Trade Credit Constraints and International Business Cycles*

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Abstract

I study how frictions in exporting firms' trade credit affect the business cycles of a small open economy within a general equilibrium framework. In the model, firms rely on external capital to cover large upfront fixed export costs but face credit constraints that limit borrowing based on the country's financial development. In quantitative general equilibrium exercises, I show that the effect of trade credit constraints on the aggregate economy is not as significant as on firm-level outcomes due to two mechanisms. First, the decrease in the extensive margin of exports from trade credit constraints is offset by an increase in the average productivity of exporters, limiting its aggregate impact. This extensive margin effect strengthens, while the selection effect weakens, when firm productivity is less dispersed. Second, wage adjustments in general equilibrium reduces the magnitude of these channels, diminishing the role of trade credit constraints at the aggregate level. This wage-adjustment effect is stronger with inelastic labor supply.

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1 Introduction

Exporting firms often rely on external capital to cover large upfront export costs through trade credit. However, they frequently face frictions that limit borrowing capacity. While firm-level effects of trade credit constraints in partial equilibrium are well studied—showing negative impacts on exports (Chaney, 2016; Manova, 2013)—their aggregate implications in general equilibrium, particularly at business-cycle frequency, remain less explored.

This paper fills that gap by examining the effects of trade credit constraints on business cycles in general equilibrium. I develop a small open economy business cycle model with monopolistically competitive firms producing differentiated goods à la Melitz (2003). Exporting firms must obtain trade credit to cover fixed export costs, but borrowing capacity is constrained by domestic financial development. The model shows how these frictions affect aggregate macro variables, and quantitative results indicate that their impact is very small—both in steady state and in responses of macro variables to productivity shocks. In contrast to their strong firm-level effects, the aggregate role of trade credit constraints is muted. Two mechanisms explain this outcome: (i) selection into exporting raises average productivity, offsetting the decrease in the number of exporters, and (ii) wage adjustment in general equilibrium dampens the transmission of shocks. I further connect these mechanisms to the firm productivity distribution and the elasticity of labor supply.

The frictions are modeled by assuming firms can pledge only a fraction of their export revenue as collateral. Some papers often allow firms to accumulate capital and use it as additional collateral, which captures another aspect of reality. My specification abstracts from that dimension but offers two advantages. First, it is more tractable to embed in a general equilibrium business cycle model. Second, because it imposes a stricter constraint, the results can be interpreted as a worst-case scenario. Even under this extreme assumption, the aggregate effects remain small, and I delve into the mechanisms.

Theoretically, trade credit constraints influence three margins: (i) the number of exporters (extensive margin), (ii) the average productivity of exporters (selection), and (iii) the average exporter profits (intensive margin). Frictions exclude some potential exporters, reducing the extensive margin but simultaneously raising average productivity through selection. The effect on the intensive margin is more subtle, as it mainly operates through adjustments in wages and other macro variables in general equilibrium.

Quantitatively, I find that trade credit constraints generate no significant differences in aggregate outcomes—either in steady state or in responses to productivity shocks. Steady-state values of key variables, including consumption and GDP, are nearly identical across economies with and without extreme frictions. Similarly, impulse response functions of such variables to productivity shocks show muted differences.

This limited aggregate effect arises through two mechanisms. First, the extensive margin and selection effects largely offset each other. Financial frictions reduce the number of exporters, but as only the most productive firms enter, the average productivity of exporters rises, neutralizing the loss in participation. Second, in general equilibrium, wages adjust in response to shocks. This wage adjustment dampens the responses of all margins—extensive, selection, and intensive—absorbing much of the impact of financial frictions on the aggregate economy.

I then explore how these two mechanisms depend on underlying structural features. When firm productivity is less dispersed, the selection effect weakens relative to the extensive margin, so aggregate outcomes become more sensitive to shocks. In this case, economies with fewer trade credit constraints achieve higher steady-state consumption and exhibit stronger percentage deviations from steady state in response to shocks. I also extend the model to include endogenous labor supply. As the elasticity of labor supply falls, wage adjustment becomes stronger, further reducing the transmission of shocks to aggregate variables.

