \(L = 1\), equation (19) and \(w_tL = (\theta - 1)Y_t/\theta\) imply that GDP is simply determined by the product of aggregate productivity and average firm-level productivity: \(Y_t = Z_t\bar{z}\). In turn, optimal pricing and the equilibrium wage in equation (19) imply that the relative price of good \(z\), \(\rho_t(z)\), is always constant and equal to \(\bar{z}/z\). It is then straightforward to obtain that firm \(z\)’s natural profits are:

\[
\pi_t^V(z) = \frac{1}{\theta} z^{\theta-1} \bar{z}^{-(\theta - 2)} Z_t. \tag{30}
\]

Note that this equation is the dynamic counterpart to the steady state profits in equation (27). Higher aggregate productivity increases GDP and thus the equilibrium demand for the consumption basket. Hence, natural profits rise.

Equation (30) implies that profits and consumption for entrepreneurs who do not list are determined by:

\[
\pi_t(0; z) = \frac{1}{\theta} z^{\theta-1} \bar{z}^{-(\theta - 2)} Z_t. \tag{31}
\]

Solving for the productivity cutoff for listing by setting \(\pi_t^V(z) = \bar{f}\) as above implies:

\[
z_{\text{list}} = \bar{z}^{\frac{1}{\theta + 2}} \left( \frac{\theta \bar{f}}{Z_t} \right)^{\frac{1}{\tau\bar{f}}}. \tag{32}
\]
Clearly, higher aggregate productivity captured through $Z_t$ increases the marginal benefit of listing. In turn, this productivity increase lowers the maximum productivity level for optimal listing. A larger number of firms are therefore present in the stock market.

The optimality condition for listing and the assumed form for the function $\tau(x_{t+1}(z))$ in equation (8) imply that the amount of equity sold by each firm that lists is determined by:

$$x_{t+1}(z) = \frac{1}{2\tau} \left(1 - \frac{f}{\pi^V_t(z)}\right).$$

The intuition is similar to the steady-state counterpart in equation (26). The difference here is that natural profits are no longer constant. Higher aggregate productivity increases natural profits and thus increases a listing entrepreneur’s incentive to sell equity. An increase in aggregate productivity has two effects on the size of the equity market by increasing the marginal benefit of selling equity: On one side, it induces more firms to list. On the other side, it causes each listing firm to sell more equity.

As above, we require an upper bound to this equity issuance of $x_{t+1}(z) = 1$. Setting equation (33) equal to one and solving for $z$ and using the solutions to $z_{list}^t$ and $\pi^V_t(z)$ as before, we can show that:

$$z_t = z_{list}^t \left(1 - \frac{1}{\pi^V_t(z)}\right)$$

Given the solution for $x_{t+1}(z)$ and the assumptions on $\tau(x_{t+1}(z))$ and $f(x_{t+1}(z))$, we can then obtain realized profits for listing firms as:

$$\pi_t(x_{t+1}(z) ; z) = \tau(x_{t+1}(z)) \left(\frac{1}{\theta} \right) z^{\theta-1}_t z^{-(\theta-2)} Z_t - f(x_{t+1}(z)).$$

We now use the dynamics of profits to determine the evolution of household consumption. For this purpose, we consider the household budget constraint (13) at equality and substitute the profits paid to shareholders from equation (35) to rewrite the constraint as:

$$\int_{z_{list}^{t-1}}^{\infty} \pi_t(x_{t+1}(z) ; z) x_t(z) dG(z) + \int_{z_{list}^{t-1}}^{\infty} v_t(z) x_t(z) dG(z) + w_tL = C_t + \int_{z_{list}^{t-1}}^{\infty} v_t(z) x_{t+1}(z) dG(z).$$

To clarify the household budget constraint relationship, we define the following variables:

$$\Pi_{t,t-1} \equiv \int_{z_{list}^{t-1}}^{\infty} \pi_t(x_{t+1}(z) ; z) x_t(z) dG(z),$$

$$V_{t,t-1} \equiv \int_{z_{list}^{t-1}}^{\infty} v_t(z) x_t(z) dG(z),$$

$$V_{t,t} \equiv \int_{z_{list}^{t-1}}^{\infty} v_t(z) x_{t+1}(z) dG(z).$$

Thus, $\Pi_{t,t-1}$ is the aggregate dividend pay-out at time $t$ to equity investors holding the aggregate listed shares from time $t - 1$. That is, for the set of shares outstanding at time $t - 1$, i.e., $x_{t+1}(z)$
for all \( \frac{z_{list}}{z_{t-1}} \), the investors receive the current profit earnings as dividends. \( V_{t,t-1} \) is the current market price of the equities held by investors entering period \( t \). However, since new shares are issued or repurchased within the period, the market price of equities at the beginning of the period differs from the end of the period. The end of period market price of outstanding shares at time \( t \) is given by \( V_{t,t} \). Recalling that \( w_tL = (\theta - 1)\frac{Y_t}{\theta} \) and \( Y_t = Z_t \tilde{z} \), the household budget constraint (36) can be rewritten using the definitions in equations (37), (38) and (39) as:

\[
\Pi_{t,t-1} + \frac{\theta - 1}{\theta}Z_t \tilde{z} = C_t + (V_{t,t} - V_{t,t-1}) \tag{40}
\]

Intuitively, equation (40) says that household income given on the left hand side must equal household spending given on the right-hand side. Household income equals dividends, \( \Pi_{t,t-1} \), plus labor income. Household income is then spent on consumption and the net inflow of new stocks listed. Households are the net absorbers of changes in equity listings, a role that significantly affects consumption dynamics below.

To solve for the dynamics of stock prices, consider next the Euler equation (14). Multiplying both sides by \( x_{t+1}(z) \) and aggregating across firms yields:

\[
\int_{z_{min}}^{\infty} v_t(z) x_{t+1}(z) dG(z) = \beta E_t \left\{ \frac{U'(X_{t+1})}{U'(X_t)} \left[ \int_{z_{min}}^{\infty} \pi_{t+1}(x_{t+2}(z); z) x_{t+1}(z) dG(z) \right] \right\},
\]

Combining this relationship with the definition of profits paid to shareholders and of the listed stock markets in equations (37) and (39), respectively, implies that these prices can be rewritten as:

\[
V_{t,t-1} = \beta E_t \left\{ \frac{U'(X_{t+1})}{U'(X_t)} \left( \Pi_{t+1,t-1} + V_{t+1,t-1} \right) \right\} \tag{41}
\]

\[
V_{t,t} = \beta E_t \left\{ \frac{U'(X_{t+1})}{U'(X_t)} \left( \Pi_{t+1,t} + V_{t+1,t} \right) \right\} \tag{42}
\]

We can then solve for the change in the value of the stock market due to newly listed firms. For this purpose, we define \( V_{t,\Delta} \equiv (V_{t,t} - V_{t,t-1}) \) and \( \Pi_{t,\Delta} = (\Pi_{t,t-1} - \Pi_{t,t}) \) and then combine equations (41) and (42) to rewrite the change in value of listed firms as:

\[
V_{t,\Delta} = \beta E_t \left\{ \frac{U'(X_{t+1})}{U'(X_t)} \left( \Pi_{t+1,\Delta} + V_{t+1,\Delta} \right) \right\} \tag{43}
\]
where clearly,

\[
\Pi_{t+1,\Delta} = \int_{z_{1,t}}^{\infty} \pi_{t+1} (x_{t+2} (z) ; z) x_{t+1} (z) dG (z) - \int_{z_{1,t-1}}^{\infty} \pi_{t+1} (x_{t+2} (z) ; z) x_{t} (z) dG (z) \\
= \int_{z_{1,t}}^{\infty} \pi_{t+1} (x_{t+2} (z) ; z) x_{t+1} (z) dG (z) \\
+ \int_{z_{1,t-1}}^{\infty} \pi_{t+1} (x_{t+2} (z) ; z) [x_{t+1} (z) - x_{t} (z)] dG (z)
\]

Thus, equation (44) shows that the difference in future market dividend payments generated by listing in period \( t \) can be decomposed into two components. The first is the aggregated future profits of newly listed firms on the interval \( z_{1,t} ; z_{1,t-1} \). The second component is the change in issued stocks by existing firms on the interval \( z_{1,t-1} \).

