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# Trade and Credit Reallocation: How Banks Help Shape Comparative Advantage\*

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## Abstract

Trade and innovation cause structural change. Productive factors must flow from declining to growing industries. Banks play a major role in cutting credit to non-viable firms in downsizing sectors and provide new credit to finance investment in expanding, innovative sectors. Structural parameters of a country's banking system thus influence comparative advantage and trade patterns. The analysis points to the importance of insolvency laws, minimum capital standards, and cost of bank equity to determine credit reallocation, sectoral expansion and trade patterns.

**JEL classification:** F10, G21, G28

**Keywords:** Capital reallocation, banking, trade, comparative advantage.

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# 1 Introduction

Innovation and trade are major sources of structural change and are importantly related. Innovative firms with better products conquer world markets and drive the expansion of export industries, while declining sectors with less productive firms must shrink. To exploit comparative advantage, capital and labor must flow from declining towards expanding industries. But the process of sectoral reallocation is, by no means, without frictions. When capital and labor are locked into current uses, a country cannot reap the gains from trade and fails to exploit its comparative advantage.

Many countries are heavily dependent on banks to finance investment, especially in Europe. A major function of the banking sector is to allocate credit to its best use. By terminating credit lines to firms with poor prospects, banks release capital that would otherwise be locked up in unprofitable firms, and make it available for investment of new or expanding firms. Thereby, banks support the Schumpeterian process of creative destruction and contribute to a more efficient allocation of capital. Given the dominant role of banks in financing aggregate investment, structural parameters of the banking system must importantly influence credit flows and capital reallocation.

The goal is to explain how banks help shape comparative advantage. Such an analysis not only sheds light on the process of capital reallocation and structural change but also identifies new determinants of trade that could be tested in empirical work. In particular, our findings point to the importance of insolvency laws, capital regulation and cost of bank equity in influencing credit reallocation and sectoral trade patterns. The analysis is also informative about the reverse effects, namely, how trade accelerates structural change in the domestic economy. More specifically, it highlights the consequences of trade liberalization on sectoral investment through the reallocation of credit by banks.

We propose a framework of credit reallocation by banks developed in earlier work (Keuschnigg and Kogler, 2017) as part of a Heckscher-Ohlin model of trade. We picture an economy with two goods and two sectors: an expanding sector with more innova-

tive, long-term investments and a traditional sector with more opaque projects. Banks initially allocate credit to both sectors. They are *Schumpeterian* in the sense that they terminate and reallocate credit when prospects change. They terminate ‘non-performing’ loans of traditional firms whenever their investments turn out to be poor, and make the proceeds available for additional investments in the innovative sector. The extent of credit reallocation inherently depends on a bank’s capital structure. When liquidating poorly performing firms, a bank must absorb short-term losses that erode its equity capital. Its capital structure thus determines the capacity to liquidate loans and to reallocate credit. Consequently, sectoral investment and trade patterns become dependent on institutional and regulatory characteristics that influence how banks choose their capital structure.

To the best of our knowledge, this is the first paper that integrates a meaningful structural banking model to explain the frictions in credit flows and the reallocation of capital in a model of international trade. Our analysis thus identifies novel bank-related and institutional determinants of trade and comparative advantage. We consider three policy interventions, namely, (i) bank regulation with higher capital standards, which capture the essence of recent banking reforms; (ii) institutional reforms relating to investor protection and bankruptcy law. They aim at a lower cost of bank equity and more efficient bankruptcy procedures; and (iii) trade liberalization targeted at lower export costs in the innovative sector. To identify the main channels, we first evaluate these policies in a small, open economy with the relative goods price given on world markets. We then proceed to policy analysis in a large, open economy. Domestic interventions affect the world price and thereby create spillovers on foreign countries.

We obtain three main results. First, *bank regulation* with tighter capital standards boosts credit reallocation. Better capitalized banks can more easily absorb larger write-offs and, in turn, liquidate and reallocate credit more frequently. Banks help shape comparative advantage by shifting investment and output to the innovative sector. By raising aggregate supply, capital standards in large, open economies decrease the world price of innovative goods and, in turn, slow down reallocation and expansion of the innovative sec-

tor abroad. Second, *institutional reforms* such as better investor protection and improved bankruptcy laws make bank equity cheaper, and enable banks to extract more capital when liquidating non-performing loans. This induces more credit reallocation and shifts final investment and output to the expanding sector. Countries with strong institutions thus tend to enjoy a comparative advantage in innovative industries. In the world market equilibrium, these reforms tend to lower the price of innovative goods and thereby favor consumers and traditional industries abroad. Third, we consider a *trade liberalization* scenario which lowers export costs and thereby allows for higher domestic producer prices in the innovative sector. Such a policy boosts investment and output in that sector both at the reallocation and entry margins, with negative consequences on foreign producers. While this result is standard, the transmission mechanism is entirely different. Another novel finding is that three seemingly unrelated policy interventions have qualitatively similar effects on sectoral investment and trade patterns. These interventions, however, exhibit significant differences in their effects on domestic demand and welfare.

The remainder of this paper is organized as follows: Section 2 explains how our analysis relates to existing research. Section 3 sets out the model. Sections 4 and 5 investigate policy interventions in a small, open economy and in an integrated world market equilibrium, respectively. Section 6 concludes.

## 2 Relation to the Literature

This paper contributes to the literature on trade and finance. Classical trade theory predicts that comparative advantage and trade patterns are determined mainly by cross-country differences in technology (Ricardian model) or factor endowment (Heckscher-Ohlin model). These perspectives abstract from frictions that emerge due to agency problems, limited contract enforcement or labor market rigidities, and which may distort specialization and trade. A general conclusion is that countries with strong institutions are more likely to enjoy a comparative advantage in industries prone to such frictions.

Almost exclusively, the literature focuses on frictions in financial and credit markets where managerial incentive problems at the firm level limit the access to credit or external finance and thereby hamper firm entry and investment. In that approach, better institutional quality relaxes the firms' incentive constraints and improve their access to external finance. Financial intermediaries channel savings to firms and are subject to a participation or break-even condition. Financial development then relates to the effectiveness of intermediaries - depending on the quality of the institutional environment - to exercise oversight and control which alleviates incentive problems and improves access to external finance. It can also relate to competitiveness in terms of intermediaries' ability to extract rents, thereby increasing firms' cost of finance. In addition, firms' own funds become a critical factor to attract external funds. A well-developed financial sector then becomes a source of comparative advantage in industries that rely on external finance as shown in early theoretical work by Kletzer and Bardhan (1987) and Baldwin (1989). More recent contributions include Beck (2002), Wynne (2005), Ju and Wei (2011), and Egger and Keuschnigg (2015, 2017). Wynne (2005) points to the role of entrepreneurial wealth in relaxing credit constraints and creating a comparative advantage in financially dependent sectors. Manova (2013) and Chaney (2016) relate financial constraints to firm heterogeneity. They highlight that exporters are particularly dependent on external finance due high fixed upfront investments.<sup>1</sup> Financial frictions may also lead to a complementarity in trade and capital movements, such that financially less developed countries may attract capital if they open up to trade (Antràs and Caballero, 2009).<sup>2</sup>

On the empirical side, the results broadly support the importance of credit constraints for international trade (e.g., Beck, 2002, 2003; Svaleryd and Vlachos, 2005; Manova, 2008; Becker et al., 2013; and Chor and Manova, 2012). More specifically, financial

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<sup>1</sup>According to Manova (2013), three quarters of the impact of credit constraints are specific to trade and result from distorted firm entry into exporting and reduced firm sales abroad.

<sup>2</sup>Financial development is usually exogenous. Do and Levchenko (2007) point to a reverse link and argue that a comparative advantage can shape financial institutions. For instance, a country specializing in financially intensive goods faces high demand for external finance, which fosters intermediation.

development boosts exports especially in financially dependent industries with high fixed costs of market entry. The estimates of Svaleryd and Vlachos (2005) suggest that in OECD countries differences in financial development have stronger effects on trade patterns than differences in human capital.

Our analysis goes an entirely different route. It abstracts from incentive problems at the firm level and, in consequence, ignores the well understood problems with access to external finance. Instead, we focus on the structural details of the banking sector and its role in financing structural change. The paper differs from the trade literature in at least three important ways: First, we emphasize credit reallocation which is a major function of banks in economies that undergo structural change. Reallocation is a driving force of productivity-enhancing innovation and creative destruction. We offer an integrated perspective on financial development that accelerates structural change and helps to exploit the comparative advantage in innovative industries. The empirical evidence on ‘Zombie’ lending (e.g., Japan in the 1990s, Europe today) demonstrates that an ill functioning banking sector can lock in capital in existing uses with little productivity. Conversely, a resilient and well-functioning financial sector is a prerequisite for the productivity enhancing reallocation mechanism to work.

Our focus on banks is consistent with their central role in reallocating capital and financing investment. Indeed, banks dominate financial intermediation in many countries, especially in Europe. The theoretical literature has either modeled banks in reduced form<sup>3</sup> or focused on how institutional and firm level parameters affect the tightness of credit constraints. We instead propose a full fledged model of banks that characterizes their main decisions such as lending, capital structure, loan liquidation and credit reallocation. We thereby identify novel determinants of comparative advantage such as capital regulation, cost of bank equity or efficiency of bankruptcy procedures.