The key message is that trade credit constraints, though highly relevant for firm-level outcomes, have limited aggregate effects. Even under an extreme "worst-case" constraint, their role in shaping business-cycle dynamics is small because general equilibrium forces—particularly the offsetting interaction of margins and wage adjustment—largely neutralize them. This conclusion, however, should be viewed with qualification: when firms are less dispersed and/or labor supply is more elastic, trade credit constraints can potentially amplify fluctuations and worsen business cycles. Moreover, this paper abstracts from other dimensions through which trade credit constraints may affect firms, such as R&D or investment decisions. Incorporating these channels into a general equilibrium business-cycle framework would be a promising direction for future research.

Related Literature.— This paper contributes to several strands of literature. The first examines how trade credit constraints shape firms' international activities. Empirical studies such as Manova (2008), Antràs and Foley (2015), and Desai et al. (2008) show that these frictions affect trade and multinational operations. Manova et al. (2015) provides firm-level evidence that credit constraints limit international trade and influence the structure of multinational activity. On the theory side, Manova (2013) embeds financial frictions into a partial equilibrium heterogeneous-firm model to identify the channels through which credit constraints affect trade and shows that financially developed economies export more in financially vulnerable sectors. Chaney (2016) develops a partial equilibrium model of international trade with trade credit constraints, where firms differ in asset holdings, and shows that exchange rate fluctuations have an ambiguous effect on exports. Foley and Manova (2015) provide a comprehensive survey of this literature.

This paper contributes by analyzing trade credit constraints in a general equilibrium setting. I show that while the model's partial equilibrium predictions on firm-level export activity align with existing studies, the aggregate impact of trade credit constraints is quantitatively negligible once general equilibrium effects are accounted for.

Second, this paper contributes to the international real business cycle (RBC) literature originating with Backus et al. (1992). More recent work highlights the role of financial frictions, such as Mendoza (2010), Bianchi (2011), and Benigno et al. (2013), who explain business cycles in small open economies through financial constraints and pecuniary externalities. Other studies incorporate firm dynamics into RBC models: Ghironi and Melitz (2005) embed

Melitz (2003)-type firms, and Fattal Jaef and Lopez (2014) extend this framework with capital accumulation, finding limited gains in matching business cycle statistics.

This paper contributes by developing a small open economy RBC model with trade credit constraints. Unlike Mendoza (2010) and Bianchi (2011), I focus on frictions in firms' export activity rather than in the representative household's problem.

This paper also relates to the literature on the 2009 trade collapse, when world trade fell by 10%. Explanations include the breakdown of international supply chains, rising protectionism, and negative shocks to investment in durables. Because the collapse followed a financial crisis, several papers, including Amiti and Weinstein (2011) and Chor and Manova (2012), attribute it to tighter trade credit. However, Bems et al. (2013) and Eaton et al. (2016) argue that trade credit and protectionism played only a limited role. This paper's results support their conclusion by finding that trade credit constraints may have little aggregate effect in general equilibrium.

Finally, Leibovici (2021) examines the effect of financial frictions on trade in a multi-industry general equilibrium model with input–output linkages. He finds that financial development reallocates trade shares from labor- to capital-intensive industries in steady state, while aggregate effects remain limited. Although both his paper and mine study the general equilibrium implications of financial frictions, the focus differs. Leibovici (2021) emphasizes cross-sectoral reallocation, whereas I examine how frictions shape the extensive margin and average productivity of exporters within an industry. I also analyze how the dispersion of firm productivity influences these channels and how wage adjustment in general equilibrium dampens their effects. Moreover, I study how trade credit constraints affect the responses of macroeconomic variables to productivity and exchange rate shocks at business-cycle frequency. The two papers are complementary: despite different settings and mechanisms, both find that financial frictions matter more at the micro level than in the aggregate.