Solving the model requires computing the integrals in the definitions (37)-(39). For this purpose, we can write the aggregate profits paid off as dividends to investors entering period \( t \) in two components using the interior solution for equity shares \( x_t \) in equation (33) yielding:

\[
\Pi_{t,t-1} = \int_{z_{1,t-1}}^{\infty} \pi_{t} (x_{t+1} (z) ; z) x_{t} (z) dG (z)
\]

\[
= \frac{1}{2\tau} \left\{ \int_{z_{1,t-1}}^{\infty} \pi_{t} (x_{t+1} (z) ; z) dG (z) - \int_{z_{1,t-1}}^{\infty} \left( \frac{\pi_{t} (x_{t+1} (z) ; z)}{\pi_{1} (z)} \right) dG (z) \right\}
\]

\[
= \frac{1}{2\tau} \left\{ \tilde{\pi}_{t,t-1} - \tilde{\pi}_{1,t-1} \right\}
\]

Clearly, \( \tilde{\pi}_{t} \) is the aggregate of profits for all listed firms and would represent pay-outs if these firms were fully public. By contrast, \( \tilde{\pi}_{1} \) is the ratio of actual profits to natural profits. If there were no managerial inefficiencies, these ratios would equal one.

These components of dividend pay-outs depend in turn upon moments of the natural profits \( (\pi_{1}^{\nu} (z))^{n} \). Therefore, it is useful to define the following generalized productivity averages:

\[
\bar{z}_{n} = \left( \int_{z_{\min}}^{\infty} z^{n(\theta-1)} dz \right)^{\frac{1}{n(\theta-1)}}
\]

\[
\bar{z}_{n,t}^{\text{list}} = \left[ \frac{1}{1 - G (z_{1,t}^{\text{list}})} \right] \left( \int_{z_{1,t}^{\text{list}}}^{\infty} z^{n(\theta-1)} dz \right)^{\frac{1}{n(\theta-1)}}
\]

where \( n \) can take any value on the real axis. The definitions (46) and (47) generalize the market-share weighted average productivity for all firms (18) and the corresponding definition of market-share weighted average productivity for listed firms by allowing adjustment of the weighting by any real number \( n \). Thus, the market-share weighted productivity average for listed firms, \( \bar{z}_{t}^{\text{list}} \), is simply given by \( \bar{z}_{t}^{\text{list}} = \bar{z}_{1,t}^{\text{list}} \).

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Given these definitions we prove the following results in the Appendix:

\[
\int_{Z_{\text{min}}}^{\infty} (\pi_t^V(z))^n dG(z) = (\pi_t^V(\tilde{z}_n))^n, \\
\int_{Z_{\text{list}}}^{\infty} (\pi_t^V(z))^n dG(z) = \left(1 - G(z_{\text{list}}^t)\right)^n (\pi_t^V(\tilde{z}_{\text{list}}^{n,t}))^n.
\]

Clearly, the aggregated profits of listed firms differ from total profits according to the probability of the firm lying above the listing cut-off, or \((1 - G(z_{\text{list}}^t))\).

4 Quantitative Implications

Given the dynamic evolution of the model described above, we can now consider its quantitative implications. We begin by describing the analytical solution of the model dynamics log-linearized around the steady state. To demonstrate how the steady state depends upon the parameters, we provide some numerical solutions. We then evaluate the model’s aggregate implications by showing impulse response functions to productivity shocks.

4.1 Log-linearized Model

To analyze the quantitative implications of the model, we compute the basic system of equations in the model. For this purpose, we use the household budget constraint (40), and its components. These components are the dividends paid, \(\Pi_{t,t-1}\), in equation (45), wages, and the Euler equation for new equity \(V_{t}\) in (43). We also use the solutions for the managerial efficiency loss \(\tilde{\tau}_t\) in equation (22) and the aggregate reporting costs \(\tilde{\epsilon}_t\) in equation (23). Together with the aggregate resource constraint in equation (24), these relationships provide six equations that determine the six endogenous variables: household consumption \(C_t\), managerial consumption \(\tilde{C}_t\), dividends paid \(\Pi_{t,t-1}\), efficiency loss \(\tilde{\tau}_t\), reporting costs \(\tilde{\epsilon}_t\), and the change in market capitalization \(V_{t}\).

We solve this system by log-linearization around the steady state. As we show in the appendix, the system can be expressed as:

\[
\hat{\Pi}_{t,t-1} + \left(\frac{\theta - 1}{\theta}\right) \tilde{Z}_t = \frac{C}{\Pi} C_t + \frac{V_{\Delta}}{\Pi} V_{t,\Delta} \quad (48)
\]
\[
\hat{\Pi}_{t,t-1} = h_0 Z_{t-1} + h_1 Z_t \quad (49)
\]
\[
\hat{\tilde{\tau}}_t = \frac{1}{\tilde{\tau}} \left\{ \tilde{Z}(1 - \phi) - \frac{\psi k}{(\theta - 1)} \right\} Z_t \quad (50)
\]
\[
\tilde{\epsilon}_t = \frac{k}{\theta - 1} Z_t \quad (51)
\]
\[
\tilde{C}_t = \frac{Z}{C} Z_t - \frac{C}{C} C_t - \frac{\tilde{\tau}}{\tilde{\tau}} \tilde{\epsilon}_t - \frac{\tilde{\epsilon}_t}{C} \quad (52)
\]
\[
V_{t,\Delta} = \gamma E_t C_{t+1} - \gamma C_t \quad (53)
\]

where we use sans serif fonts to denote percent deviations from steady state where possible and
with a hat where not. Also, the $h$’s and $\psi$ are constants that depend on structural parameters and are detailed in the appendix.

These equations have a straightforward interpretation. Clearly equation (48) simply restates the household budget constraint normalized by steady state profit pay-outs, $\Pi$. The evolution of these profits in turn are given by equation (49) and depend upon both lagged productivity, $Z_{t-1}$, and current productivity, $Z_t$. Profits to shareholders depend upon both $Z_t$ and $Z_{t-1}$ because lagged productivity determines the set of listed firms households own entering the period while current productivity determines the profit from those firms. Equation (50) shows that the evolution of efficiency loss, $\tilde{\tau}$, depends upon the interplay of two opposing effects. When the economy expands, profits rise for all firms implying a proportional increase in the resource lost through $(1 - \tilde{\tau})$ times the effect on aggregate profits $\tilde{\tau}/\theta$. On the other hand, an expansion induces more firms to list by the proportion $k/(\theta - 1)$. The effects of greater listing on the resource loss is measured by $\psi$. Similarly, the evolution of reporting costs given in equation (51) depends directly upon the increase in listing according to $k/(\theta - 1)$. Since only listed firms pay these costs and listing is pro-cyclical, reporting costs unambiguously increase with output. Given that we have solved for all other components of output, we can calculate entrepreneurial consumption as the residual as in (52). Finally, the price of newly issued equity relative to the previously issued equity $V_t$ as given in equation (53) is just given by the expected marginal rate of substitution in consumption. The intuition for this result is clear. Since both current issues and existing issues are priced with the same information both issues carry the same risk contained in the aggregate output shock.

To close this system, we assume that the aggregate productivity shocks follow the process:

$$Z_t = \phi Z_{t-1} + \xi_t,$$

where $0 \leq \phi \leq 1$ and $\xi_t$ is an i.i.d. normal innovation with zero mean and variance $\sigma^2$.

