Dynamic Inter- and Intra-Industry Adjustments to Trade Liberalization

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Abstract

This paper examines how the presence of heterogenous firms shapes the dynamic inter-industry adjustment to trade liberalization. In the short run, overaccumulation of firms in comparative-disadvantage industries delays the reallocation of resources towards comparative-advantage industries. This spills over on the dynamic intra-industry reallocation of resources and the resulting magnification of comparative advantage. In effect, specialization according to comparative advantage and the endogenous magnification of comparative advantage are manifested gradually over the full transition.

Keywords: International Trade, Firm Heterogeneity, Comparative Advantage, Dynamic Adjustment, Industry Structure

1. Introduction

How do economies adjust to trade liberalization? The answer to this question can be split into two parts. The first part tells us where the economy is heading. Bernard et al. (2007) offers new insights on this issue by combining the Melitz (2003) model of firm heterogeneity with comparative advantage. Using this framework, they provide an analysis of the steady-state implications of the resulting interaction between inter- and intra-industry reallocation of resources. Inspired by this approach, the present paper sheds some light on the second part of the answer to the above question: How the economy gets there.
To this end, I extend the dynamic two-country version of the Melitz (2003) model developed in Bache (2012) to include two industries. Comparative advantage is introduced through industry-specific distributions of productivity draws faced by new entrants. Although the source of comparative advantage is different from the Heckscher-Ohlin setup of Bernard et al. (2007), the main insights regarding the steady-state inter- and intra-industry reallocations are shown to carry over. The framework developed here allows a study of the full transition of the economy in the wake of trade liberalization. This paper reveals that, during the transition, intra-industry reallocations of resources in either industry is heavily influenced by the inter-industry reallocation of resources induced by comparative advantage. On the other hand, the dynamic inter-industry reallocation of resources, and hence the specialization according to comparative advantage over time, is shaped by the presence of heterogeneous firm. Let me briefly provide some of the intuition behind these effects.

Central to the analysis of the transition following a trade liberalization is the notion that the comparative-disadvantage industry features an overaccumulation of firms in the short run. In the post-liberalization steady state the comparative-disadvantage industry shrinks when compared to the initial steady-state. This is a consequence of specialization according to comparative advantage. However, the resources invested in firms are sunk which means that the downsizing of the comparative-disadvantage industry is delayed. The resources employed by this excess mass of firms are obviously not reallocated towards the comparative-advantage industry. Further, the excess mass of firms implies that competition is intense in the comparative-disadvantage industry. This dampens exports in the comparative-advantage industry (which exports to the comparative-disadvantage industry of the foreign country). These effects tend to delay reallocation of labor and capital across industries, and thereby the specialization according to comparative advantage.

As hinted towards above, the dynamic adjustment of the industry structure differs systematically across industries depending on comparative advantage. The excess mass of firms in the comparative-disadvantage industry also implies that competition rises relatively more than in the comparative-advantage industry immediately following the liberalization. As a conse-
quence, the production cutoff\footnote{I.e. the lowest productivity level for which continued production is profitable.} overshoots its long-run level in the comparative-disadvantage industry. In the comparative-advantage industry the adjustment is more gradual. In effect, low-productivity firms are pushed out of the market much more rapidly in the comparative-disadvantage industry. This is as much a result of the overaccumulation of firms as it is a result of intensified import competition.

Several papers analyse the role of heterogeneous firms in the dynamic adjustment of the economy following e.g. a trade liberalization.\footnote{Examples of these are provided in the introduction to Bache (2012).} To my knowledge, none of these feature comparative advantage, as they only model one industry. Most notably, the one-industry models of Ghironi and Melitz (2005) and Alessandria and Choi (2011) do feature a short-run overaccumulation of firms in the wake of trade liberalization. However, this is caused by the absence of endogenous exit, implying that intensified competition does not force the least productive firms to shut down. In the present paper, the short-run overaccumulation of firms in the comparative-disadvantage industry is caused by the (long-run) inter-industry reallocation.\footnote{The model developed in this paper does feature endogenous exit. The overaccumulation of firms in the comparative-disadvantage industry is therefore not caused by the least productive firms not being pushed out of the market.}

The remainder of the paper is structured as follows. Section 2 develops the model. Section 3 conducts a steady-state analysis of the effects of a trade liberalization and relates it to Bernard et al. (2007). Section 4 solves numerically for the full transition of the economy and discusses the result. Finally, Section 5 offers some concluding remarks.