Our work also relates to the finance-growth literature on reallocation and allocative

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<sup>3</sup>Exceptions are Ju and Wei (2011) who picture imperfect competition in intermediation, and Egger and Keuschnigg (2015) who distinguish active and passive intermediaries.

efficiency. A well-function financial system importantly contributes to an efficient capital allocation. Wurgler (2000) estimates that the elasticity of investment to value added significantly increases in various measures of financial development. Thus, more (less) productive industries grow (shrink) faster in countries with a developed financial sector. Similarly, evidence from the U.S. (Acharya et al., 2011) and France (Bertrand et al., 2007) shows that banking reforms render the capital allocation more efficient. Conversely, a weak financial sector blocks reallocation as poorly capitalized banks often delay the liquidation of non-performing loans to avoid write-offs and violating regulatory or solvency standards. Instead, they engage in ‘Zombie lending’ to quasi-insolvent borrowers, which locks up capital in unprofitable firms and depresses productivity in the economy at large. Japan’s ‘lost decade’ during the 1990s after the collapse of asset prices and collateral value serves as a prominent example (Peek & Rosengren, 2005; Caballero et al., 2008). Recent evidence points to similar problems in parts of the Euro area after the financial crisis (Acharya et al., 2016; Schivardi et al., 2017).

On the theoretical side, capital reallocation has received much less attention, however. It is addressed in the finance-growth literature like, for example, King and Levine (1993), Almeida and Wolfenzon, (2005), or Eisfeldt and Rampini (2006), who highlight distortions due to financial frictions represented, for instance, by taxes or adjustment costs. These models, however, picture financial institutions mostly in reduced-form if at all. The corporate finance literature, for example, Stein (1997) and Mueller and Giroud (2013), analyzes within-firm reallocation in the presence of financial constraints, although mostly in partial equilibrium. Recent contributions in banking theory emphasize the interaction of loan liquidation with regulatory constraints (Keuschnigg and Kogler, 2017) or risk-shifting incentives (Bruche and Llobet, 2014; Homar & Van Wijnbergen, 2017) as explanations for ‘Zombie lending’ and insufficient credit reallocation. The key novel contribution of this paper, in merging the trade and banking literature, is to shed light on the role of banks in financing productivity enhancing structural change and shaping a country’s comparative advantage in international trade.



### 3 The Model

Consider an economy with two sectors where firms produce distinct consumption goods,  $x$  and  $z$ . In our stylized model,  $x$  refers to an innovative, expanding and  $z$  to a traditional, downsizing sector. The relative price of  $x$ -goods is  $v$ , and all markets are competitive. There is a mass 1 of entrepreneurs who operate firms.

The  $x$ -sector offers innovative long-term investment projects that succeed or fail. Firms are run either by startup entrepreneurs, who successfully develop a business idea, or by ‘serial’ entrepreneurs, who first accumulate experience in a  $z$ -firm and, when failing, go for a fresh start in the expanding  $x$ -sector. Investment projects in the  $z$ -sector are more opaque and reveals a performance signal already at an early stage. If the firm is seen to have little chance for success and repayment appears quite unlikely, banks may prematurely close down the firm, liquidate the ‘non-performing’ loan and use the proceeds to lend to new firms in the expanding sector. Banks thus play a central role in financing structural change by lending up-front and reallocating credit if performance is bad.

The timing is as follows: (i) Entrepreneurs develop a business idea designed for either the innovative or the traditional sector; (ii) successful entrepreneurs start their firms in the targeted sector, take a bank loan, and invest; (iii) banks learn the performance of  $z$ -firms and liquidate loans if prospects are poor. They reallocate the proceeds to finance additional  $x$ -projects in the expanding sector, offered by serial entrepreneurs with previous business experience; (iv) production, consumption and trade take place when projects mature at the end of the period.

#### 3.1 Demand

All agents are risk-neutral and preferences are linear homogeneous. Given income  $y_j$ , demand of household  $j$  follows from

$$w_j = \max_{c_{jx}, c_{jz}} u(c_{jx}, c_{jz}) \quad s.t. \quad vc_{jx} + c_{jz} \leq y_j. \quad (1)$$

We specify Cobb Douglas utility with expenditure shares  $\gamma = vc_{jx}/y_j$  and  $1 - \gamma = c_{jz}/y_j$ . Welfare equals real income,  $w_j = y_j/v_D(v)$ . Price index  $v_D$  and welfare change by  $\hat{v}_D = \gamma\hat{v}$  and  $\hat{w}_j = \hat{y}_j - \hat{v}_D$ . Denoting aggregate income by  $Y$ , aggregate demand amounts to

$$Y = vC_x + C_z, \quad C_x = \gamma Y/v, \quad C_z = (1 - \gamma)Y. \quad (2)$$

### 3.2 Banks

Entrepreneurs have no own funds. All projects need 1 unit of capital, requiring a credit of size 1. Hence, the bank's loan portfolio prior to reallocation is  $n_x + n_z$  where  $n_x$  indicates the number of firms equal to the outstanding loan volume in the  $x$ -sector. Correspondingly,  $n_z$  is the initial credit extended to  $z$ -firms. Credit repayment depends on the firms' prospects of success or failure. In the  $x$ -sector, firms pursue more radical innovations that succeed or fail with probabilities  $p$  and  $1 - p$ , and yield output  $x$  or zero. Investments are long-term and mature at the end of period, with no information in between. In the  $z$ -sector, projects are heterogeneous and, in general, less innovative. The success probability  $q'$  may turn out quite low, making full repayment unlikely. Ex ante, prospects are unknown and uniformly distributed,  $q' \sim U[0, 1]$ . Since projects are more standard, banks can monitor and receive an early performance signal which perfectly reveals the type  $q'$ . If prospects are good, credit is continued and output is  $z$  with probability  $q'$  and zero else. If success and repayment become unlikely, banks terminate the loan.

More precisely, banks liquidate unprofitable firms with  $q' < q$  where  $q$  is the pivotal type. Only a share  $\int_q^1 dq' = 1 - q$  of startups continue, while the remaining part  $\int_0^q dq' = q$  is closed down. Ex ante, the unconditional success probability is

$$\hat{q} = \int_q^1 q' dq' = \frac{1 - q^2}{2}, \quad \frac{d\hat{q}}{dq} = -q. \quad (3)$$

The success probability conditional on not being liquidated is

$$\bar{q} = E[q' | q' \geq q] = \frac{\int_q^1 q' dq'}{1 - q} = \frac{1 + q}{2}, \quad \frac{d\bar{q}}{dq} = \frac{1}{2}. \quad (4)$$

With a uniform distribution, these probabilities are linked by  $\hat{q} = (1 - q) \bar{q} = (1 - q^2) / 2$ .

The sequence of events in bank lending is: (i) pay out  $n_x + n_z$  loans of size one; (ii) monitor and get a perfect performance signal  $q'$  on loans to  $z$ -firms; (iii) liquidate a share  $q = \int_0^q dq'$  of non-performing  $z$ -loans and use the proceeds for new loans to  $x$ -firms. Depending on the stringency of bankruptcy law, banks must write off a part  $c$  of the loan upon liquidation and can extract only a fraction  $1 - c$ .<sup>4</sup> Liquidation thus releases  $(1 - c)qn_z$  funds for new lending.

Given credit reallocation, the loan portfolio and the number of active firms evolves as

$$n'_x = n_x + (1 - c)qn_z, \quad n'_z = n_z - qn_z. \quad (5)$$

Figure 1 illustrates how credit reallocation affects the direction of aggregate investment and, thereby, the sectoral structure of the economy.

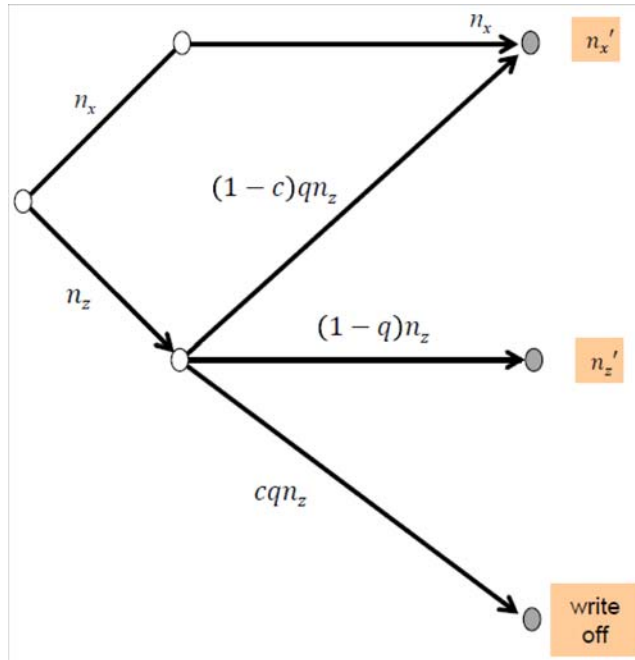


Figure 1: Credit Reallocation and Sectoral Expansion

In the beginning, banks raise deposits  $d$  and equity  $e$  from investors, paying gross returns 1 and  $\rho \equiv 1 + \theta$  with  $\theta > 0$  denoting the equity premium. In lending to firms,

<sup>4</sup>Note:  $c$  is liquidation cost, whereas  $c_j$  with an index  $j$  refers to consumption of good  $j$ .

they charge gross interest  $i_z$  on loans to  $z$ -firms and  $i_x$  and  $i'_x$  on initial and reallocated loans to  $x$ -firms. Expected profit of a bank is

$$\pi_b = pi_x n_x + \pi_{bz} n_z - d - \rho e, \quad \pi_{bz} \equiv \bar{q} i_z (1 - q) + p i'_x (1 - c) q, \quad d = n_x + n_z - e, \quad (6)$$

where  $\pi_{bz}$  denotes expected earnings on a  $z$ -loan. With probability  $1 - q$ , the bank continues lending and earns interest  $\bar{q} i_z$ . With probability  $q$ , it liquidates, extracts  $1 - c$  of the loan and incurs a loss  $c$ . Hence, the proceeds  $(1 - c) q$  become available for new loans with expected interest earnings  $p i'_x$ . Since loan size is one, the mass of additional  $x$ -firms that get funded is  $(1 - c) q n_z$ .