The rest of the paper is organized as follows. Section 2 describes the small open economy model with trade credit constraints and defines its monopolistically competitive equilibrium. Section 3 reports the quantitative results, provides the underlying economic intuition, and discusses robustness checks. Section 4 concludes.

2 Model

The model is a small open economy with a representative household and a continuum of heterogeneous firms. It has two sectors: tradable and nontradable. In the nontradable sector, a homogeneous good is endowed each period in the fixed amount Y^N. In the tradable sector, a continuum of monopolistically competitive firms produces differentiated goods. Foreign variables are denoted with an asterisk.

2.1 Household

2.1.1 Preferences

Household preferences follow a nested CES structure. The final consumption bundle C_t is a composite of tradable goods and the nontradable good, defined as

$$C_t \equiv \left[\omega {C_t^T}^{\frac{\eta-1}{\eta}} + (1-\omega) {C_t^N}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, \tag{1}$$

where C_t^T and C_t^N denote the tradable and nontradable bundles, respectively. η is the elasticity of substitution between them, and ω is the weight on tradables.

The tradable bundle C_t^T is a CES composite of imported and domestically produced tradables:

$$C_t^T \equiv \left[{C_{D,t}^T}^{\frac{\xi-1}{\xi}} + {C_{I,t}^T}^{\frac{\xi-1}{\xi}}\right]^{\frac{\xi}{\xi-1}}. \tag{2}$$

with ξ the elasticity of substitution between imported and domestic tradables.

The domestically produced tradable bundle is itself a CES aggregator of differentiated varieties:

$$C_{D,t}^T \equiv \left[\int_{i\in\Omega_t} q_{D,t}(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}, \tag{3}$$

where Ω_t is the set of available domestic goods in period t and σ is the elasticity of substitution across varieties.

By the CES property, the corresponding price indices are

$$P_t \equiv \left[\omega^\eta P_t^{T\,1-\eta} + (1-\omega)^\eta P_t^{N\,1-\eta} \right]^{\frac{1}{1-\eta}}, \tag{4}$$

$$P_t^T \equiv \left[P_{D,t}^{T\;1-\xi} + P_{I,t}^{T\;1-\xi} \right]^{\frac{1}{1-\xi}}, \tag{5}$$

$$P_{D,t}^T \equiv \left[\int_{i\in\Omega_t} p_{D,t}(i)^{1-\sigma} di \right]^{\frac{1}{1-\sigma}}. \tag{6}$$

P_t^N denotes the price of the homogeneous nontradable good, $p_{D,t}(i)$ the price of each domestically produced variety, and $P_{I,t}^T$ the price of the imported tradable bundle. All prices are expressed in a common accounting unit. I normalize $P_{I,t}^T = 1$, so the imported tradable bundle serves as the numeraire.

The demand for each domestic variety and the imported bundle is

$$q_{D,t}(i) = \omega^\eta \left(\frac{p_{D,t}(i)}{P_t} \right)^{-\sigma} \left(\frac{P_t^T}{P_t} \right)^{\xi-\eta} \left(\frac{P_{D,t}^T}{P_t} \right)^{\sigma-\xi} C_t, \tag{7}$$

$$C_{I,t}^T = \omega^\eta \left(\frac{P_t^T}{P_t} \right)^{\xi-\eta} \left(\frac{P_{I,t}^T}{P_t} \right)^{-\xi} C_t$$

where the focus is on $C_{I,t}^T$ rather than individual imported varieties, since foreign variables are exogenous.