2. The Model

I model trade between two countries, each with two industries producing a range of intermediate inputs. These enter into the production of a final good which is used for consumption, capital accumulation and investment in firm entry in the two intermediate-input industries. Technological differences give rise to comparative advantage. To ensure clarity and tractability, the two countries are mirror images of each other. In essence, the model is a two-industry version of Bache (2012) with Ricardian comparative advantage at the industry level.
2.1. Households

The representative household has an infinite horizon and provides an inelastic labor supply of $L$ units. The utility function has constant elasticity of intertemporal substitution $(1/\theta)$,

$$U_t = \int_t^\infty e^{-\rho(s-t)} \frac{C_s^{1-\theta}}{1-\theta} \, ds, \quad \theta, \rho > 0,$$

where $C$ is consumption and $\rho$ is the subjective discount factor. The disposable income of the representative household comprises labor income, net return on the capital stock, and net profits of the firms in the intermediate-good sector, all of which add up to the gross output of the final good, $Y$, less what is used for fixed costs, $F$. This income is used for consumption, $C$, investment in firms in the intermediate-good sector, $I$, and capital accumulation, $\dot{K}_t$. Thus,

$$\dot{K}_t = Y_t - F_t - I_t - C_t - \delta K_t, \quad \delta \geq 0,$$

where $K$ denotes the capital stock and $\delta$ is the depreciation rate of capital. Accumulation of capital is therefore the direct alternative to investing resources in firm entry. I assume that the capital stock can be decumulated. This implies that, in equilibrium, the interest rate on capital reflects the highest possible return that can be earned on foregone consumption. Therefore, the Euler equation, obtained from the maximization problem of the representative household, reads,

$$\dot{C}_t = \frac{1}{\theta} (r_t - \rho) C_t,$$

where $r$ denotes the net return on capital; depreciation is thus borne by the firms.

In the remainder of the modeling section, time subscripts will be dropped for expositional convenience.

2.2. Production

The final good $Y$ is produced in both countries, Home and Foreign, according to

$$Y = \left( \hat{K}^{-\gamma} \hat{L}^{1-\gamma} \right)^{1-\beta} \left( Y_1^{1/2} Y_2^{1/2} \right)^{\beta}$$
where $\hat{K}$ and $\hat{L}$ are the amounts of capital and labour, respectively, devoted to final-good production while $Y_1$ and $Y_2$ are CES aggregates of the range of intermediate inputs 1 and 2 used. They are given by

$$Y_i = \left( \int_{\omega_i \in \Omega_i} (x_i(\omega_i))^\alpha \, d\omega_i \right)^{1/\alpha}, \quad i = 1, 2$$

where $0 < \alpha < 1$ and $x_i(\omega_i)$ is the amount of intermediate input $i$ of variety $\omega_i$ used. With perfect competition in the market for final goods, the demand function

$$x_i(\omega_i) = Y \left( \frac{p_i(\omega_i)}{P_i} \right)^{-\sigma} = A_i (p_i(\omega_i))^{-\sigma}$$

arises, where $\sigma = 1/(1 - \alpha)$, $p_i(\omega_i)$ is the price of $x_i(\omega_i)$, and $P_i$ is a price index for industry $i$ given by

$$P_i = \left( \int_{\omega_i \in \Omega_i} (p_i(\omega_i))^{1-\sigma} \, d\omega_i \right)^{1/\sigma}.$$

Apart from the demand function (1), perfect competition in the final-good sector implies that the capital and labor employed in this sector is awarded with the shares $\gamma(1 - \beta)$ and $(1 - \gamma)(1 - \beta)$ of the output, respectively.