Banks are ‘Schumpeterian’ in the sense that their credit decisions drive productivity enhancing ‘creative destruction’. In liquidating poor firms, they terminate unproductive projects, extract capital and steer it towards more profitable use by lending to additional  $x$ -firms. Banks finance the expansion of the innovative sector with initial lending to  $x$ -sector startups plus credit reallocated from the downsizing sector.

### 3.3 Firms

When setting up a firm, entrepreneurs must anticipate future profits. In the innovative  $x$ -sector, firms make risky long-term investments and expect profits of

$$\pi_x = p(vx - i_x). \quad (7)$$

Creating a less innovative  $z$ -firm is initially less demanding but involves the risk of premature liquidation. The entrepreneur faces three possibilities: (i) continue with probability  $1 - q$  if the early performance signal is good; (ii) get liquidated and become a ‘serial’ entrepreneur with a new  $x$ -firm with probability  $(1 - c) q$ ; and (iii) get liquidated and fail to get a second chance with probability  $cq$ . The possibility of a fresh-start importantly hinges on bankruptcy laws, which determine liquidation losses and credit rationing.<sup>5</sup> Con-

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<sup>5</sup>Banks extract  $1 - c$  from a non-performing loan. The initial credit volume is  $n_z$ . Liquidation of  $q n_z$  firms releases funds of  $(1 - c) q n_z$  available for new lending. Since each fresh-start needs a loan of size 1,  $cq n_z$  entrepreneurs get rationed and are terminally out.

ditional on continuation or reallocation, expected firm profit is

$$\pi_z = \bar{q}(z - i_z), \quad \pi'_x = p(vx - i'_x). \quad (8)$$

The ex ante profit from entering the  $z$ -sector amounts to

$$\bar{\pi}_z = \pi_z \cdot (1 - q) + \pi'_x \cdot (1 - c)q = \bar{z} - \pi_{bz}, \quad \bar{z} \equiv \bar{q}z(1 - q) + vpx(1 - c)q, \quad (9)$$

where  $\bar{z}$  denotes expected earnings.

Before they can start a firm and attract credit, entrepreneurs must develop a business idea during the startup phase. More ambitious and innovative  $x$ -projects promise higher expected profit than more standard ventures,  $\pi_x > \bar{\pi}_z$ . We assume that talent, reflected by an early-stage success probability  $s' \in [0, 1]$ , is distributed among the mass 1 of entrepreneurs with a continuous distribution function  $F(s')$ . A more standard  $z$ -project, in contrast, involves no early stage risk but may involve premature liquidation when prospects turn out to be poor. The more talented entrepreneurs of type  $s' \geq s$  opt for an innovative strategy right from the beginning and set up  $x$ -firms,<sup>6</sup>

$$\pi_x \cdot s' > \bar{\pi}_z \quad \Rightarrow \quad s = \bar{\pi}_z / \pi_x. \quad (10)$$

Out of a mass 1 of entrepreneurs, the pivotal type  $s$  determines sectoral entry. Since the more radical innovation strategy leads to early stage failure, only  $n_x < 1 - n_z$  of those aiming for an  $x$ -project is able to successfully establish a firm,<sup>7</sup>

$$n_x = \int_s^1 s' dF(s'), \quad n_z = F(s). \quad (11)$$

We assume that experience in managing a  $z$ -project compensates for a lack of initial talent in the event of a fresh-start. A serial entrepreneur can design and manage a new project in the innovative sector with little extra cost (normalized to zero).

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<sup>6</sup>In fact, entrepreneurs compare welfare equal to real income of the two activities,  $\pi_x/v_D$  and  $\bar{\pi}_z/v_D$ , see (1), which leads to the same condition.

<sup>7</sup>The early stage success probability is 1 for  $z$ -projects but only  $\bar{s} = \int_s^1 s' dF(s') / [1 - F(s)] < 1$  for  $x$ -projects. Of all  $1 - F(s)$  innovators, only  $n_x = \bar{s}[1 - F(s)]$  successfully establish a start-up.

### 3.4 Equilibrium

Investors are endowed with capital  $I > 1$  which they invest in deposits, bank equity and an alternative investment opportunity  $A$  with a gross return 1. Investor profits are

$$\pi_i = \rho e + d + A - \theta e, \quad e + d + A = I, \quad \rho = 1 + \theta. \quad (12)$$

To exercise oversight and control, equity investors incur management costs  $\theta e$ , measured in units of traditional sector output. It is a classical result of corporate finance that active forms of financing are more costly than passive funds. For simplicity and tractability, we assume that the equity premium is fixed. Assets are perfect substitutes and the supplies of deposits and equity are perfectly elastic at rates 1 and  $\rho$ .

The economy is endowed with capital  $I$  and entrepreneurial labor of mass 1. Noting final sectoral investment in (5), aggregate sectoral output amounts to

$$X \equiv pxn'_x, \quad Z \equiv \bar{q}zn'_z + A - \theta e. \quad (13)$$

Apart from the production of traditional firms,  $z$ -sector supply is augmented by output of the alternative technology which converts one unit of capital into one unit of output. Residual capital use  $A = I - e - d$  is positive since  $I > 1$  and  $e + d = n_x + n_z \leq 1$ .

Aggregate income is  $Y = \pi_x n_x + \bar{\pi}_z n_z + \pi_b + \pi_i = pvxn_x + \bar{z}n_z + A - \theta e$ , where the second equality results upon substituting profit definitions. Using (5), (9) and (13) yields the national income identity,

$$Y = vX + Z. \quad (14)$$

The resource constraint on capital use is identically fulfilled by the assumption of residual investment in the traditional sector. Combining (2) and (14) yields

$$v(C_x - X) + (C_z - Z) = 0. \quad (15)$$

The value of the sum of excess demands must be zero by Walras' Law. This condition reflects trade balance in an open economy without international capital flows. Summing (15) across all countries, market clearing for innovative goods,  $\sum_i (C_x^i - X^i) = 0$ , implies market clearing for traditional goods,  $\sum_i (C_z^i - Z^i) = 0$ .

### 3.5 Credit Reallocation

**Capital Structure:** Banks first choose capital structure and initial lending and subsequently decide on liquidation and reallocation of credit. Their capacity to absorb liquidation losses on non-performing loans and to reallocate credit to new ventures importantly depends on the capital structure. When liquidating loans, a bank must make sure that it remains solvent and still satisfies minimum capital standards. Liquidation generates a loss and diminishes bank equity since a part  $c$  of the loan must be written off. After substantial write-offs, a bank is typically unable to quickly raise new equity. Hence, new lending is restricted to the funds  $(1 - c)qn_z$  which are released in the liquidation process.

More specifically, we assume that banks must always maintain a capital ratio of at least  $k \geq 0$ . Since lending to  $z$ -firms involves costly liquidation and banks are unable to raise new equity at a time of distress, they must raise a voluntary capital buffer ex ante to keep satisfying capital standards even after incurring liquidation losses,

$$e - cqn_z \geq k \cdot (n'_x + n'_z). \quad (16)$$

Credit reallocation has two effects. First, when a bank liquidates  $qn_z$  loans, the loss  $cqn_z$  reduces *actual* equity to  $e - cqn_z$ . Second, liquidation shrinks assets (outstanding loans) to  $n'_x + n'_z = n_x + n_z - cqn_z < n_x + n_z$ , making *required* equity fall by  $kcqn_z$ . The *net loss of equity*, which must be covered by a ‘voluntary’ buffer ex ante, is  $(1 - k)cqn_z$ . This extra buffer becomes smaller when the capital standard is tighter. Importantly, (16) is equivalent to a solvency constraint if capital requirements are zero,  $k = 0$ . In this case, the capital buffer must cover the short-term losses during the reallocation process,  $e \geq cqn_z$ .

**Reallocation:** We solve the banking problem by backward induction and first derive the liquidation rate  $q$ . After observing success probabilities, banks decide about loan liquidation to maximize expected earnings  $\pi_{bz}$  on initial  $z$ -loan. They take loan rates and capital structure as given and must satisfy capital requirements per  $z$ -project:

$$\pi_{bz} = \max_q \int_q^1 q' i_z dq' + \int_0^q p i'_x (1 - c) dq' + \lambda \cdot [e - cqn_z - kn_x - k(1 - cq)n_z] / n_z. \quad (17)$$

The optimal cut-off is characterized by

$$pi'_x(1-c) - qi_z = \lambda(1-k)c \quad \Rightarrow \quad q = \frac{pi'_x(1-c) - \lambda(1-k)c}{i_z}. \quad (18)$$

**Lending:** In the first stage, banks raise equity capital and deposits and cut loan rates to compete for borrowers until they hit break-even. Note bank profits as in (6),  $\pi_b = [pi_x - 1]n_x + [\pi_{bz} - 1]n_z - \theta e$ , and  $d\pi_{bz}/de = \lambda/n_z$  from (17). Since optimal equity must satisfy  $d\pi_b/de = \lambda - \theta = 0$ , the regulatory constraint binds as long as equity earns a premium. Using the binding constraint to substitute for  $e$  yields

$$\pi_b = [pi_x - r]n_x + [\pi_{bz} - r - \theta(1-k)cq]n_z, \quad r \equiv (1-k) \cdot 1 + k \cdot \rho = 1 + \theta k. \quad (19)$$

When the bank operates at the regulatory minimum, a loan of size 1 to an  $x$ -firm must be refinanced with equity  $k$  and deposits  $1-k$ , giving a weighted cost of capital  $r$ . Since a  $z$ -loan might involve credit losses in case of premature liquidation, the bank must raise additional equity  $(1-k)cq$  ex ante to satisfy capital requirements. A loan to the downsizing sector thus makes more intensive use of bank equity due to the extra buffer which makes the refinancing cost exceed the common cost  $r$  by  $\theta(1-k)cq$ .