The demand for the nontradable good is

$$C_t^N = (1-\omega)^\eta \left(\frac{P_t^N}{P_t} \right)^{-\eta} C_t.$$

2.1.2 Intertemporal problem

A representative household is endowed with labor L each period and faces the following intertemporal problem. It can trade two assets: (i) an internationally traded risk-free bond that delivers one unit of the tradable bundle next period, and (ii) shares of a domestic mutual fund that holds all home firms and pays their average profits as dividends. The household chooses consumption C_t, next-period bond holdings B_{t+1}, and mutual fund shares $x_t \in [0,1]$ to maximize lifetime utility:

$$\max \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma}}{1-\gamma},$$

subject to the budget constraint

$$\begin{aligned} &P_t C_t + P_t^T B_{t+1} + \frac{\nu}{2} P_t^T B_{t+1}^2 + \tilde{v}_t (M_{D,t} + M_{E,t}) x_{t+1} \\ &= W_t L + P_t^N Y^N + (1 + r_t^*) P_t^T B_t + (\tilde{v}_t + \tilde{\pi}_t) M_{D,t} x_t + T_t. \end{aligned} \tag{8}$$

Here, $\beta \in (0,1)$ is the discount factor and γ the coefficient of relative risk aversion. All bond-related terms are scaled by P_t^T because the bond promises tradable goods. The interest rate r_t^* is exogenous from the perspective of this small open economy. $\tilde{v}_t$ denotes the mutual fund price, $\tilde{\pi}_t$ its dividend, $M_{D,t}$ the mass of incumbent domestic firms, and $M_{E,t}$ the mass of entrants. The household's income derives from labor, the nontradable endowment, bonds, and mutual fund returns. The term $\frac{\nu}{2} P_t^T B_{t+1}^2$ is a bond adjustment cost (à la Schmitt-Grohé and Uribe (2003)), rebated as T_t in equilibrium but not internalized by the household.

Given C_t, the allocation across varieties and the nontradable good is a static problem. Since mutual fund shares are only traded domestically, $x_t = 1$ in equilibrium.

The household's first-order conditions yield Euler equations for bonds and mutual fund shares:

$$1 + \nu B_{t+1} = \beta \mathbb{E}_t \left[\frac{P_t}{P_{t+1}} \frac{P_{t+1}^T}{P_t^T} \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} (1 + r_{t+1}^*) \right], \tag{9}$$

$$\tilde{v}_t = \beta(1-\psi)\mathbb{E}_t\left[\frac{P_t}{P_{t+1}}\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}(\tilde{v}_{t+1}+\tilde{\pi}_{t+1})\right]. \tag{10}$$

2.2 Firms

2.2.1 Technology and pricing

A firm i's production technology in period t is

$$q_t(i) = A_t a_i l,$$

where A_t is aggregate productivity in period t, a_i is firm i's time-invariant productivity drawn from distribution $G(a)$ with support $[a_{\min}, \infty)$, and l is labor input. Since firms with the same productivity are symmetric in equilibrium, I follow convention and drop the i subscript, indexing varieties by productivity a.

Output depends on both firm-specific and aggregate productivity. The unit cost of production is $\frac{W_t}{A_t a}$, where W_t is the wage rate. I assume no fixed cost for domestic production. Exporting, however, entails two additional costs. First, an iceberg cost: delivering one unit abroad requires shipping $\tau > 1$ units. Second, a fixed export cost F_X (in effective labor units), paid each period. A fraction $\mu \in [0,1]$ must be paid in foreign labor, $\mu\frac{F_X}{A_t^*}$, and the remaining $1-\mu$ in domestic labor, $(1-\mu)\frac{F_X}{A_t}$. This formulation follows Chaney (2016), with empirical motivation from Goldberg and Campa (2010), who estimate that 50–70% of entry costs are denominated in foreign currency.

Total costs for a firm with productivity a for domestic sales and exports are therefore

$$\begin{aligned} TC_{a,D,t}(q_D) &= \frac{W_t}{A_t a} q_D, \\ TC_{a,X,t}(q_X) &= \frac{W_t}{A_t a}\tau q_X + (1-\mu)\frac{W_t}{A_t}F_X + \mu\frac{W_t^*}{A_t^*}F_X, \end{aligned}$$

where W_t^* is the foreign wage. Fixed costs depend on productivity in both countries, as in Ghironi and Melitz (2005) and Fattal Jaef and Lopez (2014).