The varieties of intermediate good in industry $i$ is produced by heterogeneous firms according to (dropping the index $\omega_i$)

$$x_i = \varphi k^\gamma l^{1-\gamma}$$

where $k$ and $l$ are the amounts of capital and labor employed, respectively, and $\varphi$ is the productivity of the firm under scrutiny. To maintain production, a fixed (flow) cost of $f$ units of the final good must be paid. Let $w$ denote the real wage. Profit maximization lead to the input demand functions for production to the domestic market, $k_i^d(w, r; \varphi)$ and $l_i^d(w, r; \varphi)$, the indirect production, revenue and profit functions $x_i^d(w, r; \varphi)$, $z_i^d(w, r; \varphi)$ and $\pi_i^d(w, r; \varphi)$, respectively. All of these can be seen in Appendix A.

### 2.3. Firm Heterogeneity and Comparative Advantage

By sinking an entry cost of $S^e$ a firm can be created in either intermediate-good industry in either country. Upon entry in a given industry in a given country a productivity level is drawn from an known exogenous distribution.
Assume that entry into industry 1 in Home and industry 2 in Foreign implies a draw from the distribution $G_a$,

$$G_a(\varphi) = 1 - \left( \frac{a}{\varphi} \right)^m.$$

Further, assume that entry into industry 2 in Home and into industry 1 in Foreign implies a draw from the distribution $G_b$,

$$G_b(\varphi) = 1 - \left( \frac{b}{\varphi} \right)^m.$$

I assume that $a > b$. Thus, Home has a comparative advantage in industry 1 production and Foreign has a comparative advantage in industry 2 production. From now on industries in a given country will be labeled $a$ or $b$ after the distribution of productivity draws. Note that in this terminology, the comparative-advantage industry, $a$, in Home produce varieties of the same good as the comparative-disadvantage industry, $b$, in Foreign and vice versa. The setup completely symmetric which implies that the wage and interest rate do not differ across countries. I assume that trade costs are high enough as to prevent complete specialization at the industry level.

2.4. Exports

Apart from selling to domestic final-good producers, a firm producing intermediates in either industry may choose to export to the foreign market. Exports are subject to an iceberg trade cost, $\tau$, and an additional fixed (flow) cost of $f^x$ units of the final good. Export profits of a firm in industry $i$ is thus given by

$$\pi_x^i(w, r; \varphi) = \pi_d^j(w, r; \varphi/\tau) + f - f^x, \quad i, j = a, b \text{ and } j \neq i.$$

Firms export whenever it entails positive profits. Let $\varphi_x^i$ denote the cutoff for exporting, given by

$$\pi_x^i(w, r; \varphi_x^i) = 0.$$
Letting $\varphi^*_i$ denote the cutoff for shutting down a firm in industry $i$, the total current profits of a firm with productivity $\varphi$ are given by

$$\pi_i(\varphi) = \begin{cases} 
\pi^d_i(w, r; \varphi_i) + \pi^x_i(w, r; \varphi_i) & \text{if } \varphi > \varphi^*_i \\
\pi^d_i(w, r; \varphi_i) & \text{if } \varphi^*_i > \varphi > \varphi^*_i \\
0 & \text{otherwise}
\end{cases},$$

assuming, in line with empirics, that some firms choose not to export.

2.5. Entry and Exit

Firms are hit with an exogenous death shock, which forces affected firms to shut down, at the rate $\eta$. Further, a firm chooses to exit voluntarily if its value is negative. The value of a firm in industry $i$, $V_i$, with productivity $\varphi$ can be described by the equation

$$(r + \eta)V_i(\varphi) = \max \left\{ 0, \pi_i + \dot{V}^c_i(\varphi) \right\},$$

where $\dot{V}^c_i(\varphi)$ is the change in value conditional on continued production. Now, the production cutoff, $\varphi^*_i$, is determined by

$$\varphi^*_i = \inf \{ \varphi : V_i(\varphi) > 0 \}.$$

Firms with productivities below this cutoff shut down.

As the pool of potential entrants into either industry is unbounded, the value of entry,

$$V^e_i = \int_{\varphi^*_i}^{\infty} V_i(\varphi) dG_i(\varphi) - F^e,$$

has to be non-positive. If the value of entry into industry $i$ is negative, the mass of (successful) entrants in that industry, $M^e_i$, is zero. Otherwise, firms enter until the value of entry is driven to zero.

