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Beyond Pangloss: Financial sector origins of inefficient economic booms☆

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ABSTRACT

Government guarantees of bank liabilities have a long-standing history and are now ubiquitous. We study a model where financial sophistication enhances banks' ability to exploit government guarantees and fuels inefficient economic booms. Driven by financial engineering, bank rent extraction creates a disconnect between lending decisions and borrower repayment prospects: In equilibrium, banks over-lend and only break-even courtesy of trading book profit. Exploitability is affected not only by financial sophistication but also by regulation. Given the pattern for regulatory changes in the last few decades, we posit that the Great Recession, partly, reversed a Great Distortion.

1. Introduction

Governments all over the world guarantee a substantial fraction of bank debt. Such guarantees have existed for approximately a century, either explicitly or implicitly. During this time, the financial system has undergone significant changes, particularly from the mid-1980s to the Global Financial Crisis (GFC), which was characterised by deregulation and financial innovation. We show in this paper that financial engineering designed to exploit government guarantees can significantly affect the real economy.

We present a model where banks support their trading book activity with their banking book. Such trading is a form of risk-shifting which is lucrative because it exploits government guarantees. Maximising the associated rents requires an expansion of the banking book. This lending expansion creates a boom in economic activity, but this boom is inefficient. The inefficiency of the boom can be such that real investment never breaks even, even in the most favourable state of the world.

The inefficiency need not be that extreme. The magnitude of the distortion depends on the extent to which banks are able to exploit the guarantees. Broadly speaking, stricter bank capital regulation makes it more difficult for banks to exploit the guarantees, but financial sophistication and deregulation increase exploitability.

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Our model has a banking sector, a firm sector that operates a constant-return-to-scale production function, and risk-neutral households. All agents act competitively. An essential ingredient of our analysis is that bank creditors anticipate that they may be bailed out by the government in bad states of the world. The key mechanisms we analyse do not hinge on the precise nature of the bailouts (nor on whether guarantees are explicit or explicit). For simplicity, we consider the case of deposit insurance.

Starting in a world with no guarantees, financial engineering, or capital regulation, the equilibrium corresponds to a Modigliani–Miller world. The introduction of government guarantees distorts investment decisions: in equilibrium, agents' behaviour is based on valuations that correspond to the best possible outcome. Krugman (1999) calls such valuations Panglossian. Even though financial incentives are distorted, the effects on the real economic outcome are relatively mild.

Introducing financial engineering has a dramatic impact: it pushes valuations *beyond Pangloss*. To capture financial engineering, we allow banks to trade in a set of Arrow securities that are senior to deposits. This captures the real world feature that many financial trades (such as repos and securitised products) are bankruptcy remote. However, government guarantees do not cover Arrow securities. So, given limited liability, banks cannot credibly sell more of any Arrow securities than the total cash flows it will receive (from loan repayment) in the corresponding state. Hence, when a bank expands its banking book, this relaxes the limits it faces on its trading book. Such a mechanism corresponds to the commonly suggested notion that banks use their banking book to support their trading activities. To fix ideas, we use the interpretation that the banking book serves as collateral for the short positions in Arrow securities.

In equilibrium, banks use such trades to extract rent from the taxpayer by moving revenue from the states where they default, to the states where they do not. Since the trades are lucrative, collateral is valuable, and banks produce more of it by lowering their lending standards in order to aggressively expand their banking books. In equilibrium, losses on banking books are just offset by profits on trading books.

We develop a direct measure of the magnitude of the distortion which we call *implied break-even productivity*. It captures the level of realised productivity required for real investment to break even with respect to the opportunity cost of funds, for a given level of capital. Panglossian valuations reflect the best of all possible worlds. They correspond to the highest possible level of productivity. Beyond-Pangloss valuations reflect unattainable productivity outcomes. This extreme result is a transparent illustration of the potential consequences of our key mechanism.

In our general model, we introduce ingredients that affect the exploitability of government guarantees in practice. In particular, we introduce capital requirements and a parameter that captures the extent to which banks are able to pledge their collateral to finance their rent-seeking trades. We find that the former impedes exploitability and the latter increases it. We argue that, through the lens of our model, historical changes in bank regulation and financial innovation led to a significant increase in such exploitability in the two decades leading to the 2008 crisis (Acharya and Richardson, 2009), and, arguably, a dramatic reduction in the immediate aftermath of the crisis.

How surprising is it that financial sophistication adversely affects the real economy? Nobel laureate William Sharpe once told Paul Volcker that financial engineering contributed nothing to economic activity (Volcker and Harper, 2018, p.206). Our take differs: in the presence of government guarantees, financial engineering can boost GDP, but to inefficiently high levels, as they are associated with lower expected consumption.

Previous studies on the macroeconomic effects of government guarantees (which mainly focused on emerging markets) have shown that they may alleviate firm borrowing constraints and boost economic growth. The cost is increased susceptibility to crisis (see McKinnon and Pill (1997), Schneider and Tornell (2004), and Ranciere et al. (2008)).

The trade-off between increased expected output and financial stability is also central to the literature on credit booms (e.g. in fire-sales models such as Lorenzoni (2008)).[1] A key mechanism is that when a negative shock occurs, asset prices fall, which tightens borrowers' credit constraints and magnifies the impact of the shock. Agents do not internalise these effects ex-ante, and the resulting excessive borrowing leads to inefficiently severe downturns when bad shock occurs. Expected output is therefore inefficiently low. Instead, in our setup, expected GDP is inefficiently high, and this can be the case even when the realised shocks are positive.[2]

Korinek (2016) shows that bank bailouts can endogenously emerge if, ex-post, investment is so constrained that households are better off transferring some of their wealth to bankers (because higher investment boosts equilibrium wages). Creating a market for Arrow securities allows bankers to exploit this mechanism further. Our analysis shares two important dimensions with Korinek's: the logic for the optimal trade and the negative impact of financial innovation on allocative efficiency. However, the mechanisms and outcomes are different. Whereas financial innovation worsens ex-post under-investment in Korinek's setup, it magnifies ex-ante over-investment in ours.

Our paper also relates to a broader literature on government guarantees to banks. While guarantees are designed to help alleviate financial panic (Diamond and Dybvig, 1983), they distort bankers' incentives and promote excessive risk-taking (see, e.g. Kareken and Wallace (1978)). Among other ramifications, our work relates to studies on the measurement of the taxpayer burden (e.g. Merton (1977) and Atkeson et al. (2019)), and on how capital requirements can mitigate the problem (e.g. Rochet (1992), Repullo and Suarez (2012), Admati and Hellwig (2014), and Malherbe (2020)).