Below we use this model to generate quantitative implications of the model.

### 4.2 Quantitative Implications on Steady State

Given the system of equations, we can examine the implications of the model on the steady state of the economy. For this purpose, we analyze the sets of parameters detailed in the columns of Table 1. These sets of parameters correspond to four different scenarios.

In the baseline case, we use the measures of $k$ and $\theta$ from Ghironi and Melitz (2006) picked to match the size distribution of US firms. The baseline magnitude of reporting costs is 10%.\footnote{In practice, issuing costs such as flotation costs in the case of bonds and IPO fees in the case of equities are expressed as a proportion of the value of the issue, not the quantity of shares per se. However, in our model the equilibrium quantity sold is related indirectly to the price since it is depends upon the firms natural profits. Also, note that the issuing costs would be one time initial costs while $f$ represents on-going reporting costs so that we are combining both fees into this measure.} We do not have direct evidence for the value of $\tau$. However, we have shown above that given our functional form it must be less than $\left(\frac{1}{2}\right)$. Also, the lower is $\tau$, the greater is the underlying
managerial inefficiency. To be conservative, therefore, we assume this parameters is 0.4 in our baseline case. For the other parameters in the baseline and other scenarios we keep the numbers as consistent as possible with other business cycle models. We set the preference parameters of $\gamma$ to two and $\beta$ to 0.95. For the standard deviation of the productivity shock, we use 2%, a number close to the estimate in Backus, Kehoe, and Kydland (1992). The choice of the persistence parameter, $\phi$, is the only parameter that deviates from standard studies. Greater persistence means that higher profits persist into the future, encouraging managers to sell more of their equity shares. In our numerical solutions, we require lower persistence to keep the economy stable around the steady state. In all of our scenarios, we normalize the minimum $z$ to be one.

Table 1: Calibration Scenarios

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Baseline</th>
<th>High $k$</th>
<th>Low $f$</th>
<th>Low $\tau$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$k$</td>
<td>3.4</td>
<td>6</td>
<td>3.4</td>
<td>3.4</td>
</tr>
<tr>
<td>$\theta$</td>
<td>3.8</td>
<td>3.8</td>
<td>3.8</td>
<td>3.8</td>
</tr>
<tr>
<td>$f$</td>
<td>.10</td>
<td>.10</td>
<td>.05</td>
<td>.10</td>
</tr>
<tr>
<td>$\tau$</td>
<td>.40</td>
<td>.40</td>
<td>.40</td>
<td>.20</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>$\beta$</td>
<td>.95</td>
<td>.95</td>
<td>.95</td>
<td>.95</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>.02</td>
<td>.02</td>
<td>.02</td>
<td>.02</td>
</tr>
<tr>
<td>$\phi$</td>
<td>.50</td>
<td>.50</td>
<td>.50</td>
<td>.50</td>
</tr>
<tr>
<td>$z_{\min}$</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

In addition to the baseline case, we consider three other scenarios. In the first scenario, we consider a higher value to the parameter in the cross-sectional distribution of firms, $k$, by setting it equal to 6. This parameter controls how much of the probability mass of firms is concentrated near the bottom. Thus, a higher $k$ means that there are more smaller firms and hence more on the margin that might list if the economy expands.

The second scenario considers the impact of a lower reporting cost at 5%. This variable is important because higher costs of reporting increase the marginal cost of listing and therefore adversely affect the listing cut-off.

The last scenario we examine is a higher level of managerial waste in the absence of listing. Higher waste corresponds to a lower proportion of natural profits available to owners, $\tau$. We consider halving this proportion relative to the baseline by setting $\tau = 0.2$.

Using these parameters, we examine the steady state shares of household consumption, entrepreneurial consumption, reporting costs, and managerial inefficiency as a proportion of GDP. These numbers are reported in Table 2. The baseline scenario implies that household consumption is 77% while managerial consumption is 13% of GDP. The aggregate reporting costs of the listed firms is 2% and our baseline parameters produce a benchmark level of managerial inefficiency of 8%. The lower four rows of the table report the implied listing cut-off productivity $z_{list}$ and upper bound of productivity where managers retain partial ownership, $\overline{z}$. These levels in combination
with the density parameter $k$ determine the proportion of firms that are listed and partially listed. In the baseline scenario, the proportion of listed firms are 84% and therefore, the proportion of unlisted firms is 16%. The percentage of firms in the economy that are fully listed is 12%.

The "High $k$" scenario increases the number of smaller firms. In this scenario, the lower bound $z^{\text{list}}$ is less than the minimum of one so that all firms list. However, the proportion of firms that are fully public is only 3%. Overall, the level of managerial inefficiency increases to 26% crowding out household consumption which declines to 56%. Since all firms now list, the reporting costs increase slightly.

Table 2: Steady State Absorption Shares and Firm Listing Distribution

<table>
<thead>
<tr>
<th>Shares</th>
<th>Baseline</th>
<th>High $k$</th>
<th>Low $\bar f$</th>
<th>Low $\tau$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household Consn $(\frac{\bar r}{\tau})$</td>
<td>0.77</td>
<td>0.56</td>
<td>0.77</td>
<td>0.63</td>
</tr>
<tr>
<td>Managerial Consn $(\frac{\bar r}{\tau})$</td>
<td>0.13</td>
<td>0.15</td>
<td>0.14</td>
<td>0.29</td>
</tr>
<tr>
<td>Reporting Costs $(\frac{\bar r}{\tau})$</td>
<td>0.02</td>
<td>0.03</td>
<td>0.01</td>
<td>0.03</td>
</tr>
<tr>
<td>Managerial Inefficiency $(\frac{\bar r}{\tau})$</td>
<td>0.08</td>
<td>0.26</td>
<td>0.07</td>
<td>0.04</td>
</tr>
<tr>
<td>Listing Lower Bound $z^{\text{list}}$</td>
<td>1.05</td>
<td>0.82</td>
<td>0.82</td>
<td>1.05</td>
</tr>
<tr>
<td>All-Public Ownership Bound $\tau$</td>
<td>1.87</td>
<td>1.78</td>
<td>1.78</td>
<td>1.27</td>
</tr>
<tr>
<td>Proportion Firms Listing $\Pr(z &gt; z^{\text{list}})$</td>
<td>0.84</td>
<td>1.00</td>
<td>1.00</td>
<td>0.84</td>
</tr>
<tr>
<td>Proportion Firms All-Public $\Pr(z &gt; \tau)$</td>
<td>0.12</td>
<td>0.03</td>
<td>0.14</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Compared to the baseline case, the scenario generated by lower marginal reporting costs, $\bar f$, implies more equity listing. The listing and all-public ownership bounds are identical to the "High $k$" scenario, but the lower level of $k$ in the baseline implies that more firms go all public. In other words, $\Pr(z > \tau)$ increases to 14%. Consequently, managerial inefficiency declines somewhat.

Finally, the "Low $\tau$" scenario represents a lower proportion of profits by unlisted firms available for consumption by households. In response, more firms choose to fully list on the margin to compensate for this greater efficiency loss, generating slightly higher reporting costs. However, the effect of lower $\tau$ is offset by greater efficiency arising from listing so that aggregate inefficiency declines.