Bank profit is linear in loans,  $n_x$  and  $n_z$ . Competition thus drives down loan rates until break-even. For  $x$ -loans, zero profits imply  $pi_x = r$ . When offering credit to a  $z$ -firm, banks set interest rates for continued and reallocated loans,  $i_y$  and  $i'_x$ . They first set the ratio of loan rates so that the liquidation decision in (18) maximizes the joint surplus. Thereafter, they scale down rates to shift the surplus to firms. These are the best deals that banks can offer since they maximize firm profits subject to a break-even condition.

Adding the surplus of banks and firms in (19) and (6) yields a joint surplus equal to  $S \equiv \bar{z} - r - \theta(1-k)cq$ . Liquidation maximizes this joint surplus ( $dS/dq = 0$ ) if the income gain  $vpx(1-c) - qz$  from reallocation is equal to the cost of bank equity  $\theta(1-k)c$  that is additionally required to absorb liquidation losses. The optimal liquidation rate is

$$q = \frac{vpx(1-c) - \theta(1-k)c}{z}. \quad (20)$$



The liquidation cost or equity premium can be so high and the capital standard so low that banks might not reallocate credit,  $q = 0$ .<sup>8</sup> In such a ‘rigid’ economy, sectoral investment and output are exclusively determined by entry.

Given  $q$ , loan rates  $i_z$  and  $i'_x$  must satisfy two conditions: the liquidation decision in (18), where  $\lambda = \theta$ , supports the optimal cut-off  $q$  in (20), and a  $z$ -loan yields zero profits,

$$\pi_{bz} \equiv \bar{q}i_z(1-q) + pi'_x(1-c)q = r + \theta(1-k)cq. \quad (21)$$

Since  $q$  is fixed by (20), one uses (18) with  $\lambda = \theta$  to eliminate  $pi'_x(1-c)$  in (21). Noting  $\bar{q}(1-q) = (1-q^2)/2$  and rearranging yields interest on a continued  $z$ -loan. Knowing  $i_z$  and  $q$ , we also find interest  $i'_x$  on a reallocated  $z$ -loan,

$$i_z = \frac{2}{1+q^2} \cdot r, \quad i'_x = \frac{q \cdot i_z + (1-k)\theta c}{(1-c)p}. \quad (22)$$

**Entry:** Initially, entrepreneurs set up a firm by design of a business plan and choose the sectoral activity, leading to entry  $n_x$  and  $n_z$ . The more talented and innovative types  $s' > s$  enter the innovative sector as long as this strategy promises higher expected real income,  $s' \cdot \pi_x/v_D \geq \bar{\pi}_z/v_D$ . Substituting for competitive loan rates gives expected profits  $\pi_x = vpx - r$  and  $\bar{\pi}_z = \bar{z} - \pi_{bz} = \bar{z} - r - \theta(1-k)cq$ . The occupational choice condition thus determines the pivotal type by

$$s = \frac{\bar{\pi}_z}{\pi_x} = \frac{\bar{z} - r - \theta(1-k)cq}{vpx - r}. \quad (23)$$

The mass of innovative and traditional firms is  $n_x = \int_s^1 s' dF(s')$  and  $n_z = F(s)$  which, in turn, determine the mass of mature firms  $n'_x$  and  $n'_z$  by (5). Reallocation shrinks the number of firms in the  $z$ -sector and augments those in the  $x$ -sector. After that, firms succeed at rates  $p$  and  $\bar{q}$  in the two sectors.

## 4 Small Open Economy

We evaluate the consequences of four policy interventions for trade structure: (i) bank regulation with higher capital requirements  $k$ ; (ii) better investor protection that reduces

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<sup>8</sup>This requires  $\theta(1-k)c > vpx(1-c) \Leftrightarrow c > vpx/[vpx + \theta(1-k)]$  leading to  $q = 0$ .

the investor's cost of managerial supervision and control, and thus contributes to a lower equity premium  $\theta$ ;<sup>9</sup> (iii) more efficient bankruptcy procedures that reduce liquidation costs  $c$  and allow banks to extract a larger share from terminated loans; and (iv) trade liberalization favoring the innovative export sector.

Our trade scenario pictures an advanced economy being an exporter of innovative goods. Exporters incur differential costs relative to foreign competitors, such as transport costs, compliance to foreign regulations, foreign market research, extra legal costs, export insurance etc. With a producer price of  $v$ , exporters must charge  $(1 + \tau)v$  to foreign clients to cover such real trade costs. Competition forces them to match the world market price  $v^*$  which links prices by  $v^* = (1 + \tau)v$ . Price changes are related by  $\hat{v}^* = \hat{v} + \hat{\tau}$  where  $\hat{\tau} \equiv d\tau/(1 + \tau)$ . Hats indicate percent changes, that is,  $\hat{v} = dv/v$ , whereas rates and shares ( $d\theta$ ,  $dk$ ,  $dc$ , etc.) are stated in absolute changes. Trade frictions reduce domestic prices,  $\hat{v} = -\hat{\tau}$ , since foreign prices are exogenous to a small open economy. Trade liberalization squeezes trade costs  $\tau$  which boosts domestic producer prices.

Without loss of generality, we evaluate equilibrium for very low capital requirements,  $k \rightarrow 0$ . This helps to simplify comparative statics and is consistent with the low capital standards in reality. As a result, the regulatory constraint (16) collapses to the solvency constraint,  $e = cqn_z$ , which ensures that bank equity never becomes negative. An increase in capital standards,  $dk > 0$ , is thus equivalent to introducing capital requirements.

## 4.1 Supply Side

The output response is driven by initial entry and credit reallocation, which depends on liquidation decision of banks. The liquidation rate  $q$  in (20) changes by

$$dq = \frac{vpx(1-c)}{z} \cdot \hat{v} - \frac{\varepsilon_{qc}}{z} \cdot dc - \frac{c}{z} \cdot d\theta + \frac{\theta c}{z} \cdot dk, \quad \varepsilon_{qc} \equiv vpx + \theta. \quad (24)$$

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<sup>9</sup>A tax reform such as an allowance for corporate equity to eliminate the debt bias in corporate taxation would have a comparable effect on the equity premium.

Quite intuitively, a higher price makes liquidation and new lending more attractive as fresh starts in the innovative sector promise larger profits. Higher bankruptcy costs reduce liquidation. If the equity premium rises, banks become more hesitant to liquidate as this would require a higher capital buffer which is costly. In contrast, higher capital requirements reduce the required capital buffer since a liquidation also shrinks a bank's balance sheet and thereby requires less equity. For this reason, the *net* use of equity in liquidation becomes smaller which facilitates reallocation.

Sectoral entry shifts in response to expected future profits which, in turn, depend on funding costs that rise with higher capital standards. Noting  $r = 1 + \theta k$  with  $k \rightarrow 0$  and  $p i_x = r$ , expected profit  $\pi_x = vpx - r$  of an  $x$ -firm clearly rises with an increasing output price but suffers on account of higher capital standard,

$$dr = \theta \cdot dk, \quad p \cdot di_x = dr, \quad d\pi_x = vpx \cdot \hat{v} - \theta \cdot dk. \quad (25)$$

By (9), the ex ante earnings of a  $z$ -startup reflect expected earnings  $\bar{q}z$  conditional on continuation and  $vpx$  conditional on liquidation and a successful fresh start. They increase in the relative price in case the firm gets a second chance in the innovative sector. They also rise if the marginal gain from reallocation,  $vpx(1-c) - qz > 0$ , accrues more frequently with a higher liquidation rate, while it declines when larger liquidation losses diminish reallocation gains,

$$d\bar{z} = vpx(1-c)q \cdot \hat{v} + [vpx(1-c) - qz] \cdot dq - vpxq \cdot dc. \quad (26)$$

Using the Envelope theorem on  $\bar{\pi}_z = \max_q \bar{z} - r - \theta cq$  yields

$$d\bar{\pi}_z = vpx(1-c)q \cdot \hat{v} - cq \cdot d\theta - (1-cq)\theta \cdot dk - \varepsilon_{qc}q \cdot dc. \quad (27)$$

Expected profit of a  $z$ -entrant rises when an increased price of innovative goods boosts the gains from reallocation. Higher funding and liquidation costs as well as tighter capital standards make these firms less profitable.

Sectoral choice in (10) yields  $\pi_x \cdot ds = d\bar{\pi}_z - s \cdot d\pi_x$  or

$$ds = -\frac{s - (1-c)q}{\pi_x} vpx \cdot \hat{v} + \frac{s - (1-cq)}{\pi_x} \theta \cdot dk - \frac{cq}{\pi_x} \cdot d\theta - \frac{\varepsilon_{qc}q}{\pi_x} \cdot dc. \quad (28)$$

Only the more talented types,  $s' \geq s$ , opt for a more innovative business model right from the beginning which affects firm entry into the  $x$ -sector according to  $dn_x = -sf(s) \cdot ds$ . Traditional firms are subject to early liquidation and use bank equity more intensively. For this reason, a higher equity premium as well as more costly liquidation reduce their profitability and unambiguously encourage entry into the innovative sector by requiring a lower minimum survival probability  $s$ . However, sectoral entry responds ambiguously to other shocks. Obviously, a higher price of the innovative good boosts expected profit of an  $x$ -startup which becomes available with probability  $s$  due to innovation risk. But a  $z$ -startup benefits as well since it expects to enter the  $x$ -sector on a second chance with probability  $(1 - c)q$ . Whether entry shifts in one or the other direction depends on the relative magnitude of these chances. Similarly, tighter capital standards increase funding costs in both sectors, giving rise to ambiguous entry effects.

Final investment and output of the innovative sector are jointly determined by initial entry plus subsequent reallocation,  $n'_x = n_x + (1 - c)qn_z$  in (5). Using  $dn_z = f(s) \cdot ds$  and  $dn_x = -sf(s) \cdot ds$  gives

$$dn'_x = -[s - (1 - c)q]f(s) \cdot ds + n_z \cdot d[(1 - c)q]. \quad (29)$$

Expansion of the  $x$ -sector rests on initial entry (first term) and subsequent reallocation (second term). Appendix A derives in several steps the response of final investment,  $dn'_x$ , and aggregate supply  $dX = px \cdot dn'_x$ .