Beyond our theoretical contribution, our model offers a new, coherent narrative that links deregulation, financial innovation, lowering of lending standards, and the relative performance of the banking and trading books to the behaviour of macroeconomic

[1] See also Shleifer and Vishny (2011) and Brunnermeier and Oehmke (2013) on fire sales; Bolton et al. (2021) on how a global saving glut may have contributed to fragility build up.

[2] In a different class of models, De Meza and Webb (1987) show that information asymmetries can also lead to over-investment.

aggregates. Overall, our model has implications for how one should evaluate the level of GDP in the years around the GFC. Our analysis suggests that decreased exploitability of guarantees may have played a role in the apparent weakness of GDP in the aftermath of the crisis. To the extent that pre-crisis GDP growth reflected inefficiencies due to rent extraction by banks, a decline in GDP should actually be welcome.

Assessing the empirical relevance of the distortion is challenging because many channels are simultaneously at work. We highlight that our narrative is consistent with much of the existing empirical evidence. To assess the strength of the capital distortion, we propose an estimate based on movements in the capital–output ratio not accounted for by other driving variables; in our model, these residuals would reflect the Beyond-Pangloss distortion. While subject to many assumptions, we show that there appears to be an excess boom in investment prior to the GFC, which is consistent with our model's predictions. We calibrate a range of implied estimates for our distortion over time; these estimates depend on how one chooses to strip out the effects, on the capital–output ratio, of many factors unrelated to our distortion. Our back of the envelope approach targets the change in the distortion before the financial crisis, which it places around 5% of GDP. This is sizeable given that the Great Recession was associated with an output gap of 5%–8% (and a typical recession gives rise to an output gap of 1%–3%). This suggests that some of the Great Recession may have been the reversal of a Great Distortion that was due to increased exploitability of government guarantees. In so far as the distortion is quantitatively relevant, a resulting policy takeaway is that distorted levels of GDP before a crisis make an assessment of appropriate amount of policy stimulus even more difficult than the existing literature implies.[3]

2. A baseline panglossian model of inefficient booms

There is a single period and a single consumption good. The economy includes households, a production sector, a banking sector, and a government.

Households. There is a representative risk-neutral household that values end-of-period consumption. It is initially endowed with an amount of consumption good and has access to a safe storage technology with rate of return $r > 0$. We assume that the household is deep-pocketed so that there is positive storage in equilibrium. Hence, the opportunity cost of funds in the economy is $1 + r$. The household is also endowed with one unit of labour, which it supplies inelastically (aggregate labour is normalised to $N = 1$) in return for a wage w. The household pays lump-sum taxes to the government.

Firms. There is a measure one of firms that maximise shareholder value. They operate a constant-returns-to-scale production function which combines physical capital (k) and labour (n) to produce output: $Ak^{\alpha}n^{1-\alpha}$, where $\alpha \in (0, 1)$ and A is aggregate productivity that takes the value A^H with probability $q \geq 0.5$ and a strictly smaller value A^L with probability $(1 - q)$. Capital fully depreciates in production. Firms start penniless and compete for bank financing. For concreteness, we assume financing takes the form of a standard debt contract (we show in Appendix I.6 that this assumption is not a driver of our results). Firms also compete to hire workers. Wages must be paid before any payment can be made to banks. There is free entry in the firm sector (which implies zero expected profit in equilibrium).[4]

Banks. There is a banking sector in which a continuum of banks intermediate lending between households and firms (they have the ability to transform, one for one, consumption goods into capital). There is free entry in the sector and banks raise funds (consumption goods) competitively by issuing liabilities to households. In Section 3, we allow banks to issue any kind of liabilities. But, to build up our argument, we first restrict these liabilities to be deposits and/or equity only.

Government. We consider two different government regimes: one with guarantees, and one without. In the former, deposits are fully insured, at no premium. In case a payment is needed, the government breaks even by imposing an ex-post lump-sum tax on households. Capital requirements are introduced later, in Section 4.1, and we show in Appendix II.2 how the analysis extends to other types of safety nets for creditors (e.g., equity injections that maintain bank solvency).

Timeline. In sequence, banks and firms enter their respective sector and raise funds, firms invest, A realises, firms hire workers, production takes place, factors are paid, banks repay deposits, other financial securities settle (including deposit insurance), taxes are raised, and consumption takes place.

Equilibrium definition. All private agents are price takers and protected by limited liability. In an equilibrium: (i) households maximise expected consumption; (ii) banks and firms maximise shareholder value; (iii) no bank or firm has an incentive to enter the market and no bank or firm makes strictly negative profit in expectation (hence, profits are zero in expectation) (iv); the government breaks even in all states.

[3] There are numerous papers evaluating the post-crisis behaviour of GDP such as Bianchi et al. (2019), de Ridder (2019), Ball (2014), DeLong and Summers (2012), Fatas and Summers (2018), and Crafts (2019). The novel feature of our analysis is that it focuses on factors that distort the behaviour of GDP in the run-up to the crisis, not the aftermath; Fernald (2015) argues that the TFP slowdown is separate to the financial disruption and it had already slowed before the Great Recession.

[4] Positive profits (which only occur out of equilibrium) are distributed to shareholders (the representative household). And shareholders are protected by limited liability in case of losses. So, in effect, banks absorb all losses and there is no need to keep track of firm ownership.

2.1. The economy without government guarantees

Our benchmark economy has no relevant friction and the financial sector is a veil only. In particular, the equilibrium marginal product of capital only depends on the opportunity cost of funds in the economy $(1+r)$, as in Modigliani and Miller (1958). The intuition is simple. Households must break even in expectation. Hence, the cost of funds for banks is $1+r$. By competing, they pass this cost along to the firms, which then invest accordingly. As a result, the competitive equilibrium is efficient.

Definition 1. We refer to the economy without government guarantees as the Modigliani and Miller (or simply MM) economy. Where necessary, we use a subscript MM to indicate variables at the equilibrium of this economy.

Equilibrium investment. Because of constant returns to scale at the firm level, all firms operate at the same capital-to-labour ratio in equilibrium, and total output in the economy is $Y = AK^{\alpha}$, where upper case variables are the aggregate counterparts of the lower cases.