Under monopolistic competition, firms set prices as a constant markup over marginal cost:

$$p_{D,t}(a) = \frac{\sigma}{\sigma-1}\frac{W_t}{A_t a},$$
$$p_{X,t}(a) = \frac{\sigma}{\sigma-1}\frac{\tau W_t}{A_t a}.$$

Profits from domestic sales and exports are

$$\pi_{D,t}(a) = \frac{1}{\sigma} p_{D,t}(a) q_{D,t}(a)$$
$$\pi_{X,t}(a) = \frac{1}{\sigma} p_{X,t}(a) q_{X,t}(a) - (1-\mu)\frac{W_t}{A_t}F_X - \mu\frac{W_t^*}{A_t^*}F_X$$

where $q_{D,t}(a)$ is given in equation (7).

Foreign demand for home varieties with productivity a is

$$q_{X,t}(a) = \omega^{\eta}\left(\frac{p_{X,t}(a)}{P_t^*}\right)^{-\sigma}\left(\frac{P_t^{T*}}{P_t^*}\right)^{\xi-\eta}\left(\frac{P_{I,t}^{T\,*}}{P_t^*}\right)^{\sigma-\xi} C_t^*. \tag{11}$$

For ease of notation, let's define the remaining part of export demand as

$$q_{X,t}^{rem} \equiv \omega^{\eta}\left(\frac{P_t^{T*}}{P_t^*}\right)^{\xi-\eta}\left(\frac{P_{I,t}^{T\,*}}{P_t^*}\right)^{\sigma-\xi} P_t^* C_t^*$$

so that $q_{X,t}(a) = p_{X,t}(a)^{-\sigma} P_t^{*\sigma-1} q_{X,t}^{rem}$ and $q_{X,t}^{rem}$ is exogenous.

2.2.2 Trade credit constraints

Without additional frictions, all firms with productivity a such that $\pi_{X,t}(a) \geq 0$—equivalently, firms above a productivity threshold—choose to export, as in Melitz (2003)-type models. In practice, however, exporters often face financial constraints because they must rely on external capital to cover large upfront fixed costs. These constraints are typically more severe than for domestically oriented firms for several reasons: (i) entering foreign markets requires extra costs such as market research, product localization, and distribution networks; (ii) cross-border shipping takes longer, increasing working capital needs; and (iii) exchange rate fluctuations heighten risk.[1]

To model trade credit constraints in a tractable way, I assume that exporting firms must pay fixed costs in advance, fully financed by external borrowing from international lenders, and repaid out of export revenues.[2] The model abstracts from firms' net worth or internal capital accumulation, which can be viewed as the "worst-case" scenario for firms.

To borrow, firms pledge export revenues as collateral. However, they can divert a fraction $1-\kappa$, creating a pledgeability problem: lenders are willing to finance only up to κ of expected revenues. The parameter $\kappa \in (0,1]$ therefore captures the degree of financial development (or contract enforcement) in a country, in line with Mendoza et al. (2009). The resulting financial constraint is

$$\kappa \cdot r_{X,t}(a) \geq (1-\mu)\frac{W_t}{A_t}F_X + \mu\frac{W_t^*}{A_t^*}F_X,$$

where $r_{X,t}(a)$ is export revenue of a firm with productivity a.[3]

Equivalently, the constraint can be expressed as

$$\pi_{X,t}(a) \geq \frac{1-\kappa}{\kappa}\left[(1-\mu)\frac{W_t}{A_t}F_X + \mu\frac{W_t^*}{A_t^*}F_X\right]. \tag{12}$$

Thus, only firms with sufficiently high productivity and export profits can serve foreign markets.

If $\kappa = 1$, diversion is impossible, and the model collapses to the standard Melitz (2003) framework without financial frictions. If $\kappa < 1$, some productive firms are excluded from exporting despite positive export profits. As $\kappa \to 0$, the share of such excluded firms rises.