4.3 Impulse response functions

Given these relationships, we can now study the properties of these scenarios around the steady state. For each of our scenarios, we consider the impact of a 1% increase in the productivity shock, $Z_t$. We examine the effects of this shock on two sets of variables separately. First, we consider the effects on the consumption of households, the consumption of entrepreneurs, and, for comparison, the effects on the consumption in a standard model without managerial waste or reporting costs. To understand this first set of responses, it is useful to understand how a productivity shock will affect each group of consumers. An increase in productivity will always reduce the listing cutoff (equation (32), thereby increasing the number of shares of stocks in the market. As the household
constraint in equation (40) makes clear, households must absorb this increase in shares. Therefore, household consumption will increase by less than it would in a world without managerial waste or reporting cost. At the same time, aggregate managerial consumption will tend to increase by more. To see this effect, we can decompose the expression for aggregate managerial consumption in (21) using the profits to non-listers in equation (31) and the budget constraint to managers in equation (12) to obtain:

\[
\tilde{C}_t = \int_{z_{\text{min}}}^{z_{\text{list}}} \pi_t (0; z) dG(z) + \int_{z_{\text{list}} - 1}^{\infty} \pi_t (x_{t+1} (z); z) dG(z) - \int_{z_{\text{list}} - 1}^{\infty} \pi_t (x_{t+1} (z); z) x_t (z) dG(z) + \int_{z_{\text{list}}}^{\infty} v_t (z) x_{t+1} (z) dG(z) - \int_{z_{\text{list}} - 1}^{\infty} v_t (z) x_t (z) dG(z)
\]

Comparing this aggregate budget constraint to that of households in equation (36) makes clear the relationship between the two groups. For this purpose, we use the definitions of aggregate relationships \( \Pi_{t,t-1} \) and \( V_{t,\Delta} \) to rewrite aggregate entrepreneurial consumption as:

\[
\tilde{C}_t = \int_{z_{\text{min}}}^{z_{\text{list}}} \pi_t (0; z) dG(z) + \int_{z_{\text{list}} - 1}^{\infty} \pi_t (x_{t+1} (z); z) dG(z) - \Pi_{t,t-1} \Delta + V_{t,\Delta}
\]

At the same time, we have shown that the household budget constraint implies:

\[
C_t = w_t L + \Pi_{t,t-1} - V_{t,\Delta}
\]

Thus, the two consumptions are negatively related by payouts to shareholders \( \Pi_{t,t-1} \) and the difference in market value from the new issues, \( V_{t,\Delta} \). The intuition is clear. Dividend payouts to shareholders is a source of income to households but a relative loss to managers. Similarly, households must reduce consumption to acquire any new shares, but these sales represent an increase in revenue to managers.

On the other hand, \( \tilde{C}_t \) and \( C_t \) also differ according to other components. First, only households supply labor and therefore earn the labor bill, \( w_t L \). Also, for managers who do not list i.e. for \( z < z_{\text{list}} \), the managers only consume profits. Finally, for managers who do list, they consume their share of profits.

In addition to the consumption responses, we also depict the impulse responses of the managerial inefficiency, \( \tilde{\tau} \), the reporting costs, \( \tilde{f} \), and aggregate profits available for dividends to shareholders, \( \tilde{\Pi} \). Since stock sales, and hence outside monitoring is pro-cyclical, both \( \tilde{\tau} \) and \( \tilde{f} \) are also pro-cyclical. Clearly, profits increase with productivity, but whether the response is greater or less than proportional to the productivity shock will depend upon how efficiently the economy responds to this shock.

Figures 3 show the effects on the endogenous variables from a 1% increase in the productivity shock when the parameters are given by the baseline case. Figure 3a depicts the effects on consumption shares of households and aggregate managers. This figure also shows how aggregate
consumption would respond in a standard model without managerial waste or reporting costs. This case is labeled "Standard Consumption" to provide a benchmark comparison of the model. Household consumption increases as wages and profits increase, but the increase in consumption is only about .1%, far less than the 1% that would be generated by a standard model without managerial and reporting frictions. The household consumption continues to increase the following period as the original expenses from listing by firms are paid. Figure 1b shows that profits available to shareholders increase by more than 1% as the benefits of reducing managerial waste magnify the effect on profits. Indeed, Figure 1b shows that reporting costs and managerial inefficiency increase after the initial listing and then decline.

Figure 3a also shows the effects of the expansion on managerial consumption. As described above, this consumption will increase with profits for unlisted firms but will depend inversely on household consumption for listed firms through the pay-out of profits to shareholders and the change in market value of newly listed firms. As we have seen in Figure 3b, shareholder profits increase significantly, thereby reducing manager consumption. However, Figure 3a also shows that the increase in listings reduces the stock market value by about .35%. Thus, the newly listing companies sell at reduced value relative to steady state. Accordingly, managerial consumption initially decreases but quickly rebounds with the value of the newly issued stocks.

Figures 4 depict the corresponding impulse responses for the "high \( k \)" case. As described in the steady state results, in this case the listing cut-off \( z_{\text{list}} \) lies below the minimum level of \( z \) so that all firms list. On the other hand, only 3% fully list so that the effects of partial listing is relevant for much of the distribution. In this case, dividend payments to shareholders are much more sensitive. As Figure 4b shows, profits increase by almost 2%. However, the effects of more small managers crowds out household consumption and the subsequent increase in household consumption profile implies an increase in the stock price as shown in Figure 4a. The stock price difference between newly listed and previously listed firms jumps up about .10% but then decreases and then slowly rises toward steady state.

The "low \( \eta \)" case is given in Figures 5. Lower marginal reporting costs increases the tendency to list as described earlier. As Figure 5b shows, reporting costs increase by about .3% but by less than the baseline case shown in Figure 3b. With the baseline distribution of firms implied by \( k = 3.8 \), dividends to shareholders increase to near 1% and both household and managerial consumption follow a similar pattern similar to the baseline case. With lower reporting costs, however, managerial consumption rebounds by more within two quarters.

Figures 6 illustrate the economy’s dynamic response when \( \tau \) is very low at .2. Table 2 reported that in the steady state only 84% of the firms are listed and 45% are fully listed, much higher than the 12% when \( \tau \) is 0.4. As a result, a much higher proportion of firms have insulated themselves from managerial inefficiency. Therefore in response to a productivity shock, managerial inefficiency increases only slightly as Figure 6b shows. Also shareholder profits do not increase by as much. The biggest response comes from managerial consumption as the number of new listers increases more on the margin.
Overall, the dynamics of the system show that the effects of listings has a significant impact on consumption. Household consumption always responds less than the productivity shock since households must absorb the newly issued stocks into their portfolios. The relative price of these new issues in turn have a strong impact on managerial consumption. When the relative price declines, managerial consumption tends to decline relative to the steady state. This impact is only offset when sufficiently new entrants increase the productivity of non-listed firms, such as when the $\overline{\tau}$ is quite low.

5 Concluding Remarks

Outside monitoring as often been touted as a vehicle for improving managerial efficiency. Despite the importance of this relationship, research has not considered the aggregate effects of managers seeking outside financing. In this paper, we have begun to fill this gap. We developed a framework to consider the implications of equity listing on managerial efficiency and, hence, the profitability of the firm. We have incorporated a cross-section of firms characteristic of the size distribution in the US economy.

Given this framework, we have shown several effects. First, the willingness to be monitored, represented in our model as net equity sales, is pro-cyclical. Moreover, larger and more productive firms are the most likely to list. Both of these results are consistent with the empirical results.

Second, the pro-cyclical equity sales do not necessarily manifest as greater aggregate managerial efficiency. An expansion induces higher profits for all firms in the economy, implying a comcomitant proportional efficiency loss. An expansion can only offset this loss when the equilibrium of the economy already contains a sufficiently high inefficiency and when enough firms enter on the margin.

Third, the listing of firms has different effects on the consumption of households and managers. Listings during expansions depress consumption spending as households must curtail spending to purchase newly listed firms. On the other hand, managers may be able to increase consumption by more or less, depending upon how well the listing improves their firm’s available profit.

Since this paper represents an first step to considering issues of managerial waste on the macro-economy, it leaves open a number of important issues. First, we have focused on the implications of outside monitoring instead of financing. In reality, firms chose to seek outside financing during expansion to fund their investments. Second, we have discussed our monitoring vehicle as equity issuance. However, this monitoring can take many forms, not just equity. While many of the relationships are likely to hold with other liabilities, the specific macroeconomic effects may differ. The approach presented in this paper provides a rich framework for considering these remaining issues.