Proposition 1. *The equilibrium allocation in the MM economy is pinned down by the following condition:*

$$\alpha E[A] K_{MM}^{\alpha-1} = 1 + r. \tag{1}$$

Proof. All the proofs are in Appendix I, where we formally solve for the equilibria of the different regimes. □

Implied break-even productivity. Given a level of capital K, one can back out the implied level of realised productivity required for real investment to ex-post just break even with respect to the opportunity cost of funds in the economy. (The relevant value needs not be in the support of A.) Formally, it is defined as:

$$\mathcal{A}(K) \equiv \left\{ A \mid \alpha A K^{\alpha-1} = 1 + r \right\} \tag{2}$$

Corollary 1. *Equilibrium investment in the MM economy is the same as if productivity was deterministic, and equal to* $E[A]$*:*

$$\mathcal{A}(K_{MM}) = E[A]. \tag{3}$$

However, this will generally not be the case in the presence of government guarantees. $\mathcal{A}(K)$ will then provide us with a direct measure of equilibrium distortions: $\mathcal{A}$ increases with over-investment because higher productivity is needed to compensate decreasing marginal return to capital.

2.2. The economy with government guarantees

All securities must yield an expected payoff of $(1+r)$ to their holders in equilibrium. When deposits are insured and the bank defaults with positive probability, part of deposits' payoff comes from the taxpayer. From the bank's point of view, this implicit subsidy makes deposits the cheaper source of finance.

Definition 2. We refer to the economy with government guarantees and no capital requirement as the Panglossian economy (with associated subscript P).

Lemma 1. *In the Panglossian economy the bank only issues deposits in equilibrium.*

Thus, to lend an amount k to firms, the bank must promise to repay $k(1+r)$ to depositors. A bank therefore solves:

$$\max_{k \geq 0} E\left[k(1+\rho_l) - k(1+r)\right]^{+}, \tag{4}$$

where $[.]^{+} \equiv \max\{0, .\}$ and ρ_l is the realised rate of return to lending. In equilibrium, ρ_l depends on A and K. The bank takes K as given, so, from its perspective, ρ_l can only take two values in equilibrium, which we denote ρ_l^L and ρ_l^H. Since the bank has no equity buffer, it is vulnerable to any adverse shock.[5] Hence:

Lemma 2. *In the Panglossian economy the bank fails in state* A^L.

As a result, in effect, the bank ignores the marginal effect of its decisions in the bad state (a marginal increase or decrease in losses is irrelevant to shareholders since they get 0 anyway) and, accordingly, maximises profits in the good state:

$$\max_{k \geq 0} k(1+\rho_l^H) - k(1+r). \tag{5}$$

The associated first order condition $(\rho_l^H \leq r)$ binds in equilibrium.

[5] Later, when we introduce capital requirements, the bank is vulnerable if its equity buffer is insufficient compared to the shock.

Proposition 2. *The equilibrium allocation in the Panglossian economy is pinned down by the condition:* $1+\rho_l^H \equiv \alpha A^H K_P^{\alpha-1} = 1+r$.

Corollary 2. *In the Panglossian economy, investment only breaks even if productivity is at its highest:*

$$\mathcal{A}(K_P) = A^H. \tag{6}$$

Note that $1+\rho_l^H = 1+r$ implies banks only break even on lending if the high state realises. Why are they willing to lend, then? Because the taxpayer is on the hook for the downside risk. Hence, what matters to banks is profits in the good state. But such profits are competed away in equilibrium. Hence, they lend up to the point where they just break even in the high state.[6] Competition also means that the artificially low rates at which banks borrow deposits are passed onto firms. Firms, in turn, equate the capital marginal rate of return to this rate, which explains over-investment (formally $1+\rho_l^H = 1+r$ implies $E[1+\rho_l] < 1+r$). So, equilibrium investment corresponds to the efficient level in a fictitious world where productivity would always be at its highest level. Accordingly, Krugman (1999) dubs such equilibrium valuation of loans *Panglossian*. This is after Professor Pangloss who, in Voltaire (1759), argues that *all is for the best, in the best of all possible worlds*.

Proposition 3. *In the Panglossian equilibrium, investment is inefficiently high. That is, while gross output is higher than in the MM economy, expected consumption is lower.*

Investment (K) comes out of the household's endowment and generates Gross Domestic Product (GDP) AK^α. The part of the endowment that is not invested is kept in storage (at the rate of return r). Ultimately, GDP goes to households.[7] In case of a bailout, they pay a tax that just offsets the transfer they receive. Hence, in equilibrium, household consumption boils down to:

$$\underbrace{E\left[AK^\alpha\right]}_{\text{GDP}} + \underbrace{(\text{endowment} - K)(1+r)}_{\text{storage}} = \underbrace{E\left[AK^\alpha - K(1+r)\right]}_{\text{NDP}} + \underbrace{\text{endowment} \times (1+r)}_{\text{Future value of endowment}}$$

Economic efficiency must take depreciation into account, at the opportunity cost of funds. That is, the relevant statistic for expected consumption is not GDP, but Net Domestic Product (NDP): $E\left[AK^\alpha - K(1+r)\right]$. NDP is maximised at the point where the expected marginal product of capital equals $1+r$. Any further investment increases GDP (for any realisation of A), but decreases expected consumption.

Remark 1. In the Panglossian economy, higher equilibrium investment (compared to the MM economy) translates into higher wages too, for any given realisation of A. Expected consumption is lower because the increase in expected wage is more than offset by the expected tax bill associated with the depositor bailout.

Remark 2. In our model, Panglossian effects materialise in equilibrium quantities for capital (which is supplied elastically) and in equilibrium prices for labour (which is supplied inelastically). In Appendix II.4 we show that the logic generalises to production factors of intermediate supply elasticity.

3. Beyond Pangloss: Financial engineering and magnification

In the Panglossian economy, the bank fails in the low state. Shareholders are protected by limited liability and depositors are fully compensated by the taxpayer. Hence, the extent of bankruptcy does not matter to either of them. From the bank's point of view, any repayment made to depositors in the low state can therefore be seen as money left on the table. This gives banks an incentive to divert cash flows from the low state towards the high state. As they do so, the distortion from government guarantees is magnified to the point that implied break-even productivity actually goes *beyond* Pangloss.

3.1. The Beyond Pangloss economy

The economy is the Panglossian economy but with a trading environment:

(i) The representative bank can trade in a set of Arrow securities: security H is a promise to pay 1 unit of consumption good in state A^H, and similarly for security L in state A^L. These securities trade competitively in financial markets and are actuarially fairly priced (which follows from risk neutrality): their prices are $q/(1+r)$ and $(1-q)/(1+r)$, respectively. The only constraint on the bank's ex-ante trading position is that it must be self-financed. Hence, to be able to buy some securities, the bank must sell others. Formally, we impose: $qh + (1-q)l \leq 0$, where h and l denote the bank's net holding of the two securities (a negative number indicates a short position). (In the next section, we explicitly introduce capital requirements and banking supervision. Both will affect the bank's ability to use security trading to extract rent.)