[1] For a detailed overview of trade credit constraints, see Foley and Manova (2015).

[2] Chaney (2016), in a partial equilibrium model, assumes instead that fixed costs are financed out of domestic profits and shows that constrained firms may arise under certain conditions. By assuming repayment from export revenues, as in this paper, one can guarantee the existence of financially constrained firms without imposing additional assumptions that may fail in general equilibrium.

[3] For simplicity, I assume the interest rate on external borrowing is negligible. Since it is exogenous to domestic firms, this assumption has no qualitative effect on the results.

Conditions (12) and (13) define two productivity cutoffs:

$$\pi_{X,t}(\bar{a}_{X,t}) = 0, \tag{13}$$

$$\pi_{X,t}(\bar{a}_{\kappa,t}) = \frac{1-\kappa}{\kappa}\left[(1-\mu)\frac{W_t}{A_t}F_X + \mu\frac{W_t^*}{A_t^*}F_X\right]. \tag{14}$$

It is straightforward that $\bar{a}_{X,t} \leq \bar{a}_{\kappa,t}$. These cutoffs classify firms into three groups. Firms with productivity $a \in [a_{\min}, \bar{a}_{X,t})$ are insufficiently productive to export and serve only the domestic market. Firms with $a \in [\bar{a}_{X,t}, \bar{a}_{\kappa,t})$ are productive enough to earn positive export profits but are prevented from exporting by financial constraints. Firms with $a \in [\bar{a}_{\kappa,t}, \infty)$ export. If $\kappa = 1$, then $\bar{a}_{X,t} = \bar{a}_{\kappa,t}$ and no firm is financially constrained.

2.2.3 Entry, exit, and ownership

Entry and exit follow Melitz (2003). The ownership structure is closest to Ghironi and Melitz (2005) and Fattal Jaef and Lopez (2014). In each period, an infinite mass of potential entrants exists. To enter, a firm must pay a sunk cost F_E in effective labor units, $\frac{F_E}{A_t}$. Upon entry, the firm draws productivity from $G(a)$ with support $[a_{\min}, \infty)$ and then decides whether to export in addition to serving the domestic market. Financial constraints may prevent exporting even when profitable.

Because there is no fixed cost of serving the domestic market, all entrants at least produce domestically. Firms face an exogenous exit probability ψ each period. For tractability, I assume a one-period time-to-build lag, so entrants in t begin production in $t+1$. Prospective entrants are forward-looking and enter if the expected present value of entry equals the sunk entry cost. The free-entry condition is therefore

$$\tilde{v}_t = \frac{W_t}{A_t}F_E, \tag{15}$$

where

$$\tilde{v}_t = \mathbb{E}_t \sum_{s=0}^{\infty} [\beta(1-\psi)]^s \frac{P_t}{P_{t+s}} \frac{U_C(C_{t+s})}{U_C(C_t)} \tilde{\pi}_{t+s}. \tag{16}$$

Here, $\tilde{v}_t$ is the average firm value conditional on entry, with $\tilde{\pi}_{t+s}$ denoting average profits, discounted by both exit risk and the household's stochastic discount factor $\beta^s \frac{P_t}{P_{t+s}} \frac{U_C(C_{t+s})}{U_C(C_t)}$. Because all firms produce domestically, the expected value of entrants equals the average value of incumbents. The free-entry condition determines the mass of new entrants $M_{E,t}$ each period. With the time-to-build lag, the mass of domestic firms evolves as

$$M_{D,t+1} = (1-\psi)(M_{D,t} + M_{E,t}). \tag{17}$$

The mass of exporters is

$$M_{X,t} = (1 - G(\bar{a}_{\kappa,t}))M_{D,t}. \tag{18}$$

Firms are owned by a mutual fund that distributes average profits $\tilde{\pi}_t$ as dividends. Households trade shares x_t of this fund at price $\tilde{v}_t$. Iterating the mutual fund Euler equation forward and applying the law of iterated expectations yields the expected value of entry in (16).[4]