References


[20] La Porta, Rafael; Lopez-de-Silanes, Florencio; Shleifer, Andrei; Vishny, Robert W., "Investor Protection and Corporate Valuation," Journal of Finance 57, pp. 1147-1170.


Appendix

A Production Equilibrium

Our model focuses upon the effects of managerial inefficiencies on the consumption side of the economy. Therefore, the production equilibrium is standard as in this class of models. Specifically, aggregate absorption is implies an equilibrium output demand. This assumption implicitly implies that even distorted absorption such as the managerial inefficiencies and the reporting costs are spent in the same proportion as managers and households.

Therefore, as in the standard model, output demand is given by

\[ y_t^D(z) = \rho_t(z)^{-\theta} Y_t^A \]

Together with the production

\[ y_t(z) = Z_t z l_t(z) \]

these together imply

\[ l_t(z) = \frac{\rho_t(z)^{-\theta} Y_t^A}{Z_t z} = \left( \frac{\theta}{\theta - 1} \right)^{-\theta} w_t^{-\theta} (Z_t z)^{\theta-1} Y_t^C, \]

where we used (16). Thus, we have:

\[ Y_t = \left( \frac{\theta}{\theta - 1} \right)^{1-\theta} \left( \frac{w_t}{Z_t} \right)^{1-\theta} Y_t^A \int_{z_{min}}^{\infty} z^{\theta-1} dG(z). \]

In equilibrium, total output of the consumption basket must be equal to the economy’s total absorption, or \( Y_t = Y_t^A \). Hence,

\[ 1 = \left( \frac{\theta}{\theta - 1} \right)^{1-\theta} \left( \frac{w_t}{Z_t} \right)^{1-\theta} \int_{z_{min}}^{\infty} z^{\theta-1} dG(z). \]

Solving this equation for \( w_t \) implies equation (19).

B Model Solution Set-up

We now combine the standard production solution above with our novel consumption side of the economy to solve the model. As described in the text, the model can be fully solved using five equations describing the state variables and two Euler equations. In particular, the five equations are:

- Aggregate profits distributed to existing shareholders \( \Pi_{t,t-1} \): equation (37)
- Aggregate managerial inefficiency \( \tilde{\tau} \): equation (22)
- Aggregate reporting costs \( \tilde{f} \): equation (23)
- Household budget constraint: equation (13)
- Aggregate economy resource constraint: equation (24)
In addition, the model requires solving for the stock market value of the existing shares, $V_{t,t-1}$, and of the current shares including the newly issued shares, $V_{t,t}$, defined in equations (38) and (39), respectively. These share prices are determined by the two Euler equations:

- Aggregate price of existing shares $V_{t,t-1}$: equation (41)
- Aggregate price of total current shares $V_{t,t}$: equation (42)

The household budget constraint and aggregate economy resource constraint are straightforward to calculate given the aggregate profits, managerial inefficiency, reporting costs, and pricing of shares. We describe the solution of each in turn below.

Before doing so, note that all these variables depend upon integrals of the profit of firms,

$$\pi_t (x_{t+1} | z) \equiv \tau (x_{t+1} | z) \pi_t^V (z) - f_R (x_{t+1} | z)$$

(A.1)

In turn, these profits depend upon the natural profits $\pi_t^V (z)$ both directly and indirectly through the equilibrium effect on equity sold, $x_{t+1} (z)$ given by equation (33). These natural profits using the production equilibrium in the appendix above can be written:

$$\pi_t^V (z) = \frac{1}{\theta} \rho_t (z)^{1-\theta} Y_t^A = \frac{1}{\theta} \bar{z}^{-(\theta-2)} Z_t \bar{z}^{\theta-1}$$

(A.2)

Clearly, then, since all other parameters including the aggregate state variable $Z_t$ are independent of $z$, the aggregate variables depend upon integrals of the moments of the distribution of $z^{\theta-1}$. Since this distribution is Pareto, we define a general form of these moments as given by (46) or conditional on a time varying lower bound as exemplified by (47) in the text. Substituting this time varying lower bound more generally as $z_{lb}$, we can restate (47) as:

$$\bar{z}^{lb}_{n,t} \equiv \left[ \frac{1}{1 - G (z_{lb}^{\theta})} \int_{z_{lb}^{\theta}}^{\infty} z^{n(\theta-1)} dz \right]^{1/n(\theta-1)}$$

(A.3)

where using the definition of a Pareto distribution:

$$G (z_{lb}^{\theta}) = 1 - \left( \frac{z_{min}}{z_{lb}^{\theta}} \right)^k$$

Using properties of the moment-generating function, we can then rewrite

$$\bar{z} = \nu_n \bar{z}_{min}$$

(A.3)

$$\bar{z}_{lb}^{lb} = \nu_n \bar{z}_{lb}^{lb}$$

(A.4)

where:

$$\nu_n \equiv \frac{1}{k-n(\theta-1)} \left[ k \right]^{1/n(\theta-1)}$$

A-2
To show the relationships given in the text, substitute natural profits in equation (A.2) into the moments of natural profits across all firms, \( \int_{z_{min}}^{\infty} (\pi_t^V (z))_n^dG(z) \) and across the conditional group of firms above \( z_t^{lb} \) given by \( \int_{z_t^{lb}}^{\infty} (\pi_t^V (z))_n^dG(z) \). Using the definitions of \( \bar z \) in equation (55) and \( z_{n,t}^{lb} \) in equation (55), the solution to these integrals is immediate:

\[
\int_{z_{min}}^{\infty} (\pi_t^V (z))_n^dG(z) = (\pi_t^V (\bar z_n))^n, \tag{A.5}
\]

\[
\int_{z_t^{lb}}^{\infty} (\pi_t^V (z))_n^dG(z) = \left(1 - G\left(z_t^{lb}\right)\right) (\pi_t^V (z_{n,t}^{lb}))^n. \tag{A.6}
\]

Equation (55) gives the solution for moments of natural profits when profits and the lower bound both depend upon the current state of the economy, \( Z_t \). However, the profits paid out to existing shareholders, \( \Pi_{t,t-1} \) depends upon the number of firms listed at \( t - 1 \). Therefore, we also require solutions of moments of the distribution of the form: \( \int_{z_{t-1}^{list}}^{\infty} (\pi_t^V (z))_n^dG(z) \). In this case, the profits are driven by the current aggregate state, \( Z_t \), but the set of existing shares was previously determined by the lagged aggregate state, \( Z_{t-1} \). In this case, aggregate natural profit moments conditional on previous listers becomes

\[
\int_{z_{t-1}^{list}}^{\infty} (\pi_t^V (z))_n^dG(z) = \left(1 - G\left(z_t^{list}\right)\right) (\pi_t^V (z_{n,t-1}^{list}))^n
\]

or more generally, for lower bound \( z_t^{lb} \)

\[
\int_{z_t^{lb}}^{\infty} (\pi_t^V (z))_n^dG(z) = \left(1 - G\left(z_t^{lb}\right)\right) (\pi_t^V (z_{n,t-1}^{lb}))^n \tag{A.7}
\]

### B.1 Model Solution: Profit Payouts to Share-holders

As described in the text, the profit payouts to existing share-holders is given by equation (45) repeated here for convenience:

\[
\Pi_{t,t-1} = \int_{z_{t-1}^{list}}^{\infty} \pi_t (x_{t+1} (z); z) x_t (z) dG(z)
= \frac{1}{2\tau} \left\{ \int_{z_{t-1}^{list}}^{\infty} \pi_t (x_{t+1} (z); z) dG(z) - \int_{z_{t-1}^{list}}^{\infty} \left( \frac{\pi_t (x_{t+1} (z); z)}{\pi_t^V (z)} \right) dG(z) \right\}
\]

\[
\Pi_{t,t-1} = \frac{1}{2\tau} \left\{ \bar \pi_{t,t-1} - \bar f \bar z_{t,t-1} \right\}
\]