2.6. Equilibrium

To express market clearing conditions in a convenient way, an average productivity, analogous to that of Melitz (2003), must be defined. Letting $H_i(\varphi)$ denote the distribution of incumbent firms in industry $i$, the average productivity over inputs from industry $i$ used in production of the final good
is given by

\[ \tilde{\varphi}_i = \left[ \frac{M_i}{M_T} \int_{\varphi_i}^{\infty} \varphi^{\sigma-1} dH_i(\varphi) + \frac{M_j}{M_T} \tau_1^{1-\sigma} \int_{\varphi_j}^{\infty} \varphi^{\sigma-1} dH_j(\varphi) \right]^{\frac{1}{\sigma-1}}, \]

where \( M_i \) is the mass of firms in industry \( i \), \( M_j^x \) is the mass of exporters in industry \( j \), and \( M_T^i \) is the total mass of varieties from industry \( i \) used in production of final goods. This is given by \( M_T^i = M_i + M_j^x \). Notice that, due to the absence of sunk export costs, \( M_j^x = (1 - H_i(\varphi_j))M_i \). Now, the market clearing conditions for labor and capital can be expressed as

\[ L = \hat{L} + \sum_{i=a,b} M_i^T t_i^d(w, r; \tilde{\varphi}_i) \]

and

\[ K = \hat{K} + \sum_{i=a,b} M_i^T k_i^d(w, r; \tilde{\varphi}_i), \]

respectively. Besides the input markets clearing, we need that the expenditure in either industry \((Y/2)\) equals the revenue generated by the intermediate-good producers, i.e.,

\[ Y/2 = M_i^y z_i^d(w, r; \bar{\varphi}_i^y), \quad i = a, b. \]

Further, two equations analogous to that of Bache (2012) describe the evolution of the masses of firms, \( M_a \) and \( M_b \). Finally, we can express \( I \) and \( F \) as

\[ I = \sum_{i=a,b} M_i^e S^e \]

and

\[ F = \sum_{i=a,b} [M_i f + M_i^x f^x], \]

respectively. This closes the model.

3. Steady State

The present section discusses steady-state responses to trade liberalization which is modeled as a reduction of the iceberg transport cost, \( \tau \). These responses are then related to those presented by Bernard et al. (2007).
Steady-state values of a range of central variables are presented in Figure 1 for iceberg trade costs between 20 and 60 per cent.\(^4\)

Consider first the steady state for a given value of the trade cost \(\tau\). The comparative-advantage (CA) industry offer a better distribution of productivity draws than the comparative-disadvantage (CD) industry, and hence, due to free entry, more firms enter the CA industry (as is seen in Figure 1). Because the CA industry features better productivity draws combined with an export market (the CD industry of the foreign country) where firms have worse productivity draws, the CA industry is relatively more competitive than the CD industry. As a consequence, the production cutoff is even higher in the CA industry than what is accounted for by the difference in the ex-ante distribution of productivity draws. In effect, the Ricardian comparative advantage is magnified by firm selection, completely analogous to Bernard et al. (2007). The fiercer competition of the CA industry offsets the better distribution of productivity draws, such that firms are indifferent between entering the two industries. The export cutoff, on the other hand, is lower in the CA industry. This is because firms from the CA industry in one country exports into the CD industry in the other and vice versa. Since exporting into the CD industry of the other country is more attractive than exporting into the CA industry,\(^5\) the cutoff for exporting is lower in the CA industry. The larger mass of firms in the CA industry and the higher share of exporters in this industry\(^6\) imply that the CA industry has more exporters. Summing up, the comparative advantage industry has more firms, more exporters, fiercer competition (lower profits for given productivity), and, as a result, its ex-ante comparative advantage is magnified by firm selection.

Next, consider what happens when trade is liberalized. The reaction in the industry-level variables discussed so far arises from two reallocation effects. First, trade liberalization induces intra-industry reallocations as emphasized by Melitz (2003). Second, in this Ricardian world, trade liberalization induces inter-industry reallocations. Thus, as in Melitz (2003), the production cutoff rises and the export cutoff falls in both industries, but the effect is stronger in the CA industry (same reasoning as above). This means that the comparative advantage of industry \(a\) over industry \(b\) is magnified

\(^4\)The parametrization used is presented in Appendix B.

\(^5\)The CA industry has a higher production cutoff which implies that less profits are earned for a given productivity.