(ii) We continue to assume that labour is senior to capital. Additionally, we assume that Arrow securities are senior to deposits. This captures the real world feature that many financial trades (such as repos and securitised products) are bankruptcy remote

[6] In contrast, in the MM economy, the bank charges a higher interest rate to the firm to compensate for the losses in the bad state. Given this higher interest rate, the firm internalises the downside and makes a socially efficient investment decision.

[7] They not only receive the labour share, but also the capital share (they receive their deposits back and, potentially, a dividend as shareholders).

(discussed further in Section 5). However, government guarantees do not cover Arrow securities. Hence, the bank cannot credibly promise a payment in a given state of the world that is higher than the total cash flows it will receive in that state (from its loan portfolio or other financial trades).

Definition 3. We refer to the economy with government guarantees, no capital requirement, and security trading as the Beyond Pangloss economy (with associated subscript BP for equilibrium variables).

3.2. Beyond Pangloss equilibrium

Lemma 3. *Given an amount of lending k, and associated rates of return ρ_l^L and ρ_l^H, the optimal trade for the bank is given by $l = -(1+\rho_l^L)k$ and $h = \frac{(1-q)}{q}(1+\rho_l^L)k$.*

For a given amount of lending k, the maximum amount the representative bank can credibly commit to repay in state A^L is $(1+\rho_l^L)k$. The natural interpretation is that the bank faces a collateral constraint: $-l \leq (1+\rho_l^L)k$. Selling security L increases the losses of the bank in the low state. But this does not directly affect its expected profits because of limited liability (based on Lemma 2, we take for granted that the bank fails in state A^L). Hence, from the bank's perspective, the expected marginal cost of selling the L security is nil (this corresponds to selling promises that will be honoured with resources that would otherwise be used to repay depositors). The strategy that maximises trading profit directly follows: sell as much as possible of the L security, and use the proceeds to buy the H security. Since the securities are fairly priced, this allows the bank to buy $h = \frac{(1-q)}{q}(1+\rho_l^L)k$ of the H security.[8]

Our trading environment is extremely stylised. Inspired by financial innovation before the GFC, we wish to capture the essence of the mechanism whereby banks use securitised loans as bankruptcy-remote collateral to support speculative trades that magnifies risks they are initially exposed to. (More on this in Section 4.)

In practice, existing trading opportunities do not span the full state space. Furthermore, the optimal trade constitutes blatant gambling with taxpayer money. In Appendix II.1, we show that the optimal trade can be implemented, under some conditions, through standard repo contracts. So, the mechanism also works with trades that are more realistic, in the sense that they could be disguised as legitimate ones.

Optimal lending in the presence of trading. Lemma 3 establishes the optimal trading strategy for a given k. In the good state, the bank receives a payment equal to h. Hence, its lending problem can be rewritten:

$$\max_{k\geq 0} \left(\rho_{l,\mathrm{BP}}^H - r\right) k + \underbrace{\frac{(1-q)}{q}\left(1+\rho_{l,\mathrm{BP}}^L\right)k}_{=h}. \tag{7}$$

In equilibrium, we get:

$$q(1+\rho_{l,\mathrm{BP}}^H) + (1-q)(1+\rho_{l,\mathrm{BP}}^L) = q(1+r) \tag{8}$$

The second term on the left-hand side shows that more lending helps relax the collateral constraint and allows the bank to buy more of the security that pays in the good state. Given (8), we have $E[1+\rho_{l,\mathrm{BP}}] = q(1+r)$, and the first order conditions of the firm yield (9) below.

Financial trading magnifies over investment.

Proposition 4. *The Beyond Pangloss equilibrium allocation is pinned down by:*

$$\alpha E[A] K_{BP}^{\alpha-1} = q(1+r). \tag{9}$$

So, investment is even higher (and more inefficient) than in the Panglossian equilibrium $\left(K_{\mathrm{BP}} > K_{\mathrm{P}}\right)$.[9]

To get the intuition, evaluate the objective function at the *Panglossian* level of lending K_{P} (as opposed to *Beyond-Panglossian* level K_{BP}):

$$\underbrace{\left(\rho_{l,\mathrm{P}}^H - r\right)}_{=0} k + \underbrace{\frac{(1-q)}{q}(1+\rho_{l,\mathrm{P}}^L)k}_{>0} > 0, \tag{10}$$

and notice that banks just break even on loans in the good state (the first term is nil), but make strictly positive profit on trading in that state. From an individual bank's point of view, profits are proportional to collateral. Hence, it is profitable to issue more loans.

[8] This strategy is similar to that in Korinek (2016) where bankers funnel their endowment from a low state to a high state, which results in larger bailouts in the former. Korinek shows that such trades can also be interpreted as distorted ex-ante productive decisions.

[9] The equilibrium wage is: $w_{\mathrm{BP}} = (1-\alpha)E[A]K_{\mathrm{BP}}^{\alpha}$. It is not necessarily greater than that in the Panglossian equilibrium. See Appendix III for details.

However, in the aggregate, the marginal return to lending is decreasing. The equilibrium will be reached when banks' expected profits are nil, that is when the expected loss from the banking book are just offset by profits form the trading book:

$$\underbrace{\left(\rho^{H}_{l,\mathrm{BP}} - r\right) k}_{\text{lending losses}} + \underbrace{\frac{(1-q)}{q}(1+\rho^{L}_{l,\mathrm{BP}})k}_{\text{trading profit}} = 0. \tag{11}$$

Eq. (11) suggests a novel interpretation to the well-documented decrease in lending standards in the run up to the crisis in the US and other countries (see, e.g., Keys et al. (2010) and Bassett et al. (2014)), and for the sharp increase in the importance of trading activities for bank profits. In particular, an implication of the model is that, as banks become better able to exploit the guarantees, trading book profits should grow in importance relative to profits from the loan book, *despite* an increase in lending volume.[10] Haldane and Alessandri (2009) document the growth of the trading book as a source of bank profits. They describe the period before the financial crisis as "an Alice in Wonderland world in which everybody had won and all had prizes".[11] When the financial crisis came, they highlight that trading book losses were sizeable. Atkeson et al. (2019) decompose movements in the ratio of banks' market value of equity over book value of equity into franchise value and the value of government guarantees. This ratio grew strongly prior to the financial crisis and then declined sharply. Our model is consistent with their interpretation of this phenomenon, as they emphasise the role of banks' efforts to "increase leverage and exposure to losses in credit crisis states" as a primary driver of the time-variation of the value of government guarantees. In our model, however, we additionally emphasise the importance of competitive forces and, in the next section, we will also formalise the role of the exploitability of guarantees in determining the size of the distortion.

Beyond Pangloss: A complete-disconnect result.