In order to use our moment relationships and still account for the fact that \( x_{t+1} = 1 \) for \( z > \bar z \), we rewrite profits as:

\[
\Pi_{t,t-1} = \int_{z_{t-1}^{list}}^{\infty} \pi_t (x_{t+1} (z); z) x_t (z) dG(z) + \int_{\bar z_{t-1}}^{\infty} \pi_t^V (z) dG(z) - \int_{\bar z_{t-1}}^{\infty} \pi_t (x_{t+1} (z); z) x_t (z) dG(z) \tag{A.8}
\]

A-3
We first determine profits for each firm, \( \pi_t(x_{t+1} ; z) \), by substituting into equation (A.1) the solution for equity sold in equation (33), and the function form for \( \tau(x_{t+1} ; z) f_R(x_{t+1} ; z) \). We then note that as given by equation (34), \( z_t = z_t^{list}(1 - 2\tau)(\pi_0^{\frac{1}{z_1}}) \). Then using the relationships from the moments of natural profits in equation (A.7) along with the fact that for the Pareto distribution, \( 1 - G(z_t^b) = (z_{min} / z_t^b)^k \) we can write \( \tilde{\pi}_{t,t-1} \) and \( \tilde{\pi}^{*}_{t,t-1} \) in terms of the aggregate state variable \( Z \) in the form of:

\[
\tilde{\pi}_{t,t-1} = g_0 Z_t^{k/(\theta-1)} \left( Z_t^{(\theta-1)} f_1(1 - 2\tau)(\pi_1^{Z_t}) + S_{t,t-1} - \bar{S}_{t,t-1} (1 - 2\tau)(\pi_0^{\frac{1}{Z_t}}) \right)
\]

where:

\[
g_0 = (z_{min} / z_t^{list}) Z_t^{-k/(\theta-1)} = z_{min} \pi_t^{\frac{1}{k}} (\theta f_1)^{-k/(\theta-1)}
\]

and

\[
S_{t,t-1} = f_1 \left( (\tau + 1) \nu_1^{Z_t} + \left( \frac{f_1}{4\tau} \right) \nu_1^{-Z_t} \right) \left( \frac{Z_t}{Z_{t-1}} \right)^{-1} - \left( \frac{f_1}{2\tau} \right)
\]

and

\[
\bar{S}_{t,t-1} = (1 - 2\tau)^{-1} f_1 \left( (\tau + 1) \nu_1^{Z_t} + (1 - 2\tau) \left( \frac{f_1}{4\tau} \right) \nu_1^{-Z_t} \right) \left( \frac{Z_t}{Z_{t-1}} \right)^{-1} - \left( \frac{f_1}{2\tau} \right)
\]

Intuitively, \( g_0 \) measures the effects on aggregate profits from the conditional probability of listed firms based on \( z_t^{list} \). \( S_{t,t-1} \) accounts for the evolution of the aggregate state on profits of listed firms while \( \bar{S}_{t,t-1} \) adjusts for the fact that \( x = 1 \) for firms with productivity above \( \pi \).

Following the same steps, we find that:

\[
\tilde{\pi}^{*}_{t,t-1} = g_0 Z_t^{k/(\theta-1)} \left( S_{t,t-1} - \bar{S}_{t,t-1} (1 - 2\tau)(\pi_0^{\frac{1}{Z_t}}) \right)
\]

where:

\[
S_{t,t-1}^{*} = \left( \tau + 1 \right) \left( \frac{Z_t}{Z_{t-1}} \right) + \left( \frac{1}{4\tau} \right) \nu_2^{-2(\theta-1)} \left( \frac{Z_t}{Z_{t-1}} \right)^{-1} - \left( \frac{1}{2\tau} \right) \nu_2^{-\frac{1}{2}(\theta-1)}
\]

and

\[
\bar{S}_{t,t-1}^{*} = \left( \tau + 1 \right) \left( \frac{Z_t}{Z_{t-1}} \right) + \left( \frac{1}{4\tau} \right) \nu_2^{-2(\theta-1)} \left( \frac{Z_t}{Z_{t-1}} \right)^{-1} (1 - 2\tau)^2 - \left( \frac{1}{2\tau} \right) \nu_2^{-\frac{1}{2}(\theta-1)} (1 - 2\tau)^2.
\]

Substituting the solutions for \( \tilde{\pi}_{t,t-1} \) and \( \tilde{\pi}^{*}_{t,t-1} \) back into equation (45) gives the evolution of profits paid to shareholders according to the current and lagged aggregate productivity, \( Z_t, Z_{t-1} \).

### B.2 Model Solution: Managerial Inefficiency

Next we determine the solution to the aggregate managerial inefficiency in equation (22) repeated here for convenience:
\[ \tilde{\tau}_t \equiv \int_{z_{\min}}^{\infty} \pi_t^V(z) (1 - \tau(x_{t+1}(z))) \, dG(z) \]

Substituting for the equilibrium \( \tau(x_{t+1}(z)) = \tau(x(\pi_t^V(z))) \) as above, we can rewrite the managerial inefficiency as:

\[ \tilde{\tau}_t \equiv \int_{z_{\min}}^{\infty} \pi_t^V(z) \left\{ 1 - \left( \tau + x_{t+1}(z) - \tau [x_{t+1}(z)]^2 \right) \right\} \, dG(z) \quad (A.9) \]

where

\[
\begin{align*}
x_{t+1}(z) &= 0, \text{ for } z < z_{\text{list}}^t \\
x_{t+1}(z) &= 1, \text{ for } z > z_t^t
\end{align*}
\]

To use the moments of the aggregate profit, we decompose this integral by decomposing the integral in (A.9) as:

\[
\tilde{\tau}_t \equiv \int_{z_{\min}}^{\infty} \pi_t^V(z) (1 - \tau) \, dG(z) - \int_{z_t^t}^{\infty} \pi_t^V(z) (1 - \tau) \, dG(z)
\]

\[
- \left\{ \int_{z_{\text{list}}^t}^{\infty} \pi_t^V(z) x_{t+1}(z) \, dG(z) - \int_{z_t^t}^{\infty} \pi_t^V(z) x_{t+1}(z) \, dG(z) \right\}
\]

\[
+ \tau \left\{ \int_{z_{\text{list}}^t}^{\infty} \pi_t^V(z) [x_{t+1}(z)]^2 \, dG(z) - \int_{z_t^t}^{\infty} \pi_t^V(z) [x_{t+1}(z)]^2 \, dG(z) \right\}
\]

Using the moments of \( \pi_t^V \) as above, and collecting terms, the managerial inefficiency can be rewritten as:

\[ \tilde{\tau}_t = \left( \frac{1}{\theta} \right) \tilde{\epsilon}(1 - \tau) Z_t - \omega Z_t^t \left( \frac{k}{1 - \tau} \right) \quad (A.10) \]

where:

\[
\omega = g_0 \{ (1 - \tau) \nu_1^{(\theta-1)}(1 - 2\tau) \left( \frac{k}{1 - \tau} \right) - \left( \frac{1}{2\tau} \right) \left[ \left( \nu_1^{(\theta-1)} - 1 \right) - \left( \nu_1^{(\theta-1)}(1 - 2\tau)^{-1} - 1 \right) (1 - 2\tau) \left( \frac{k}{1 - \tau} \right) \right] \}
\]

\[
+ \left( \frac{1}{4\tau} \right) \left[ \left( \nu_1^{(\theta-1)} + \nu_{-1}^{(\theta-1)} - 2 \right) - \left( \nu_1^{(\theta-1)}(1 - 2\tau)^{-1} + \nu_{-1}^{(\theta-1)}(1 - 2\tau) - 2 \right) (1 - 2\tau) \left( \frac{k}{1 - \tau} \right) \right] \}
\]

Though messy looking, the equilibrium managerial waste has an intuitive interpretation. The first term, \( \left( \frac{1}{\theta} \right) \tilde{\epsilon}(1 - \tau) Z_t \) corresponds to \( \int_{z_{\min}}^{\infty} \pi_t^V(z) (1 - \tau) \, dG(z) \). In other words, it is the effect of managerial inefficiency in the absence of outside monitoring. Without this monitoring, managerial inefficiency is clearly pro-cyclical and increases with the aggregate economy through \( Z_t \). On the other hand, the second term, \( \omega Z_t^t \left( \frac{k}{1 - \tau} \right) \) corresponds to the offsetting effects of listing, both through
partial listing from $z^{list}_t$ to $z_t$ and from full listing for firms with productivity above $z_t$. It is straightforward to verify that $\omega > 0$ for $k > (\theta - 1)$, our maintained assumption. Therefore, listing always offsets the procyclical impact of managerial inefficiency.