\(^6\)The consequence of a higher production cutoff and a lower export cutoff.
Figure 1: Steady state for different values of $\tau$. When displaying industry-level variables, dashed lines indicate the disadvantage industry. MOF and MOX are short for mass of firms and mass of exporters, respectively.

further when trade is liberalized as the world production of either industry’s intermediate goods is concentrated in the country with the comparative advantage.\footnote{This is also the case in the Heckscher-Ohlin world of Bernard et al. (2007).} The mass of firms in the CD industry falls as resources are shifted towards the CA industry. The mass of firms in the CA industry falls slightly or increases as the Melitz (2003) effect of intra-industry reallocation towards exporters (which tends to reduce the mass of operating firms) is mitigated or overcome by capital accumulation and the inter-industry reallocation towards this industry (which tend to increase the mass of firms). The mass of exporters in the CA industry rises, as access to the foreign market improves and as the foreign country imports more in their CD industry (imports which come from home’s CA industry) and relies less on domestic production. The mass of exporters in the CD industry increases slightly or decreases, as the
effect of capital accumulation and easier access to foreign markets provided by the trade liberalization is mitigated or overcome by the inter-industry reallocation away from this sector.

Considering the aggregate effect of a trade liberalization, the picture is very similar to that of Bache (2012). The trade liberalization expands production of intermediate goods which induces a larger capital stock, a higher wage, and a larger production of the final good. Finally, the trade liberalization increases welfare, reflected in a higher level of consumption.

It is obvious from Figure 1 and the discussion above, that, in the face of freer trade, the steady-state responses in the production and export cutoffs, the mass of firms and exporters, and welfare (consumption), along with the underlying mechanism, are very similar to what is presented by Bernard et al. (2007).

4. Transition

The contribution of the steady-state analysis above is merely to confirm that the main steady-state results of Bernard et al. (2007) on the firm selection, inter- and intra-industry allocations, still applies when comparative advantage stems from Ricardian technology differences. This is not that surprising. More interestingly, having build the model on the dynamic framework of Bache (2012), it is now possible to explore how the inter- and intra-industry reallocations are realized over time. To this end, let us consider a (substantial) trade liberalization reducing the iceberg trade cost, $\tau$, permanently and unexpectedly from 1.60 to 1.20, assuming that the economy is initially in steady-state. The induced transition paths of key variables, which are analysed in the remainder of the present section, are depicted in Figure 2.

At the aggregate level, the adjustment process is pretty straightforward. Immediately following the trade liberalization the demand for capital and labor increases and thus, so do the wage and the interest rate. Further, output and consumption expands. The capital stock decreases as some resources are invested in new firms in the CA industry. As time goes by, capital is accumulated and the interest rate returns to the steady-state level.\(^8\) The larger

\(^8\)The path of the interest rate and the capital stock seems to feature a kink around seven years after the liberalization. This is point where entry into the CD industry picks up again. Invested resources are thus shifted away from capital accumulation to some
capital stock induces a continued expansion of output and consumption. The demand for labor rises further which makes the wage increase.

4.1. Overaccumulation of Firms in the CD Industry

To understand the transition at the firm and industry level, it is important to remember that trade liberalizations induces an inter-industry reallocation of resources, and hence, an increase in the steady-state mass of firms in the CA industry relative to the CD industry. However, due to the sunk cost of entry, the mass of firms in each industry behaves somewhat like a non-decumulable capital stock. In effect, each country features overaccumulation of firms in the CD industry and underaccumulation of firms in the CA industry immediately following the liberalization of trade. The overaccumulation extent. This makes the capital stock increase more slowly. As a consequence the interest rate decreases at a lower pace.
of firms in the CD industry means that the value of entering this industry is negative for seven years following the liberalization. In this period, no firms enter and thus, the mass of firms steadily declines due to firms being hit by the death shock. After seven years, the mass of firms has declines sufficiently for the value of entry into the CD industry to reach zero again and entry into this industry picks up. The described overaccumulation of firms in the CD industry influences the dynamic adjustment within and across industries as the following two subsections reveal.\(^9\)