Corollary 3. *In the Beyond Pangloss economy, even in the high state, investment does not break even:*

$$\mathcal{A}(K_{BP}) = A^H + \frac{1-q}{q}A^L > A^H. \tag{12}$$

In the Panglossian equilibrium, banks value loans based on implied productivity A^H. With financial trading, banks value loans based on an even higher implied productivity. In fact, the implied equilibrium valuation corresponds to that in a fictitious economy where realised productivity is always impossibly high. Hence, we say that the equilibrium allocation is *beyond Pangloss*.

Of course, such an outcome is extreme and somewhat unrealistic. In practice, banks face restrictions on their on- and off-balance-sheet risk exposure and are subject to supervision. We examine the impact of these on limiting the trading activity of banks in Section 4.1. Nevertheless, this extreme outcome illustrates that financial engineering that is aimed at rent extraction from government guarantees can lead to a total disconnect between lending decisions and borrower repayment prospects: even in the most favourable state, the real investment associated with the marginal loan does not break even, and banks can only break even on the loan thanks to the associated trading book profit. Financial sophistication, therefore, generates an inefficiency in which expected economic surplus not only is lower, but is also ex-post inefficient in all possible states. This contrasts with models where increased financial instability is the cost to pay for higher expected economic surplus.

4. The exploitability of guarantees

We now introduce our general model, in which we show how the magnitude of the distortion depends crucially on the exploitability of government guarantees. Such exploitability decreases in the tightness of capital regulation and the intensity of bank supervision, and increases in the sophistication of the banking sector.

4.1. Capital requirements, financial innovation, and supervision

First, assume that banks face a capital requirement: equity must be at least a fraction $\gamma \in (0,1)$ of lending. Given deposits are implicitly subsidised, the constraint will bind in equilibrium.[12] We broadly interpret γ as the strictness of prudential regulation (which, in practice, involves different risk-weights for different assets and several tiers of capital requirements).

Second, assume that banks can only use a fraction $\phi \in (0,1)$ of the proceeds from lending as collateral. Accordingly, we refer to ϕ as pledgeability. However, the reader should keep in mind that what we aim to capture is both a measure of financial innovation, or bank sophistication, and the extent to which financial supervisors tolerate (or are unable to detect) the use financial trades for gambling with taxpayer money.

[10] See Philippon (2015) on the surge in the volume of intermediation.

[11] And the more complete answer that William Sharpe gave Paul Volcker, discussed in the introduction, was that financial engineering "just moves the [economic] rents in the financial system" and "it's a lot of fun" (Volcker and Harper, 2018, p.206).

[12] In reality, capital requirement do not exactly bind, as banks would risk breaching them with the smallest negative shock. However, there is growing evidence that they are essentially binding. See, for instance, Bahaj and Malherbe (2016) and Jiang et al. (2020).

Assuming the bank still fails in the low state (which, as we show below, will be the case unless γ is sufficiently high and ϕ sufficiently low), the bank expected profit is:

$$q\underbrace{\left((1+\rho_l^H)k - \underbrace{(1-\gamma)(1+r)k}_{\text{deposit repayment}} + \underbrace{\frac{1-q}{q}\phi(1+\rho_l^L)k}_{=h}\right)}_{\text{payoff in the high state}} - \underbrace{\gamma(1+r)k}_{\text{cost of equity}}. \tag{13}$$

The first term differs in two ways compared to the previous section. First, only $(1-\gamma)$ deposits can be used per unit of lending, which affects the due repayment. Second, only a fraction ϕ of the low-state cash flow can be used has collateral, which affects the trading profit h. The second term appears because the bank now has to raise an amount γk in equity upfront (and shareholders' opportunity cost of funds is $1+r$).

Dividing across by q gives the realised profit in state H. Note that a unit repayment of $\frac{1+r}{q}$ is needed for shareholders to compensate their losses in the low state (where they are wiped out). In contrast, as before, depositors accept a promised repayment of $1+r$ because they are always made whole courtesy of the taxpayer.

Using subscript G to denote equilibrium variable in the general model, the equilibrium conditions (first order, zero profit, and market clearing) yield:

Proposition 5. *In the general model with guarantees, trading, capital requirement γ, and limited pledgeability ϕ, the equilibrium capital stock, denoted K_G, is pinned down by the following condition:*

$$\alpha K_G^{\alpha-1}\left(A^H + \frac{(1-q)}{q}\phi A^L\right)\left(\frac{q}{q+\gamma(1-q)}\right) = (1+r). \tag{14}$$

Corollary 4. *In the general model, equilibrium implied break-even productivity is:*

$$\mathcal{A}(K_G) = \left(A^H + \frac{(1-q)}{q}\phi A^L\right)\left(\frac{q}{q+\gamma(1-q)}\right). \tag{15}$$

It is increasing in ϕ and decreasing in γ.

Again, $\mathcal{A}(K)$ provides a direct measure of the magnitude of the distortion in equilibrium.[13] Here, it is made up of two parts that interact.

The first part is the Beyond Pangloss effect described in Section 3, adjusted for the limit on loan cash flows pledgeability (ϕ). Intuitively, $\mathcal{A}(K_G)$ increases with ϕ: the higher the pledgeability (which, again, should be interpreted as a higher sophistication of the financial sector and/or looser supervision), the higher the distortion.

The second part reflects that $\mathcal{A}(K_G)$ decreases with the capital requirements. Since shareholders lose money in the bad state, they will only enter up to the point where the profit they make in the good state just offsets (in expectation) their losses in the bad state. Lower entry means a decrease in the equilibrium level of investment and mitigates the distortion.

Franchise value. Besides capital requirements, bank franchise value may affect incentives to shift risk (as any defaulting bank would lose the benefit of future rents). Our model is static and therefore abstracts from such a mechanism. However, we conjecture that our mechanism would still operate in a dynamic model. The logic is the following: limited liability makes the objective function of the bank convex. Hence, we get corner solutions at the bank level. However, at the aggregate level (as in Martinez-Miera and Suarez (2012)), we would likely get bank specialisation up to the point where individual banks are indifferent: some banks would go all in on risks (using Arrow securities, and therefore overvaluing collateral, as in our mechanism) and some banks would play safe, in order to survive if the low state occurs and benefit from reduced competition.