Consider first the entry channel. Importantly, more entrants to the innovative sector reflected by a smaller marginal survival probability,  $ds < 0$ , do not necessarily lead to larger final investment and output: If the marginal entrant chooses the  $x$ -sector, she survives, reaches the expansion stage, and invests with probability  $s$  only. If the same entrepreneur starts in the  $z$ -sector, she will also arrive with probability  $(1 - c)q$  in the  $x$ -industry, as a result of liquidation and reallocation. The relative magnitude of these transition probabilities is proportional to  $s - (1 - c)q$ , which can be of either sign. Although there is no natural argument for one transition probability being larger than the other, one can show  $s - (1 - c)q > 0$  in two important cases, namely, in a *flexible* economy

with  $c \rightarrow 0$  such that  $q \rightarrow vpx/z$  and in a relatively *rigid* economy with  $c \rightarrow vpx/\varepsilon_{qc}$  such that banks reallocate very little credit,  $q \rightarrow 0$ . Since the relation between the relative transition probabilities and the liquidation cost is non-monotonic, the sign might become negative for intermediate values of  $c$ .

The second term in (29) reflects the response of final investment and output to changes in the reallocation rate. Noting  $d(1-c)q = (1-c)dq - qdc$ , the latter consists of a *behavioral* effect due to more aggressive liquidation and a *mechanical* effect in case of a rising liquidation cost, which directly lowers the proceeds. More frequent credit reallocation unambiguously raises investment and output in the innovative sector.

Motivated by these two channels, we define the reallocation and entry elasticities,  $\mu \equiv (1-c)n_z/z > 0$  and  $\eta \equiv [s - (1-c)q]f(s)/\pi_x$ . The latter is proportional to the relative transition probabilities, and its sign is ambiguous. Using (A.2), we finally obtain

$$\hat{X} = \delta_v \cdot \hat{v} - \delta_c \cdot dc - \delta_\theta \cdot d\theta + \delta_k \theta \cdot dk, \quad (30)$$

where coefficients are defined by

$$\begin{aligned} \delta_v &\equiv \frac{(\pi_x/f(s))\eta^2 + (1-c)\mu}{n'_x} vpx, & \delta_c &\equiv \frac{n_z q + (\mu - \eta q)\varepsilon_{qc}}{n'_x}, \\ \delta_\theta &\equiv \frac{c(\mu - \eta q)}{n'_x}, & \delta_k &\equiv \frac{c(\mu - \eta q) + (1-s)\eta}{n'_x}. \end{aligned}$$

A higher price of the  $x$ -good boosts earnings  $vpx$  and profits  $\pi_x$  and  $\pi'_x$ . Both firms expect higher profits and entry may shift in either direction, depending on the survival probability  $s$  of a marginal  $x$ -entrant and the probability  $(1-c)q$  of a  $z$ -entrant to secure credit for a fresh start in the  $x$ -sector after liquidation, see (28). As discussed earlier, any entry reaction  $ds$  affects the number  $n'_x$  of mature firms in the same ambiguous way depending on the relative transition probabilities  $s - (1-c)q$ , see (29). If  $s - (1-c)q > 0$  or, equivalently,  $\eta > 0$ , entry shifts unambiguously towards the innovative sector since expected profit gains are relatively larger for  $x$ -entrants. This effect is magnified by the fact that the transition probability to arrive in the  $x$ -sector is larger for the marginal  $x$ - than for a  $z$ -entrant. If  $\eta < 0$ , effects are reversed. Initial entry shifts towards the  $z$ -sector,

but now these firms also have a larger probability to arrive in the  $x$ -sector after liquidation and reallocation. In both cases, the price increase unambiguously raises aggregate supply of the  $x$ -sector, in proportion to  $\eta^2$ . The only difference is that mature  $x$ -firms tend to have a different ‘innovation history’ in these two alternative scenarios.

At the reallocation margin, the higher price boosts profits  $\pi'_x$  from fresh starts. This induces more aggressive liquidation (24) thereby expanding final investment and aggregate supply of the innovative sector. Hence, the entry and reallocation margins reinforce each other in response to a price increase, and the coefficient  $\delta_v$  is unambiguously positive.

Credit reallocation with ‘Schumpeterian banks’ renders aggregate supply  $X$  sensitive to several regulatory and institutional factors like capital standards, insolvency laws that influence liquidation costs, or investor protection that affect the equity premium. This contrasts with a completely rigid economy (i.e.,  $c > vpx/\varepsilon_{qc}$ ) without any reallocation where supply would adjust only at the entry margin. Output would positively respond to changes in the relative price and - due to sectoral differences in using costly bank equity - in capital standards (see Appendix A).

With regard to changes in the institutional environment, reallocation and entry are reinforcing only if  $\eta < 0$  but are offsetting each other if  $\eta > 0$ . We henceforth assume that reallocation responds more elastically to shocks than entry, that is,  $\mu \geq \eta q$ . In this scenario, the net behavioral effect is thus dominated by reallocation. This requires  $\eta q$  to be negative or positive but ‘sufficiently small’. The latter case is induced by a small density  $f(s)$  in the neighborhood of the pivotal type  $s$ , or a high liquidation cost  $c$  (implying a low  $q$ ), for example.

Consider an increase in the liquidation cost. The direct, mechanical effect clearly slows down the expansion of the  $x$ -sector since less capital is extracted upon liquidation of non-performing loans and, consequently, less bank credit is made available to finance additional investment in the innovative sector. In addition, a higher liquidation loss reduces the liquidation rate in (24) which locks up a larger number of weak firms in the traditional sector. Since more costly liquidation cuts the ex ante profits of traditional

firms without affecting profitability of innovative investment, entry in (28) shifts towards the innovative sector. If the marginal  $x$ -entrant has a lower chance than reallocated  $z$ -entrants to continue with an innovative project ( $\eta < 0$ ), the entry response magnifies the other effects and slows down expansion of the  $x$ -sector. Otherwise, entry partly offsets the other adjustments. Our analysis emphasizes a small or even negative entry elasticity. A higher liquidation cost thus shrinks the innovative sector,  $\delta_c > 0$ .

If bank equity becomes more costly, for instance, due to lacking investor protection or tax disadvantages of equity, banks seek to economize on the voluntary capital buffer by liquidating non-performing loans less aggressively, see (24). This slows down reallocation and locks up credit in the traditional sector. Expansion shifts from the innovative to the traditional sector. The shock also raises funding costs in the traditional sector which uses bank equity more intensively. As  $z$ -firms become relatively less profitable, entry shifts towards the innovative sector. In our main scenario where reallocation responds more elastically, a higher equity premium leads to a contraction of aggregate supply in the innovative sector, and  $\delta_\theta \geq 0$ .

Finally, a regulatory reform with tighter capital requirements leads banks to liquidate more aggressively and boosts the expansion of the innovative sector upon more frequent reallocation, see (24). In addition, firms in both sectors incur higher capital costs,  $dr = \theta \cdot dk$ . Expected profits of  $x$ -entrants shrink by  $s \cdot d\pi_x = -s\theta \cdot dk$ . When financing  $z$ -firms, higher capital standards reduce the bank's capital buffer so that expected profit of a  $z$ -entrant declines by  $d\bar{\pi}_z = -(1 - cq)\theta \cdot dk$ . The net effect on relative profits remains ambiguous and entry may shift in either direction, see (28). Provided that the reallocation channel dominates, however, tighter capital standards boost the expansion of the innovative sector,  $\delta_k > 0$ .

## 4.2 Demand Side

We start with  $Y = vpxn_x + \bar{z}n_z + A - \theta e$  as noted prior to (14), where aggregate bank equity is  $e = cq \cdot n_z$  by the binding regulatory (solvency) constraint and residual investment

amounts to  $A = I - (n_x + n_z)$ . Since the equilibrium is constrained efficient, any marginal behavioral effects on aggregate income are zero, as the gains and losses from liquidation and entry just offset each other.<sup>10</sup> The change in national income simply reflects the direct effects of the shocks,

$$\hat{Y} = \gamma_s \cdot \hat{v} - q_Y \cdot dc - e_Y \cdot d\theta - n_Y \theta \cdot dk, \quad (31)$$

where coefficients are defined as

$$\gamma_s \equiv \frac{vX}{Y}, \quad q_Y \equiv \frac{\varepsilon_{qc} q n_z}{Y}, \quad e_Y \equiv \frac{e}{Y}, \quad n_Y \equiv \frac{n_x + (1 - cq) n_z}{Y} = \frac{n'_x + n'_z}{Y}.$$

with  $\varepsilon_{qc} = vpx + \theta$ . A higher price boosts national income, depending on the supply side income share  $\gamma_s$  of the innovative sector. Quite intuitively, higher liquidation costs impose a marginal income loss of  $q_Y$  percent of GDP. First, when banks liquidate a non-performing  $z$ -loan, they are left with less funds for new lending to additional  $x$ -projects. The marginal output loss is  $d\bar{z}/dc = vpxq$  per  $z$ -startup, or  $vpx$  for each of the  $qn_z$  liquidated loans. Second, higher liquidation costs force banks to raise a larger capital buffer ex ante. Those additional resource costs associated with bank equity amount to  $\theta \cdot de/dc = \theta q n_z$ , or  $\theta$  per liquidated loan. Adding up gives a total marginal income loss equal to  $\varepsilon_{qc}$  per liquidated loan, or  $q_Y$  percent of GDP in total. Higher resource costs of managing bank equity shrink income in proportion to the GDP share  $e_Y$  of bank equity. Finally, bank regulation in terms of a higher capital standard  $k$  erodes income in proportion to the final credit to GDP ratio  $n_Y$  multiplied by the equity premium.