### 4.2. Short-Run Inter-Industry Reallocations

In the new steady-state a substantial amount of labor is shifted from the CD industry to the CA industry compared to the old steady-state, as countries specialize in producing the intermediate goods of their CA industry. Consequently, the amount of capital employed in the CA and CD industry has increased and decreased, respectively. However, in the short run, the overaccumulation of firms in the CD industry to some extent delays the reallocation of labor and capital towards the CA industry, and thereby the specialization according to comparative advantage. Even though an amount of labor and capital shifts from the CD industry to the CA industry immediately following the trade liberalization, the overaccumulation of firms implies that these "extra" firms in the CD industry hogs capital and labor. During the period of zero entry into the CD industry, the overaccumulation slowly disappears as the CD industry shrinks. Labor and capital is gradually released from the firm that cease production. These inputs are absorbed by the expanding CA industry, and the inter-industry reallocation is gradually realized. Note that the gradual inter-industry reallocation of inputs over the first seven years is substantially larger than the immediate reallocation that takes place at the time of liberalization.

It is seen from Figure 2 that the CES aggregates of the output, \(Y_i\), from both industries increases immediately following the trade liberalization. This is due to the expansion of imports. However, during the period of zero entry into the CD industry, the CES aggregate of output from the CD industry\(^{10}\)

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\(^9\)Such overaccumulation also shapes adjustment to trade liberalization in the models by e.g. Ghironi and Melitz (2005) and Alessandria and Choi (2011). However, in these models the overaccumulation persist mainly due to the absence of endogenous exit, whereas in the present model it persists due to a downsizing of the CD industry.

\(^{10}\)This consists of both domestic production in the CD industry and imports from the
declines, due to the effective decumulation of domestic firms. Demand shifts towards imports in this industry, but the increase in imports is dominated by the decrease in domestic production. The CES aggregate of output from the CA industry increases in this period, as more resources are invested in, and allocated to, this industry. After the period of zero entry into the CD sector, the aggregates of the output of both industries increase as capital is accumulated. However, the CD industry never reaches the same level as immediately following the trade liberalization and therefore exhibits overshooting in the short run.

4.3. Intra-Industry Reallocations

At the time of the trade liberalization (time zero), the export cutoff of both industries decrease. Both the CA and the CD industry experiences intra-industry reallocations as old and new exporters attract more resources at the expense of domestic producers. Therefore, the production cutoff increases in both industries. These effects are to some extent the standard Melitz (2003) story, but the paths of the cutoffs along the transition are strongly affected by overaccumulation of firms in the CD industry (and the implied delay of inter-industry reallocation).

Due to the overaccumulation of firms in the CD industry at the time of the liberalization combined with the increased import competition, the competition in this industry is quite intense. Therefore, the production cutoff in the CD industry rises above the new steady-state level immediately. Even though this causes some firms to be pushed out of the market, there is still overaccumulation of firms in the industry.

In the CA industry on the other hand, there is underaccumulation of firms. This means that a mass of firms enter this industry as an immediate reaction to the trade liberalization. Since entry requires an investment to be sunk, the capital stock is reduced. Despite this immediate entry of new firms, the mass of firms in the CA industry decreases at the time of trade liberalization because the mass of low-productivity firms being pushed out of the industry (due to the increase in the production cutoff) is larger than the mass of new firms entering the industry. Further, as the CA industry does not feature an overaccumulation of firms, the production cutoff does not rise above the new steady-state level. Rather, it only adjusts some of

CA industry of the foreign country.
the way towards the new steady-state level, as capital is scarce in the short run and investment in new firms therefore is more expensive than in the long run (the interest rate on capital is high). This tends to dampen competition compared to the new steady-state level, completely analogous to Bache (2012).

To sum up, the overaccumulation of firms in the CD industry in the short run implies that the production cutoff (and thereby the average productivity of domestic firms) overshoots the new steady-state level in this industry. In the CA industry, on the other hand, the production cutoff adjust only some of the way toward the new steady-state level immediately. Thereafter, it gradually approaches the steady-state level as capital is accumulated and the interest rate decreases. The decreasing interest rate effectively makes entry cheaper, thus inducing more entry which increases the production cutoff. In effect, the behaviour of the domestic cutoff, and thereby the adjustment of the industry structure, is less erratic and more "smooth" in the CA industry.