4.2. The scale of the capital distortion

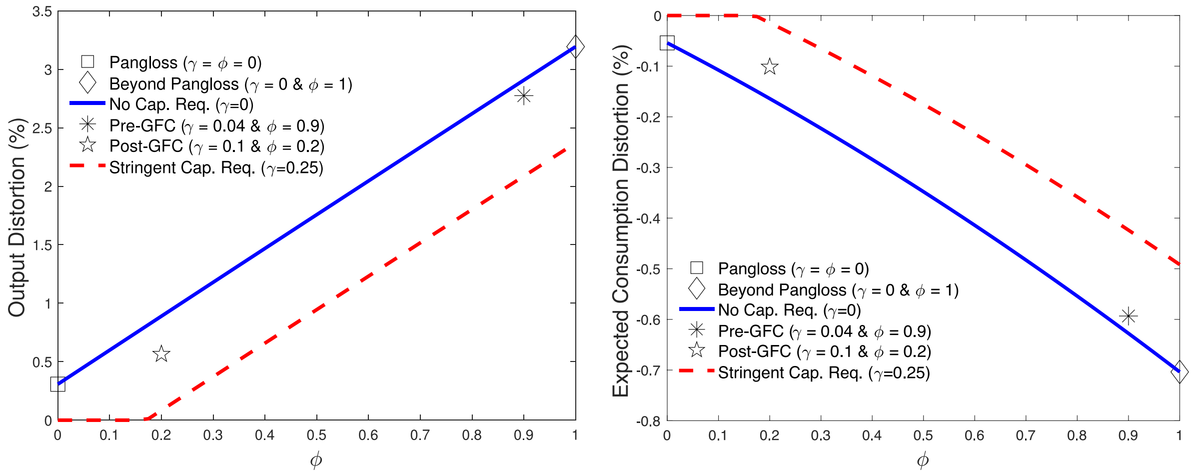
We now explore the quantitative relevance of the distortion in a simple calibration exercise to show that the distortion can be economically meaningful. The key takeaway is that, for reasonable calibrations, even at high capital requirements, pledgeability gives rise to a substantial magnification of the basic Panglossian inefficiency induced by guarantees.

We compare our general model to the MM economy. We first focus on the visible symptoms: over-investment and higher GDP.[14] Then, we translate this into a measure of decreased expected consumption.

[13] Noting that $\mathcal{A}\left(K_G \mid \gamma=0,\phi=0\right) = \mathcal{A}\left(K_P\right)$ and $\mathcal{A}\left(K_G \mid \gamma=0,\phi=1\right) = \mathcal{A}\left(K_{BP}\right)$ make clear that the Panglossian, and Beyond-Panglossian economies are special cases of the general model.

[14] From Propositions 1 and 5, where Y_G and Y_{MM} denote GDP in each model respectively, we get:

$$\frac{K_G(\gamma,\phi)}{K_{MM}} = \left(\frac{\mathcal{A}(K_G(\gamma,\phi))}{E[A]}\right)^{\frac{1}{1-\alpha}}; \text{ and } \frac{Y_G(\gamma,\phi)}{Y_{MM}} = \left(\frac{\mathcal{A}(K_G(\gamma,\phi))}{E[A]}\right)^{\frac{\alpha}{1-\alpha}}. \tag{16}$$



(a) Effect of ϕ on the output distortion (b) Effect of ϕ on the consumption

Fig. 1. Model effects of varying pledgeability (ϕ). Notes: These figures shows a calibration of the general model in Section 4.1. The outcome variable (on the vertical axis) is plotted for different values of pledgeability between 0 and 1 for the cases of no capital requirements (blue solid line) and stringent capital requirements (red, dashed line). The markers highlight the four specific environments as described in the text.

The key parameters are those determining the exploitability of the guarantees (ϕ and γ); we shall consider a variety of values for them, and in Appendix Section IV we consider an even wider range of calibrations.[15]

In Fig. 1(a) we show the relative output distortion, and in Fig. 1(b) the relative distortion to expected consumption. In each, we plot the relative distortion for all possible pledgeability values ($\phi \in [0, 1]$) considering two benchmark regulatory regimes namely no capital requirements ($\gamma = 0$) and stringent capital requirements ($\gamma = 0.25$ which, given real world typical average risk-weights of 50%, corresponds to a capital requirement of 50% of risk-weighted assets). We also highlight the Panglossian environment ($\phi = \gamma = 0$) and the Beyond Pangloss environment ($\gamma = 0$ and $\phi = 1$). To fix ideas, we also examine two more realistic environments: a low regulation, high pledgeability regime which we label Pre-GFC ($\gamma = 0.04$ and $\phi = 0.9$); and a high regulation, moderate pledgeability which we label Post-GFC ($\gamma = 0.1$ and $\phi = 0.2$).[16]

In the Panglossian economy ($\phi = \gamma = 0$), output is greater (than in the MM economy) by 0.3% and expected consumption is lower by 0.05%. These are modest numbers, in terms of economic significance, and compared to what follows. Imposing capital requirements makes them even lower (e.g., a 4% requirement reduces them by almost a half).

However, sophistication in the financial sector and supervisory forbearance can lead to an impressive magnification of the distortion. For instance, our Pre-GFC regime ($\gamma = 0.04$ and $\phi = 0.9$) adds nearly 3% to GDP (compared to the MM economy) but translates in a 0.6% loss in expected consumption. For context, this is an order of magnitude larger than Lucas's (1987) welfare cost of business cycles. In contrast, in our Post-GFC regime ($\gamma = 0.1$ and $\phi = 0.2$), the numbers are back to more modest levels, not far from the Panglossian outcome.

Capital requirement, restriction on trades, and stress tests. For all $\gamma < 1$, there exists a $\phi \leq 1$ such that the bank fails in equilibrium. So, no matter how stringent capital requirements are (excluding $\gamma = 1$, and noting that trading activities are not covered by the requirement), there exists a sophistication level for the financial sector at which Beyond Pangloss effects more than offset the mitigating impact of capital regulation. This result provides a foundation for regulation, such as the Volcker Rule, that aims to curb bank trading activities.

The result also speaks to the attempt by regulators to incorporate derivatives exposures into regulatory capital requirements. As mentioned above, we do not impose capital requirements on financial trades in our model. But, in practice, banks do face constraints of this sort, so our setup can be seen as an extreme case of laissez-faire. However, we also assume that trades cannot be directly financed by deposits. But, in practice, they sometimes can. A recent case in point is that of Silicon Valley Bank using huge amounts of deposits (ex-ante uninsured but ex-post insured) to invest in a portfolio of securities that were: (i) massively exposed to interest rate risk; (ii) carrying zero risk-weight. In such cases, our set of assumptions may actually look conservative. All in all, the only way for capital requirements to prevent risk-shifting in our model is to make sure that the bank cannot default, even in the worst possible scenario. This resonates with the logic for stress-tests exercises that have been imposed on banks since the global financial crisis.