Given constant expenditure shares, demand in (2) changes by  $\hat{C}_x = \hat{Y} - \hat{v}$  or

$$\hat{C}_x = -(1 - \gamma_s) \cdot \hat{v} - q_Y \cdot dc - e_Y \cdot d\theta - n_Y \theta \cdot dk. \quad (32)$$

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<sup>10</sup>The effect of entry is zero: Using  $r = 1 + \theta k$ ,  $\pi_x = vpx - r$  and  $\bar{\pi}_z = \bar{z} - r - \theta cq$  and finally noting  $dn_x = -s \cdot dn_z$  yields  $dY = (\bar{\pi}_z - s\pi_x) \cdot dn_z = 0$  on account of (10). Given equal expected profits, the marginal entrant is indifferent between sectors so that a marginal variation of entry has no effect on income. The same holds for a variation of the liquidation rate: Noting how  $\bar{z}$  and  $e$  depend on  $q$ , we have  $dY = [vpx(1 - c) - qz - \theta c] n_z \cdot dq = 0$  since competition by banks leads them to chose the liquidation rate so as to maximize the expected output (joint surplus) of a  $z$ -firm as in (20).



Domestic demand for innovative goods changes in proportion to income, plus an additional price effect. A price increase of one percent reduces demand by one percent. Since it also boosts income by  $\gamma_s$  percent, demand shrinks by  $1 - \gamma_s$  percent on net. The other demand shocks simply reflect the income changes noted in (31).

Eventually, we summarize the welfare effects. Domestic welfare is equal to real income,  $w = Y/v_D$ , and reacts to shocks by  $\hat{w} = \hat{Y} - \gamma\hat{v}$ . Substituting (31) for  $\hat{Y}$  gives

$$\hat{w} = (\gamma_s - \gamma) \cdot \hat{v} - q_Y \cdot dc - e_Y \cdot d\theta - n_Y \theta \cdot dk. \quad (33)$$

Since the market equilibrium is constrained efficient, only the direct effects matter. A higher domestic price of innovative goods benefits an export country ( $\gamma_s > \gamma$ ). Better insolvency laws and a lower equity premium raise welfare but tighter capital requirements are welfare-reducing as more equity increases the cost of supervision and management.

### 4.3 Trade Balance

We finally study how Schumpeterian banks help shape comparative advantage by determining the process of resource reallocation across sectors. The change in the trade structure is reflected in the trade balance  $\zeta_x = X - C_x$  equal to the domestic excess supply for innovative goods. In defining  $\hat{\zeta}_x \equiv v d\zeta_x / Y$ , one obtains

$$\hat{\zeta}_x = \gamma_s \cdot \hat{X} - \gamma \cdot \hat{C}_x. \quad (34)$$

We focus on a developed and technologically advanced country which runs a trade surplus  $\zeta_x < 0$  in innovative  $x$ -goods such that the supply exceeds the demand share of good  $x$ ,  $\gamma_s > \gamma$ . Upon substitution, we have

$$\hat{\zeta}_x = \sigma_v \cdot \hat{v} - \sigma_c \cdot dc - \sigma_\theta \cdot d\theta + \sigma_k \theta \cdot dk. \quad (35)$$

with coefficients

$$\sigma_v \equiv \gamma_s \delta_v + (1 - \gamma_s) \gamma, \quad \sigma_c \equiv \gamma_s \delta_c - \gamma q_Y, \quad \sigma_\theta \equiv \gamma_s \delta_\theta - \gamma e_Y, \quad \sigma_k \equiv \gamma_s \delta_k + \gamma n_Y.$$

A higher domestic price unambiguously boosts the trade surplus in innovative  $x$ -goods since it stimulates supply and cuts back domestic demand,  $\sigma_v > 0$ . A higher capital standard also contributes to a larger trade surplus,  $\sigma_k > 0$ . By fostering credit reallocation, it supports the expansion of the  $x$ -sector, whereas domestic demand shrinks since the larger cost of managing additional equity erodes national income.

The liquidation cost and the equity premium, in contrast, have offsetting supply and demand effects on the trade balance. More costly liquidation reduces both supply and demand for the innovative good. The supply side response involves *mechanical* and *behavioral* effects on the reallocation and entry margins as discussed earlier. Appendix A derives the combined adjustment by substituting coefficients. As long as the entry elasticity  $\eta$  is negative, or positive but small - as in our main scenario - higher liquidation costs create excess demand and shrink the export surplus in innovative goods,  $\sigma_c > 0$ .

When the equity premium rises, banks economize on the capital buffer by liquidating non-performing loans less often. Slowing reallocation eventually reduces supply of the  $x$ -sector. At the same time, demand falls due to higher management costs. Appendix A calculates the net effect and finds that the trade surplus shrinks when the entry elasticity is positive but small, or even negative. Intuitively, with low capital standards, the GDP share of bank equity is very low so that the supply side reactions of raising the cost of bank equity dominate. A higher equity premium and, in turn, rising funding costs of firms thus tend to shrink the export surplus in innovative goods,  $\sigma_\theta > 0$ .

#### 4.4 Policy Interventions

How do tighter capital standards, institutional reforms, and trade liberalization influence the investment process, trade patterns, and comparative advantage? In general, these policy interventions support a comparative advantage in innovative goods but they considerably differ in their effects on national income, consumption, and welfare. We now summarize the preceding analysis.

**Bank regulation:** Capital standards affect the size of the extra capital buffer that banks must build up when lending to traditional firms, with consequences for credit reallocation and sectoral investment.

**Proposition 1** *Higher capital standards boost credit reallocation and raise innovative investment. They expand supply of innovative goods but lower aggregate income, consumption demand, and welfare. They raise the trade surplus.*

Raising the minimum capital standard reduces the *net* loss of equity during the reallocation process. Liquidating loans shrinks the balance sheet. In turn, this reduces the required amount of equity, and more so if the capital standard is higher. Better capitalized banks thus need a smaller voluntary buffer to assure that the capital standard remains fulfilled upon liquidation. The fact that liquidation requires a smaller voluntary buffer, induces more aggressive liquidation of loans, see (24). In the main scenario of a negative or positive but small entry elasticity, investment and supply in the innovative sector increase, see (29) and (30). Moreover, consumption demand for  $x$ -goods falls as shown in (32). Larger supply and smaller demand clearly swells the trade surplus in innovative goods as in (35). Tighter capital requirements for banks thus help shape a comparative advantage in innovative goods. Since equity investors incur a resource cost due to management and supervision, however, such an intervention is associated with lower national income and welfare, see (32) and (33).

**Institutional reforms:** A second set of policies - institutional reforms - includes better investor protection, which decreases the shareholders' costs of supervision and control and thereby results in a lower equity premium  $\theta$ . Furthermore, rendering bankruptcy procedures more efficient helps banks to extract more capital from terminating non-performing loans (smaller liquidation cost  $c$ ).

**Proposition 2** *Better investor protection and improved insolvency laws boost credit reallocation and raise innovative investment. They expand supply of innovative goods and*

*raise aggregate income, consumption demand, and welfare. The effect on the trade surplus tends to be positive.*

Such reforms boost reallocation by raising the liquidation rate  $q$ . In addition, lowering the liquidation cost has a mechanical effect as more capital becomes available from terminated loans for given behavior. Although more entrepreneurs start a firm in the traditional sector, see (28), innovative investment and output increase when the entry effect on final investment is small or even negative. At the same time, aggregate income also rises either due to higher average earnings of  $z$ -firms or smaller management costs related to bank equity. This raises consumption demand for innovative goods. Although supply and demand both increase, the supply effect prevails under our assumptions and the trade surplus rises. Good institutions foster comparative advantage in innovative goods by facilitating the process of credit reallocation. In reducing resource costs, they also expand national income and raise welfare.

**Trade liberalization:** Cutting real export costs allows domestic firms to raise their producer price by  $\hat{v} = \hat{\tau}$ , for any given world price of innovative goods.

**Proposition 3** *A higher price of  $x$ -goods boosts credit reallocation and innovative investment. It expands supply of the innovative good, raises aggregate income and welfare but lowers consumption demand thereby increasing the trade surplus.*

A higher relative price leads to higher earnings and profits in the  $x$ -sector. Fresh starts in this industry promise higher profits which induces banks to terminate non-performing loans more often which strengthens reallocation. This effect is reinforced by a shift in entry such that more firms end up with an  $x$ -project, see (24) and (28). Investment and output of the innovative sector thus unambiguously increase. The higher price cuts back demand, see (32). The net effect is to boost the trade surplus in innovative goods. Trade liberalization aimed at lowering export costs thus helps foster a comparative advantage in innovative goods. They also expand national income due to higher firm profits and raise welfare in an export country.

## 5 World Economy

In large open economies, national policies affect the world price  $v^*$ . The induced price changes have an additional second-order effect on the domestic economy and cause spillovers to other countries.