4.4. Exporters and Specialization According to Comparative Advantage

Consider now the adjustment of exports. Immediately following the trade liberalization, the export cutoffs decreases in both industries (as mentioned above) and thus the mass of exporters increases. This is a direct implication of the easier access to the foreign market. Hereafter, the masses of exporters in the two industries move in opposite directions.

The export cutoff in the CA industry decreases during the period of zero entry into the CD industry. This is because the decreasing number of firms in the CD industry of the foreign country softens competition in this industry. Thereby, exporting becomes more attractive in the CA industry which exports into the CD industry of the foreign country. The mass of exporters increase in the CA industry, partly due to the increase in the number of firms (some of which exports) and partly due to the decreasing export cutoff. After the period of zero entry into the CD industry, the mass of exporters in the CA industry increase only slightly as the mass of firms increases.

In the CD industry, on the other hand, the mass of exporters is decreasing during the period of zero entry, partly due to the decrease in the number of firms in this industry (some of which exports) and partly due to the increased competition in the export market (the CA industry of the foreign country).

Effectively, the movement in the masses of firms and exporters during the period of zero entry into the CD industry reflect the inter-industry reallocation towards the CA industry, i.e., specialization according to comparative advantage. The mass of firms in the CA industry increases while the mass of
imported varieties, which comes from the CD industry of the foreign country, decreases. At the same time, the mass of firms in the CD industry decreases while the mass of imported varieties, which comes from the CA industry of the foreign country, increases.

Finally, note that during the period of intra-industry reallocations (with zero entry into the CD industry), the share of exporters increase substantially\(^\text{11}\) in the CA industry and decrease slightly in the CD industry. This also reflects the gradual specialization according to comparative advantage.

5. (Preliminary) Concluding Remarks

This paper have examined the dynamic inter- and intra-industry adjustments to trade liberalization in the context of heterogeneous firms and comparative advantage. However, this is still work in progress. Among other things, I plan to look into how the endogenous magnification of comparative advantage evolves during the transition. The evolution of average productivity along with the share of imports relative to domestic production in each industry will also be examined.

Appendix A. Firm Optimization

Firm optimization lead to the following input demand functions,

\[
 k^d_i(w, r; \varphi) = \alpha^\sigma A_i \left( \frac{1 - \gamma}{w} \right)^{(\sigma-1)(1-\gamma)} \left( \frac{\gamma}{r + \delta} \right)^{(\sigma-1)\gamma + 1} \varphi^{\sigma-1}
\]

\[
 l^d_i(w, r; \varphi) = \alpha^\sigma A_i \left( \frac{1 - \gamma}{w} \right)^{(\sigma-1)(1-\gamma)+1} \left( \frac{\gamma}{r + \delta} \right)^{(\sigma-1)\gamma} \varphi^{\sigma-1},
\]

The resulting production is given by

\[
 x^d_i(w, r; \varphi) = \alpha^\sigma A_i \left( \frac{1 - \gamma}{w} \right)^{\sigma(1-\gamma)} \left( \frac{\gamma}{r + \delta} \right)^{\sigma\gamma} \varphi^\sigma,
\]

\(^{11}\)Include in Figure 2.
yielding revenue

\[
    z_i^d(w, r; \varphi) = \alpha^{\sigma-1} A_i \left( \frac{1 - \gamma}{w} \right)^{(\sigma-1)(1-\gamma)} \left( \frac{\gamma}{r + \delta} \right)^{(\sigma-1)\gamma} \varphi^{\sigma-1}
\]

and profits

\[
    \pi_i^d(w, r; \varphi) = \alpha^{\sigma-1}(1 - \alpha) A_i \left( \frac{1 - \gamma}{w} \right)^{(\sigma-1)(1-\gamma)} \left( \frac{\gamma}{r + \delta} \right)^{(\sigma-1)\gamma} \varphi^{\sigma-1} - f.
\]

The price chosen by a firm with productivity \( \varphi \) is

\[
    p(w, r; \varphi) = \left( \frac{w}{1 - \gamma} \right)^{1-\gamma} \left( \frac{r + \delta}{\gamma} \right) \gamma \frac{1}{\alpha \varphi}.
\]

Appendix B. Parametrization

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<td>( \gamma )</td>
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<tr>
<td>( S^e )</td>
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<td>( \eta )</td>
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References