**B.3 Model Solution: Reporting Costs**

We now solve for reporting costs in equation (23) repeated here for convenience:

$$\tilde{f}_t \equiv \int_{z_{\text{min}}}^{\infty} f(x_{t+1}(z)) \, dG(z) = \int_{z^{list}_t}^{\infty} f(x_{t+1}(z)) \, dG(z).$$

Using the assumed form of $f(x_{t+1}(z)) = f_{x_{t+1}}(z)$, we can rewrite the aggregate reporting costs as:

$$\tilde{f}_t \equiv \int_{z^{list}_t}^{\infty} x_{t+1}(z) \, dG(z).$$

To write this relationship in terms of the aggregate state, we use the interior solution of equity sold in equation (33) and adjust for the range where $x_{t+1}(z) = 1$ for $z > z_t$. Thus, we rewrite the integrals as:

$$\tilde{f}_t = \frac{f_t}{27} \int_{z^{list}_t}^{\infty} dG(z) - \frac{f_t}{27} \int_{z^{list}_t}^{\infty} \left(\frac{V_t}{G_t}\right)^{-1} dG(z)$$

$$- \left[\frac{f_t}{27} \int_{z_t}^{\infty} dG(z) - \frac{f_t}{27} \int_{z_t}^{\infty} \left(\frac{V_t}{G_t}\right)^{-1} dG(z)\right]$$

$$+ \frac{f_t}{27} \int_{z_t}^{\infty} dG(z)$$

Using the moments of natural profits in equation (55) and rearranging aggregate reporting costs can be rewritten as:

$$\tilde{f}_t = f_{90} q Z^k_t/(\theta - 1)$$

(A.11)

where

$$q = \left(1 - \nu_{-1}^{(\theta - 1)}\right) \frac{1}{27} \left[(1 - 2\tau)^{-\left(\frac{1}{\theta - 1}\right)} - 1\right] (1 - 2\tau)^{(\frac{1}{\theta - 1})+1}$$

It is straightforward to verify that $q > 0$ and thus aggregate reporting costs are pro-cyclical. The intuition is clear. An increase in productivity increases the number of firms listing, measured by the probability of listing through $g_0$. In turn, the degree of listing is captured in the difference in shares from firms in the intermediate listing range $z^{list}_t < z < z$ and those fully listed above $z$. These offsetting effects are captured by $q$.

**B.4 Model Solution: Euler Equations**

Households enter every period holding the existing shares of firms listed the previous period. During the period, managers issue new shares. Some of these managers may have been unlisted the previous
period. Thus, households consider in their budget constraint the value of two different aggregate sets of shares. We have defined these aggregate market values in the text as in equations (38) and (39) restated here for convenience

\[
V_{t,t-1} \equiv \int_{z_{t-1}^{list}}^{\infty} v_t(z) x_t(z) dG(z),
\]

\[
V_{t,t} \equiv \int_{z_{t}^{list}}^{\infty} v_t(z) x_{t+1}(z) dG(z).
\]

Note that \(V_{t,t}\) differs from \(V_{t,t-1}\) for two reasons. First, in period \(t\) there is a new set of listers. For example, if the productivity shock is positive, then \(z_{t}^{list} < z_{t-1}^{list}\) so that some firms begin to list on the margin. Second, for the firms that were listed at \(t-1\), the number of shares issued will differ. Again, if the productivity shock is positive, then for existing firms, \(x_{t+1} > x_t(z)\) unless firms were previously fully public as above \(\bar{z}\) in which case the number of shares do not respond.

When the asset market opens at time \(t\), households will absorb any additional stock issues in their portfolio. Therefore, they will price both \(V_{t,t-1}\) and \(V_{t,t}\). These are priced according to the Euler equations given in (41) and (42) given here as:

\[
V_{t,t-1} = \beta E_t \left\{ \frac{U'(C_{t+1})}{U'(C_t)} (\Pi_{t+1,t-1} + V_{t+1,t-1}) \right\}
\]

\[
V_{t,t} = \beta E_t \left\{ \frac{U'(C_{t+1})}{U'(C_t)} (\Pi_{t+1,t} + V_{t+1,t}) \right\}
\]

where \(\Pi_{t+1,t}\) are the profits paid to shareholders at time \(t+1\) holding the shares issued at time \(t\) and \(\Pi_{t+1,t-1}\) are the profits paid to shareholders at time \(t+1\) holding the shares issued at time \(t-1\). In other words, \(\Pi_{t+1,t}\) is the same as \(\Pi_{t+1,t-1}\) from equation (37) led one period or:

\[
\Pi_{t+1,t} \equiv \int_{z_t^{list}}^{\infty} \pi_{t+1}(x_{t+2}(z);z) x_{t+1}(z) dG(z)
\]

while \(\Pi_{t+1,t-1}\) is the same integral but based upon shares at \(t-1\):

\[
\Pi_{t+1,t-1} \equiv \int_{z_{t-1}^{list}}^{\infty} \pi_{t+1}(x_{t+2}(z);z) x_t(z) dG(z)
\]

Iterating the Euler equations forward imply that:
\[ V_{t,t-1} = E_t \left\{ \sum_{j=1}^{\infty} \beta^j \frac{U'(C_{t+j})}{U'(C_t)} \Pi_{t+1,t-1} \right\} \]  
\[ V_{t,t} = E_t \left\{ \sum_{j=1}^{\infty} \beta^j \frac{U'(C_{t+j})}{U'(C_t)} \Pi_{t+1,t} \right\} \]  

(A.12)

\section*{C Steady State}

We can now solve for the steady-state of the economy using the sequence of equations described in the Model Set-up section. We drop time subscripts to all steady state variables and impose the steady state production, \( Y = \tilde{z} \). Then, aggregate profits distributed to existing shareholders from equation (A.8) using the solution in terms of aggregate \( Z_t \) becomes:

\[ \Pi = g_0 Z^{k/(\theta-1)} \nu_1^{(\theta-1)} \mathcal{F}(1 - 2\tau) (\frac{z}{\pi - 1}) + \frac{1}{2\tau} \left\{ S_0 - \overline{S}_0 (1 - 2\tau) (\frac{z}{\pi - 1}) \right\} \]

\[ - \frac{\bar{f}}{2\tau} \left[ S_0^* - \overline{S}_0^* (1 - 2\tau) (\frac{z}{\pi - 1}) \right] \}

where \( S_0, \overline{S}_0, S_0^*, \overline{S}_0^* \) are the steady state counterparts to \( S_{t,t-1}, \overline{S}_{t,t-1}, S_{t,t-1}^*, \) and \( \overline{S}_{t,t-1}^* \) where \( Z_t = Z_{t-1} = Z = 1 \). Or more succinctly,

\[ \Pi = g_0 Z^{k/(\theta-1)} X_0 \]  
\[ \text{(A.13)} \]

Similarly, by setting the aggregate shocks to one in equation (A.10), we get that in the steady state managerial inefficiency is:

\[ \tilde{\tau} = \left( \frac{1}{\theta} \right) \tilde{z} (1 - \tau) - \omega \]  
\[ \text{(A.14)} \]

Steady state aggregate reporting costs as determined from equation (A.11) as:

\[ \hat{f} = \bar{f} g_0 q \]  
\[ \text{(A.15)} \]

Next, using the household budget constraint in equilibrium,equation (40)

\[ \Pi + \frac{\theta - 1}{\theta} \tilde{z} = C \]  
\[ \text{(A.16)} \]

where we have used the fact that in steady state there is no net equity issuance so that :\( (V_{t,t} - V_{t,t-1}) = V_{t,\Delta} = V_{0,\Delta} = 0 \).