### 5.1 World Market Equilibrium

Again, we picture an economy that is an exporter of innovative goods,  $\zeta_x < 0$ . Recall that the changes in domestic and world prices are related by  $\hat{v} = \hat{v}^* - \hat{\tau}$ . At the outset, we assume that countries are symmetric at least with regard to trade frictions,  $\tau^i = \tau$  such that  $v^i = v$ . World market equilibrium requires  $\zeta_x + \sum_i \zeta_x^i = 0$  and  $d\zeta_x + \sum_i d\zeta_x^i = 0$  where  $\zeta_x^i$  denotes excess supply in other countries. Multiplying by  $v = v^i$ , dividing by world income  $Y + \sum_i Y^i$ , and using a country's income share  $\omega^i \equiv Y^i / (Y + \sum_i Y^i)$  gives global market clearing  $\omega \hat{\zeta}_x + \sum_i \omega^i \hat{\zeta}_x^i = 0$ , which pins down the impact on the world price. Note that income shares add up to one,  $\omega + \sum_i \omega^i = 1$ . The domestic trade surplus,  $\zeta_x$ , responds according to (35). Trade imbalances in foreign countries are directly affected by changes in the world price:

$$\hat{\zeta}_x^i = \sigma_v^i \cdot \hat{v}^*, \quad \sigma_v^i \equiv \gamma_s^i \delta_v^i + (1 - \gamma_s^i) \gamma^i > 0. \quad (36)$$

Solving world market clearing for  $\hat{v}^*$  by substituting (35) for  $\hat{\zeta}_x$  and (36) for  $\hat{\zeta}_x^i$  yields the responses of the world price

$$\hat{v}^* = \frac{\omega}{\sigma_v^*} [\sigma_v \cdot \hat{\tau} + \sigma_c \cdot dc + \sigma_\theta \cdot d\theta - \sigma_k \theta \cdot dk], \quad (37)$$

where  $\sigma_v^* \equiv \omega \sigma_v + \sum_i \omega^i \sigma_v^i > 0$  is the GDP-weighted average price elasticity of countries' trade balances.

**Lemma 1** *The world price  $v^*$  unambiguously falls in the capital standard  $k$ , and rises in the export cost  $\tau$ , the liquidation cost  $c$ , and the equity premium  $\theta$  of a large, open economy.*

The signs of those elasticities reflect how the related variables affect the country's trade balance  $\zeta_x$  in (35). The world price reacts more elastically to domestic shocks, the larger the country is measured by its income share  $\omega$ .

## 5.2 Policy Interventions

Contrary to a small, open economy, policy interventions now entail both a direct (first-order) and an second-order effect due to the induced changes in the world price  $v^*$ . Domestically, the responses of investment, production, and consumption are usually less pronounced compared to a small open economy as the price changes tend to partly offset the direct effects. By influencing the world price, domestic policy interventions also create spillovers to foreign countries as firms, banks, and consumers adjust their decisions. The magnitude of those spillovers critically depends on the size of the country where the intervention takes place.

**Bank Regulation:** Higher capital standards directly boost reallocation, innovative investment and output but lower income and consumption, see Proposition 1. Now, they also generate a counteracting second-order effect by decreasing the world price  $v^*$ .

**Proposition 4** *Tighter capital requirements  $k$  increase innovative investment and output and/or lower consumption demand for  $x$ -goods in the domestic economy. The trade surplus rises. In foreign countries, credit reallocation, innovative investment and output fall but consumption demand rises, leading to a smaller surplus.*

Appendix B derives detailed results. In the domestic economy, first- and second-order effects tend to offset each other: Tighter capital standards directly foster credit reallocation, whereas a lower price has the opposite effect. One observes similar patterns regarding investment, supply, and consumption demand. Aggregate income, in contrast, declines because more equity is associated with supervision costs of investors and entrepreneurs in the  $x$ -sector earns smaller profits due to the lower price, see (31). Importantly, the trade

surplus in innovative goods unambiguously rises with higher capital standards. Noting the relation  $\hat{\zeta}_x = \gamma_s \cdot \hat{X} - \gamma \cdot \hat{C}_x$ , this requires either a larger supply (i.e.,  $\hat{X} > 0$ ) or a lower demand (i.e.,  $\hat{C}_x < 0$ ) or a combination of both. Therefore, the direct effect of tighter capital requirements dominates the induced price change at least on one side such that either investment and supply of the innovative sector increase or consumption demand falls or both.<sup>11</sup> A larger supply, in turn, usually results from more aggressive credit reallocation by banks, while the induced shifts in entry may even lower final investment and output of the  $x$ -sector.

The intervention creates spillovers and lower world price translates into lower domestic prices abroad where it reduces innovative investment and output, see (30). On the other hand, the lower price allows for more consumption despite smaller income, see (31) and (32). These changes in supply and demand affect the trade patterns: In countries that are net exporters of the  $x$ -good, the surplus falls, while the deficit rises in countries that are net importers. Overall, the rest of the world is a net importer vis-à-vis the domestic economy such that their joint deficit rises.

**Institutional Reforms:** Better investor protection and improved insolvency laws directly lower equity premium and liquidation cost. They are also associated with a lower world price in our main scenario with a positive but small or even negative entry elasticity.

**Proposition 5** *Strengthening investor protection and improving insolvency laws boosts innovative investment, output, and consumption demand in the domestic economy. The trade surplus increases. In foreign countries, such reforms reduce credit reallocation, innovative investment and output but raise consumption demand leading to a larger (smaller) trade deficit (surplus).*

Appendix B computes the detailed results. Domestically, better investor protection and insolvency laws that allow banks to extract more capital from terminated loans in-

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<sup>11</sup>It is most plausible that the direct effect prevails on both sides but it seems possible that demand falls strongly (i.e., the direct effect dominates) and supply is slightly smaller at the same time (i.e., the price effect dominates) or vice versa.

crease innovative investment and output despite the negative price effect. This increase mainly rests on a higher reallocation rate  $(1 - c)q$  at least as long as  $s - (1 - c)q > 0$ . In addition, these reforms boost consumption demand for  $x$ -goods, which is driven by the positive direct effect on national income and reinforced by a lower relative price, see (37).

Given both a larger supply and demand, the net effect of the reforms on the domestic trade balance appears ambiguous. Nevertheless, we can make use of world market clearing to derive more precise predictions. Recall that improving insolvency laws and investor protection tends to lower the world price, see Lemma 1. This price decline causes a larger trade deficit (or smaller surplus) in foreign countries,  $\hat{\zeta}_x^i = -\sigma_v^i \cdot \hat{v}^*$ . By world market clearing, the larger trade deficit in the rest of the world must be offset by a larger trade surplus of the domestic economy.

**Trade liberalization:** Consider a decrease in export costs by  $-\hat{\tau}$ . It affects the domestic price  $v$  directly and through its effect on the world price. Substituting (37) in  $\hat{v} = \hat{v}^* - \hat{\tau}$  gives

$$\hat{v} = - \left[ 1 - \frac{\omega \sigma_v}{\sigma_v^*} \right] \cdot \hat{\tau}. \quad (38)$$

The square bracket is positive and equal to  $\sum_i \omega^i \sigma_v^i / \sigma_v^*$ . The direct effect of lower export costs prevails and the domestic price  $v$  rises. Compared to a small open economy, this price increase is less pronounced as the world price declines at the same time.

**Proposition 6** *Reducing the export cost  $\tau$  boosts credit reallocation, innovative investment, and output and lowers consumption demand for innovative goods in the domestic economy. The trade surplus increases. In foreign countries, credit reallocation, innovative investment and output fall but consumption demand increases leading to a larger (smaller) trade deficit (surplus).*

The induced increase in the domestic price shifts final investment and output to the  $x$ -sector, see (30), and lowers consumption demand, see (32). Consequently, trade liberalization clearly leads to a larger domestic trade surplus.



The effects of this policy on foreign countries are just the opposite: The lower world price translates into a lower domestic price one by one,  $\hat{v}^i = \hat{v}^* = -\hat{\tau}$ . This reduces credit reallocation, investment, and output of the innovative sector and raises consumption demand. Since the rest of the world is a net importer of the  $x$ -good ( $\sum_i \zeta_x^i > 0$  due to  $\zeta_x < 0$ ), the overall trade deficit increases.

## 6 Conclusion

This paper shows how banks finance structural change and enhance the expansion of innovative industries by reallocating credit. It identifies new, bank-related and institutional determinants of trade and specialization such as the quality of insolvency laws, capital regulation and cost of bank equity. Those factors importantly influence the capital structure of banks which, in turn, affect the banks' capacity to liquidate non-performing loans in the downsizing sector and redirect credit flows towards expanding industries.

Our main finding is that three different policy interventions - bank regulation with tighter capital standards, reforms of investor protection and bankruptcy procedures that lower the cost of bank equity and loan liquidation, and trade liberalization reducing export costs - affect trade patterns in similar ways. In general, these interventions accelerate credit reallocation and shift investment from declining to more innovative and growing industries. Although the effects on trade patterns are similar, these policies differ in their effects on domestic consumption and welfare. We also analyze spillovers of policy reform in large countries to the rest of the world where they tend to benefit consumers and traditional industries.

# Appendix

## A. Small Open Economy

**Supply Side Reactions:** To derive the impact on aggregate supply, we start with (29) and substitute (24) for  $d(1-c)q = (1-c) \cdot dq - q \cdot dc$  and (28) for  $ds$ , giving

$$\begin{aligned}
 dn'_x &= \left[ \frac{(1-c)^2 n_z}{z} + \frac{(s-(1-c)q)^2}{\pi_x} f(s) \right] vpx \cdot \hat{v} \\
 &: - \left[ n_z q + \left( \frac{(1-c)n_z}{z} - \frac{s-(1-c)q}{\pi_x} f(s)q \right) \varepsilon_{qc} \right] \cdot dc \\
 &: - \left[ \frac{(1-c)(1-k)cn_z}{z} - \frac{s-(1-c)q}{\pi_x} cqf(s) \right] \cdot d\theta \\
 &: + \left[ \frac{(1-c)cn_z}{z} - f(s) \frac{(s-(1-c)q)(s-(1-cq))}{\pi_x} \right] \theta \cdot dk.
 \end{aligned} \tag{A.1}$$

Inspecting (29) motivates the definition of a reallocation elasticity  $\mu \equiv (1-c)n_z/z > 0$  and an entry elasticity  $\eta \equiv [s-(1-c)q]f(s)/\pi_x$ , leading to

$$\begin{aligned}
 dn'_x &= [(1-c)\mu + (\pi_x/f(s))\eta^2] vpx \cdot \hat{v} - [n_z q + (\mu - \eta q) \varepsilon_{qc}] \cdot dc \\
 &: -c(\mu - \eta q) \cdot d\theta + [c(\mu - \eta q) + (1-s)\eta] \theta \cdot dk.
 \end{aligned} \tag{A.2}$$

Using this in  $dX = px \cdot dn'_x$  pins down the response in aggregate supply given in (30).