[15] Other parameters are calibrated as follows (see Appendix IV for more details). The production function parameter, α, is set to 0.38 and the real interest rate r to 2%. We calibrate the states of the world as a relatively infrequent but large shock. We assume that there is a 10% productivity loss in the low state ($A^H = 1$ and $A^L = 0.9$); the low state only occurs about once every 20 years ($q = 0.95$). This calibration satisfies the requirement that $A^L - (1 - \alpha)A^H > 0$ so that the firm can repay wages in full in state A^L.

[16] Recall that pledgeability increases with ϕ and that $\gamma = 0.04$ corresponds to the Basel I pre-crisis 8% regulatory requirement, and $\gamma = 0.1$ to a conservative upper bound for post-GFC requirements (Basel III requirements are in the double digits of risk-weighted assets, but below 20%).

Table 1
Important milestones which increased the exploitability of guarantees.

Year	Milestone
1984	Repurchase agreements are confirmed to be bankruptcy remote (extended in mid-1990s and 2005).
1996	The Glass-Steagall Act is reinterpreted to allow banks to have up to 25% of revenue from their investment banking activities.
1997	Bear Sterns securities the first loans under the Community Reinvestment Act (these, potentially problematic, loans are guaranteed by Fannie Mae).
1999	The Glass-Steagall Act is repealed.
2000	The FDIC grants safe harbour protection (i.e. bankruptcy remoteness) for securitisation.
2004	The SEC removes leverage restriction on investment banks.
2004	The OCC removes anti-predatory lending restrictions on national banks.

5. Exploitability in practice: Milestones in the US financial sector since the 1990s

In our analysis, an environment with guarantees is necessary for a Panglossian distortion to operate. But, as highlighted in the previous section, sufficient exploitability is necessary for a substantial inefficiency. As just described, a strict regulatory environment can mitigate exploitability. So, banks have incentives to lobby against regulation and to innovate to circumvent it. We argue that, in the two decades leading to the 2008 crisis, the US saw a significant increase in exploitability, and a dramatic reduction in the aftermath of the crisis.

In terms of the pre-crisis increase in exploitability, we argue that both weakening of regulation and financial innovation may have been important. Engineering trades that resemble the optimal positions in Arrow securities in the model require several ingredients. An essential one, was to make such trades effectively senior to deposits. In practice, this mainly happened with the creation of new financial products (e.g. collateralised loan obligations, or *CLOs*) and contracts (e.g. repurchase agreements, or *repos*) that were structured in a way that made them bankruptcy remote (which means that even the most senior claimants in the bankruptcy cannot touch the proceeds). Another important ingredient was to be able (and allowed) to lend more in the aggregate. Again, financial innovation helped banks to extend credit to new classes of borrowers (e.g. in the sub-prime segment), but removal of regulation also enabled aggressive increases in lending volume in such segments. Finally, a mix of regulatory capture and forbearance arguably contributed to making guarantees more exploitable.

Pre-crisis growth of exploitability was somewhat gradual as such changes in regulation and sophistication happened over time. As an illustration, Table 1 provides a selected list of important milestones which increased the exploitability of guarantees:

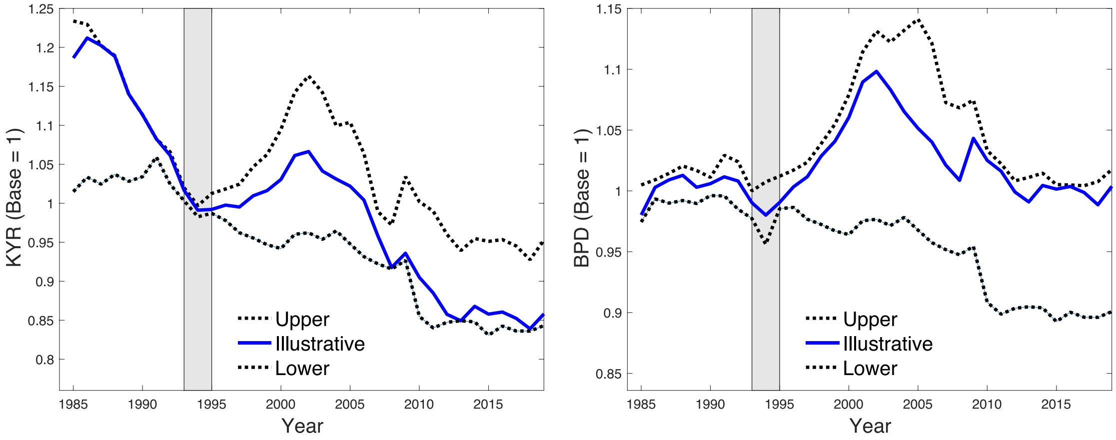
In practice, all banks did not improve their sophistication (and therefore their ability to exploit the guarantees) at the same time. In the early years, due to limited competition, it may have been the case that trading book profit was not offset by expected losses on lending.

In the aftermath of the GFC, government guarantees, of course, did not disappear fully, though they have become more limited (see, e.g. Berndt et al. (2020)). Even during the SVB collapse, there was widespread concern that the deposits beyond the $\$250,000$ guaranteed by the FDIC would be lost but the Treasury Department, the Federal Reserve, and the FDIC announced that depositors would not lose out. We do not want to argue there was no residual effect of guarantees, but rather that the regulatory crackdown that followed the crisis contributed to a decrease in banks' ability to exploit the guarantees. This would mitigate the impact of guarantees on economic activity. For example, the Volcker Rule limits proprietary trading and stress-tests aim to make sure that, even in the most adverse scenario, banks would not fail. If we take stress tests' recent positive results at face value, this rules out Panglossian valuation (and beyond), and could also explain a reversion to a lower but more efficient and sustainable level of GDP.

A large literature discusses the political economy aspects of financial regulation (see, for example, Wolfson and Epstein, 2013). This includes discussion of the idea that regulation could be cyclical (Dagher, 2018; Almasi et al., 2018). Such cycles of tougher and more lenient financial regulation could result from time variation in the bargaining power of politicians, policy makers and the financial industry (Calomiris and Haber, 2014). Or it could be fading memories of crises that contribute to such regulatory cycles (Reinhart and Rogoff, 2009, p.287). And the decade since the GFC has, predictably, been marked by moves to relax some of the post-GFC regulatory environment. Volcker colourfully describes the period as being characterised by "scurrying lobbyist chipmunks nibbling away in the name of efficiency and simplification (good, in itself), but with the ultimate aim of weakening the new safeguards" (Volcker and Harper, 2018, p.209). And new financial innovation may serve the purpose of circumventing regulation. Such efforts, though gradual, would be expected to increase exploitability. In our model, this would be associated with an increase in GDP as the economy moves, once again, to a distorted level of output.