Finally, the aggregate steady-state resource constraint implies \( \tilde{z} = \tilde{C} + C + \tilde{\tau} + \hat{f} \) which determines managerial consumption:
\[ \hat{C} = \int_{z_{\min}}^{z_{\text{list}}} \pi(0; z) \, dG(z) + \int_{z_{\text{list}}}^{\infty} C(z) \, dG(z). \]  
(A.17)

In addition, the steady state values of market values are given by setting \( Z_t = Z_{t-1} = Z = 1 \) in equations (55) implying that:

\[ V_{0,-1} = V_{0,0} = \frac{\beta}{1 - \beta} \Pi_0 \]  
(A.18)

Thus, in the absence of growth, the steady state value of the equity market is the \( \beta \)-discounted present value of aggregate profits distributed to shareholders.

D Model Dynamics: Solution Details

Given the solution to the model above and the steady state, we can now consider the dynamic responses of all the state variables by first-order log-linearization. We again follow the same sequence as above.

First, we consider the response of profits paid to shareholders. Using the solution to (A.8) and the definitions of \( S_{t,t-1}, \bar{S}_{t,t-1}, S^*_{t,t-1}, \) and \( S^*_{t,t-1} \), the log-linear approximation of these profits becomes:

\[ \hat{\Pi}_{t,t-1} = \left( \frac{k}{\theta - 1} \right) Z_{t-1} + X_1 (Z_t - Z_{t-1}) \]  
(A.19)

where

\[
X_1 = \int \nu_1^{(\theta-1)} (1 - 2\tau) \left( \frac{k}{\tau^{-1}} - 1 \right) \left[ \left( \frac{\tau + 1}{4\tau} \right) \nu_1^{(\theta-1)} - \left( \frac{1}{4\tau} \right) \nu_-^{(\theta-1)} \right] \\
- \left( \frac{1 - 2\tau}{2\tau} \right) \left( \frac{k}{\tau^{-1}} \right) \left( \left( 1 - 2\tau \right)^{-1} \left( \frac{\tau + 1}{4\tau} \right) \nu_1^{(\theta-1)} - \left( 1 - 2\tau \right) \left( \frac{1}{4\tau} \right) \nu_-^{(\theta-1)} \right) \\
- \frac{1}{2\tau} \left[ \left( \frac{\tau + 1}{4\tau} \right) - \left( \frac{1}{4\tau} \right) \nu_-^{2(\theta-1)} \right] \\
+ \left( \frac{1 - 2\tau}{2\tau} \right) \left( \frac{k}{\tau^{-1}} \right) \left[ \left( \frac{\tau + 1}{4\tau} \right) - \left( 1 - 2\tau \right)^2 \left( \frac{1}{4\tau} \right) \nu_-^{2(\theta-1)} \right]
\]

The profit dynamics in equation (A.19) has two components. The first component depends only upon lagged \( Z_{t-1} \). This effect arises because a lagged shock increases listings and thereby profits on the margin by \( \left( \frac{k}{\theta - 1} \right) \). The second component depends upon the percentage increase in productivity over the two periods, \( (Z_t - Z_{t-1}) \). This component captures the increase in profits available for distribution to current shareholders arising from the increase in current profits after managerial inefficiency and reporting costs. The effect includes the endogenous listing decisions of managers in the three regions of \( z \) truncated at \( z_{\text{list}} \) and \( \bar{z}_t \). Clearly, equation (A.19) provides the same equation as given in the text as equation (49).

Next, straightforward log-linearization of the managerial inefficiency equation (A.10) yields:
Again, as we described above, managerial inefficiency has two components. Greater output increases managerial inefficiency for all firms according to natural profits by \( \left( \frac{1}{\theta} \right) \tilde{z}(1 - \tau) \). On the other hand, greater output increases the proportion of aggregate profits from listed firms with this effect measured as: \( \frac{k}{\theta - 1} \). The degree to which firms respond depend upon the differences in aggregate natural profit moments, detailed above in \( \omega \). Clearly, equation (A.20) establishes equation (50) in the text.

Similarly, the response of aggregate reporting costs as determined by log-linearizing equation (A.11) implying:

\[
\hat{f} = \frac{k}{\theta - 1} Z_t \tag{A.21}
\]

The intuition for this result is clear. An increase in output increases the number of firm shares by \( \frac{k}{\theta - 1} \) as described above, increasing reporting costs in this proportion. Equation (A.21) establishes equation (51) in the text. Next, log-linearizing the household budget constraint in equation (40) immediately yields equation (48) in the text. Finally, log-linearizing the aggregate steady-state resource constraint, \( \tilde{z} = \tilde{C} + C + \tilde{\tau} + \tilde{f} \) directly verifies equation (52) in the text.

To determine the evolution of the household budget constraint we must solve for the dynamics of the market values of existing and new equity shares given in equations (38) and (39). For this purpose, we log-linearize the Euler equations (41) and (42) implying:

\[
\begin{align*}
\hat{V}_{t-1} &= E_t \left\{ -\gamma (C_{t+1} - C_t) + \hat{\Pi}_{t+1,t-1} \right\} \\
\hat{V}_{t,t} &= E_t \left\{ -\gamma (C_{t+1} - C_t) + E_{t+1,t} \right\}
\end{align*}
\]

or

\[
\hat{V}_{t,\Delta} = E_t \left\{ -\gamma (C_{t+1} - C_t) + \hat{\Pi}_{t+1,\Delta} \right\}
\]

But we have shown above that at steady state, \( \hat{\Pi}_{t+1,\Delta} = 0 \). That is, profits from newly listed firms are equal to currently listed firms around steady state. In this case, the dynamics of \( \hat{V}_{t,\Delta} \) are simply:

\[
\hat{V}_{t,\Delta} = -\gamma E_t (C_{t+1} - C_t) \tag{A.22}
\]

Intuitively, newly listed firms and previously listed firms will pay out according to the aggregate state in all future periods. Since firms pay dividends to existing shareholders before any new equity issuance, the households are indifferent between holding these firms or the risk-free rate.
Figure 1 Listing Decision Given Productivity
Figure 2 Effects of Productivity Shock

$Z_{t+1} > Z_t$
Figure 3a: Baseline Parameters

\[ \theta = 3.8 \quad k = 3.4 \quad \tau = 0.4 \quad f_R = 0.10 \]

Figure 3b: Baseline Parameters

\[ \theta = 3.8 \quad k = 3.4 \quad \tau = 0.4 \quad f_R = 0.10 \]
Figure 4a: Baseline Parameters
\[ \theta = 3.8 \quad k = 6 \quad \tau = 0.4 \quad f_R = 0.10 \]

Figure 4b: Baseline Parameters
\[ \theta = 3.8 \quad k = 6 \quad \tau = 0.4 \quad f_R = 0.10 \]
Figure 5a: Baseline Parameters
\( \theta=3.8 \ k=3.4 \ \tau=.4 \ f_R=.05 \)

Figure 5b: Baseline Parameters
\( \theta=3.8 \ k=3.4 \ \tau=.4 \ f_R=.05 \)