The ambiguity of  $\eta$  results from reallocation. In a rigid economy without reallocation,  $q = 0$  and  $\bar{q} = 1/2$ , so that  $dq$  and, in turn,  $\mu = 0$ . In this case,  $\eta = sf(s)/\pi_x$  and  $dn'_x = (\pi_x/f(s))\eta^2 vpx \cdot \hat{v} + (1-s)\eta\theta \cdot dk$ . Such an economy responds on the entry margin only. There cannot be any effect of  $c$  when there is no liquidation, and of  $\theta$  when there is consequently no required voluntary offer  $e = eqn_z$ .

**Trade Balance:** We first evaluate the effect of liquidation costs  $c$  on the trade deficit,  $\sigma_c \equiv \gamma_s \delta_c - \gamma q_Y$ . Substituting  $\delta_c$  and  $q_Y$ , separating the mechanical supply effect, collecting the other terms and using  $\gamma_s = vpx n'_x / Y$  yields  $\sigma_c = \gamma_s \frac{n_z q}{n'_x} + \left[ \mu - \eta q - \gamma \frac{qn_z}{vpx} \right] \frac{\gamma_s \varepsilon_{qc}}{n'_x}$ .

Rewrite the square bracket by substituting  $\mu = (1 - c) n_z/z$ , expanding by  $\frac{qn_z}{vpx}$  and using  $\theta c = vpx(1 - c) - qz$  from optimal liquidation in (20) which yields

$$\sigma_c = \left[ n_z q + \left( (\theta c + (1 - \gamma) q) \frac{n_z}{vpx} - \eta q \right) \varepsilon_{qc} \right] \frac{\gamma_s}{n'_x} > 0. \quad (\text{A.3})$$

The coefficient is positive if  $\eta$  is negative or positive but small.

To derive the effect of a higher equity premium  $\theta$ ,  $\sigma_\theta \equiv \gamma_s \delta_\theta - \gamma e_Y$ , we substitute coefficients, isolate  $\eta$ , factor out  $\gamma_s/n'_x$ , substitute for  $\gamma_s$  and expand by  $e/(vpx)$ ,

$$\sigma_\theta = \left[ (1 - \gamma) \frac{e}{vpx} + c\mu - \frac{e}{vpx} \right] \frac{\gamma_s}{n'_x} - \eta \gamma_s \frac{\varepsilon_{s\theta}}{n'_x}.$$

Next, substitute for  $\mu$  and for  $e$  as noted in (17) in the last two terms of the square bracket, replace  $q$  by the optimal liquidation rate in (20), and factor out  $vpx$  to obtain

$$\sigma_\theta = [(1 - \gamma) e + c^2 \theta n_z/z - \eta qc \cdot vpx] \gamma_s / (vX),$$

which is positive in our main scenario with a small or even negative entry elasticity.

## B. World Economy

**Bank Regulation:** Capital requirements  $k$  lower the world price  $v^*$ , see (37). To obtain the effects on innovative investment and supply, we substitute for  $\hat{v} = \hat{v}^* = \omega \sigma_k / (\sigma_v^*) \cdot dk$  in (30) and use  $\sigma_k = \gamma_s \delta_k + \gamma n_Y$ :

$$\hat{X} = \left[ -\delta_v \frac{\omega (\gamma_s \delta_k + \gamma n_Y)}{\sigma_v^*} + \delta_k \right] \theta \cdot dk. \quad (\text{B.1})$$

Collecting terms and using  $\omega \gamma_s \delta_v < \sigma_v^*$  from the definition of  $\sigma_v^*$  shows that the expression in square brackets can be positive or negative:

$$\delta_k \left( 1 - \frac{\omega \gamma_s \delta_v}{\sigma_v^*} \right) - \frac{\omega \gamma \delta_v n_Y}{\sigma_v^*}. \quad (\text{B.2})$$

Aggregate income  $Y$  clearly decreases in capital requirements due to the negative direct effect and due to a lower world price, see (31). To get the effects on consumption  $C_x$ , we substitute for  $\hat{v}^*$  in (32):

$$\hat{C}_x = \left[ (1 - \gamma_s) \frac{\omega (\gamma_s \delta_k + \gamma n_Y)}{\sigma_v^*} - n_Y \right] \theta \cdot dk. \quad (\text{B.3})$$

Again, we note  $s\gamma(1 - \gamma_s) < \sigma_v^*$  such that  $s\gamma(1 - \gamma_s)/\sigma_v^* < 1$  and find that the sign of the expression in square brackets remains ambiguous:

$$-n_Y \left( 1 - \frac{\omega\gamma(1 - \gamma_s)}{\sigma_v^*} \right) + \frac{\omega\gamma_s(1 - \gamma_s)\delta_k}{\sigma_v^*}. \quad (\text{B.4})$$

Substituting these results into  $\hat{\zeta}_x = \gamma \cdot \hat{C}_x - \gamma_s \cdot \hat{X}$  and collecting terms yields

$$\hat{\zeta}_x = -(\gamma_s\delta_k + \gamma n_Y) \left[ 1 - \frac{\omega(\gamma_s\delta_v + \gamma(1 - \gamma_s))}{\sigma_v^*} \right] \cdot dk < 0. \quad (\text{B.5})$$

Noting  $\omega[\gamma_s\delta_v + \gamma(1 - \gamma_s)] = \omega\sigma_v < \sigma_v^*$ , tighter capital requirements lower the trade deficit in innovative goods.

Therefore, aggregate supply  $X$  must increase, which by inspection of (28) and (29) usually requires more credit reallocation given that the induced entry effect on supply tends to be negative (at least if  $s - (1 - c)q$  is negative or positive and large), or consumption demand  $C_x$  must fall or a combination of both.

**Institutional Reforms:** Liquidation cost  $c$  and equity premium  $\theta$  have an ambiguous effect on the world price  $v^*$  although the former is likely positive. To obtain the effects on innovative investment and supply, we use (37) to substitute for  $\hat{v} = \hat{v}^* = \omega[\sigma_c \cdot dc + \sigma_\theta \cdot d\theta]/\sigma_v^*$  in (30) together with  $\sigma_c = \gamma_s\delta_c - \gamma q_Y$  and  $\sigma_\theta = \gamma_s\delta_\theta - \gamma e_Y$ :

$$\hat{X} = \left[ \delta_v \frac{\omega(\gamma_s\delta_c - \gamma q_Y)}{\sigma_v^*} - \delta_c \right] \cdot dc + \left[ \delta_v \frac{\omega(\gamma_s\delta_\theta - \gamma e_Y)}{\sigma_v^*} - \delta_\theta \right] \cdot d\theta. \quad (\text{B.6})$$

Collecting terms and using  $\omega\gamma_s\delta_v < \omega\sigma_v < \sigma_v^*$  reveals that both expressions in square brackets are negative implying that the domestic supply of  $x$ -goods decreases in liquidation cost and equity premium taking even after taking into account the world price effect:

$$-\delta_c \left( 1 - \frac{\omega\gamma_s\delta_v}{\sigma_v^*} \right) - \frac{\omega\gamma\delta_v q_Y}{\sigma_v^*} < 0, \quad -\delta_\theta \left( 1 - \frac{\omega\gamma_s\delta_v}{\sigma_v^*} \right) - \frac{\omega\gamma\delta_v e_Y}{\sigma_v^*} < 0. \quad (\text{B.7})$$

The decrease in supply implies a smaller reallocation rate  $(1 - c)q$ : Noting (28) and (29), the entry effect is unambiguously positive (i.e., the minimum survival rate falls and more firms enter the  $x$ -sector) if  $s - (1 - c) > 0$  and becomes more ambiguous otherwise. The smaller aggregate supply  $X$  thus requires the reallocation rate to fall.

Similarly, we get the effects on consumption  $C_x$  by substituting for  $\hat{v}^*$  in (32):

$$\hat{C}_x = - \left[ (1 - \gamma_s) \frac{w(\gamma_s \delta_c - \gamma q_Y)}{\sigma_v^*} + q_Y \right] \cdot dc - \left[ (1 - \gamma_s) \frac{w(\gamma_s \delta_\theta + \gamma e_Y)}{\sigma_v^*} - e_Y \right] \cdot d\theta. \quad (\text{B.8})$$

Noting  $\omega\gamma(1 - \gamma_s) < \omega\sigma_v < \sigma_v^*$ , we find that the square brackets are positive such that consumption of the  $x$ -good decreases in liquidation cost and equity premium:

$$\begin{aligned} q_Y \left( 1 - \frac{\omega\gamma(1 - \gamma_s)}{\sigma_v^*} \right) + \frac{\omega\gamma_s(1 - \gamma_s)\delta_c}{\sigma_v^*} &> 0, \\ e_Y \left( 1 - \frac{\omega\gamma(1 - \gamma_s)}{\sigma_v^*} \right) + \frac{\omega\gamma_s(1 - \gamma_s)\delta_\theta}{\sigma_v^*} &> 0, \end{aligned} \quad (\text{B.9})$$

A smaller supply and demand of  $x$ -goods have offsetting effects on the trade balance. To assess the net effect, the change in the world price becomes crucial. Recall that the world price rises with  $c$  and  $\theta$  (see Lemma 1). As a result, the trade deficit in other countries must fall,  $\hat{\zeta}_x^i = -\sigma_v^i \cdot \hat{v}^*$ . Noting that the domestic economy is a net exporter, the rest of the world jointly runs a smaller trade deficit vis-à-vis this country. World market clearing thus requires a smaller domestic trade surplus.

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