6. The Beyond Pangloss distortion and the Great Distortion

The main message of the paper is that the Beyond-Pangloss distortion, driven by the exploitability of government guarantees in the financial system, can lead to inefficiently high GDP. A series of stylised facts about the behaviour of the US economy prior to the GFC are consistent with the predictions from our model. This includes the rise in the ratio of GDP to NDP, the growing importance of trading profits for financial firms, the loosening of lending standards and unusually large dividend payouts, as well as the behaviour of real wages, which seems to have grown strongly relative to productivity until 2000, and then stalled. Qualitatively, our narrative



(a) Capital-Output Residuals (KYR_t) (b) Beyond-Pangloss Distortion (BPD_t)

Fig. 2. Estimates of the Beyond Pangloss distortion - BPD_t. Notes: These figures display alternative estimates of the KYR_t (left panel) and BPD_t (right panel) series making different assumptions on confounding factors and, for the BPD_t, different approaches to detrending. The shaded area indicates the base years.

is also consistent with the finding that financial crises are associated with persistent declines in GDP (e.g., Jordà et al. (2013)), and with Adrian et al. (2019) who show that credit booms predict an increase in the volatility of GDP growth and a decline in its mean.

Even though attempts at quantifying the implicit subsidy generated by government guarantees go back a long way (e.g. Merton (1977)), its economic significance was typically downplayed until the GFC. Since then, however, many papers have documented sizeable amounts for both ex-ante subsidies and ex-post bailouts (see, e.g. Acharya et al. (2016), Atkeson et al. (2019) and Kelly et al. (2016)). Such quantification exercises are challenging. Measuring the associated distortions in the real economy is even more challenging,[17] and an econometric estimation of the distortion is beyond the scope of this paper. Nonetheless, we propose a simple framework in the spirit of Solow (1957) to give a back-of-the-envelope estimate of the change in the size of the distortion over time. Evidence of a meaningful distortion would imply some of the persistent weakness of the economy since 2010 may relate to an unwinding of inefficiently high GDP before the GFC.

The framework is described fully in Appendix V. The overall idea is that the effects of the distortion could be measured by examining changes in the economy's capital to output ratio. Recognising that many factors unrelated to our distortion are known drivers of the capital–output ratio, we take care to control for these confounding factors. At short horizons, these include variation in the cost of capital, depreciation rates and productivity; we use available data to control for confounding factors which leaves us with the capital–output residuals (KYR) that cannot be explained in a frictionless model with a neoclassical production function.[18] Taking to our model at face value, KYR measures the distortion we have highlighted. The left panel of Fig. 2 shows an illustrative calculation from this approach as well as the upper and lower bounds that come from using different combinations of capital measures from different sources (e.g. BLS or BEA) and different assumptions on confounding variables.

Over a long horizon, there are changes in the structure of the economy which make the investment to GDP ratio hard to compare (and the effect of these differs between BLS and BEA measures of capital stock). One strategy to account for these other, unmeasured, confounding factors, is to remove trends from the residuals to back out the part that is plausibly due to the Beyond-Pangloss Distortion; we call the series BPD. In the right hand panel of Fig. 2 we plot the calculation from this approach and the upper and lower bounds, where now the range of outcomes also depends on the choice of alternative detrending approaches. Based on the estimates, the distortion under our illustrative example averages around 5% of GDP before the GFC. This is sizeable given that recessions typically give rise to a negative output gap of 1%–3%. Even under alternative choices which do not appear to have increased before the GFC, there is a sizeable drop around the GFC which is important as this calculation just captures the change in the distortion.

Taking these at face value, some of the Great Recession may have been the reversal of a Great Distortion that was due to increased exploitability of government guarantees. However, other factors, such as market power or taxes, could have been distorting investment and output below or above their efficient level. While it may be tempting to think that factors that we may not have controlled for adequately would reduce the scale of the distortion, that is not necessarily the case. Though even if these other forces pushed us below the efficient level, it is not clear that a distorted (and riskier) financial allocation is the best way to increase efficiency; an investment subsidy would seem more appropriate.

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[17] For instance, as shown by Bahaj and Malherbe (2020), since the implicit subsidy is state contingent, it may in fact make the bank *undervalue* the marginal loan if its risk profile differs from that of the rest of the balance sheet.

[18] We use independent measures of the evolution of these factors over time to filter out the effect a secular decline in interest rates affecting the cost of finance (r_t), the rate of depreciation (δ_t) from BEA data on nominal capital consumption, and actual productivity relative to its expected value $\left(A_t/E_{t-1}[A_t]\right)$ which we measure using capacity-utilisation-adjusted TFP estimates (Fernald, 2012) relative to a rolling AR(1) with trend forecasting model.

Moreover, our back-of-the-envelope calculation only focuses on the quantity dimension of the distortion; the impact of the distortion on prices is not captured. This suggests our BPD estimate is only a partial reflection of the overall distortion in reality. As we describe in Appendix II.4, the more inelastic a factor of production the more the Beyond Pangloss distortion materialises in higher asset prices rather than in high quantities. The overall price of investment has been on a well-documented secular downward trend since the 1970s. But this trend is driven by the price decline equipment goods. There is evidence that structures increased in prices and in quantities in the run-up to the GFC (see e.g., Rognlie et al. (2018)).

Notwithstanding the challenges in measuring the distortion, an important take-away is that such distortions complicate the real-time assessment of economic activity. This is particularly problematic after a financial crisis because pre-crisis data is a poor guide to the sustainable level of activity which economic policy should try to achieve. If some of the Great Recession reflects the reversal of a distortion, the amount of demand stimulus that was warranted would be reduced.[19]

7. Conclusion

Our central message is that financial engineering that enables banks to exploit government guarantees fuels inefficient credit booms. The inefficiency reflects a disconnect between lending decisions and borrower repayment prospects. The real investment associated with the marginal loan does not break even, and banks can only break even on the loan thanks to the associated trading book profit.

The second key message is that while capital regulation helps, other measures to reduce exploitability of government guarantees should go hand in hand. These could include the use of stress tests or other measures (such as the Volcker Rule) that limit the use of loan books as collateral in financial trades.

We have argued that, along a number of dimensions, the US economy in the run up to the GFC behaved in a manner that is consistent with the predictions of our model. And our quantification of the distortion suggests a role for our mechanism during that period. From that viewpoint, the Great Recession can look, partly, like the reversing of a great distortion.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jmoneco.2024.103558.

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[19] Papers that stress deficient aggregate demand (for example, Hall (2011), Krugman (2012) and Mian and Sufi (2014), or Summers (2015)) conclude that fiscal policy did not respond enough.

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