2.2.4 Productivity distribution and aggregation

Following Ghironi and Melitz (2005), firm productivity a is drawn from a Pareto distribution with lower bound $a_{\min}$ and shape parameter $\alpha > \sigma - 1$: $G(a) = 1 - \left(\frac{a_{min}}{a}\right)^{\alpha}$. The parameter α governs the dispersion of productivity: higher α implies less dispersion, with draws concentrated near $a_{\min}$. In the limit, as $\alpha \to \infty$, the density collapses to 1 at $a_{\min}$. For aggregation, it is convenient to define $\theta \equiv \left[\frac{\alpha}{\alpha-(\sigma-1)}\right]^{\frac{1}{\sigma-1}}$.

As in Melitz (2003)-type models, aggregation can be done by focusing on the average firm rather than tracking each firm. Define the average productivity of all domestic firms, $\tilde{a}_D$,

[4] See Appendix A.1 for the derivation.

and of exporters, $\tilde{a}_{X,t}$, as

$$\tilde{a}_D \equiv \left[\int_{a_{min}}^{\infty} a^{\sigma-1} dG(a) \right]^{\frac{1}{\sigma-1}}, \tag{19}$$

$$\tilde{a}_{X,t} \equiv \left[\frac{1}{1 - G(\bar{a}_{\kappa,t})} \int_{\bar{a}_{\kappa,t}}^{\infty} a^{\sigma-1} dG(a) \right]^{\frac{1}{\sigma-1}}. \tag{20}$$

Since domestic production entails no fixed cost, all firms produce domestically, making $\tilde{a}_D$ time-invariant. By contrast, $\tilde{a}_{X,t}$ varies with the export cutoff $\bar{a}_{\kappa,t}$. Using θ, these expressions simplify to $\tilde{a}_D = \theta \cdot a_{\min}$ and $\tilde{a}_{X,t} = \theta \cdot \bar{a}_{\kappa,t}$.

Average profits from domestic sales and exporting are

$$\tilde{\pi}_{D,t} \equiv \pi_{D,t}(\tilde{a}_D),$$

$$\tilde{\pi}_{X,t} \equiv \pi_{X,t}(\tilde{a}_{X,t}).$$

Since a fraction $1 - G(\bar{a}_{\kappa,t})$ of firms export, average total profits are

$$\tilde{\pi}_t = \tilde{\pi}_{D,t} + (1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t}. \tag{21}$$

which corresponds to the dividends paid by the mutual fund.

Average prices can be defined analogously as $\tilde{p}_{D,t} \equiv p_{D,t}(\tilde{a}_D)$ and $\tilde{p}_{X,t} \equiv p_{X,t}(\tilde{a}_{X,t})$. Price indices then simplify to

$$P_{D,t}^T = M_{D,t}^{\frac{1}{1-\sigma}} \tilde{p}_{D,t}, \tag{22}$$

$$P_{X,t}^T \equiv \left[\frac{1}{1 - G(\bar{a}_{\kappa,t})} \int_{\bar{a}_{\kappa,t}}^{\infty} p_{X,t}(a)^{1-\sigma} M_{X,t} dG(a) \right]^{\frac{1}{1-\sigma}} = M_{X,t}^{\frac{1}{1-\sigma}} \tilde{p}_{X,t}. \tag{23}$$

2.3 Small open economy monopolistically competitive equilibrium

The price of the nontradable good P_t^N is determined by market clearing:

$$(1-\omega)^\eta \left(\frac{P_t^N}{P_t}\right)^{-\eta} C_t = Y^N. \tag{24}$$

The labor market clearing condition pins down the wage rate:

$$L = M_{D,t}\frac{q_{D,t}(\tilde{a}_D)}{A_t\tilde{a}_D} + M_{E,t}\frac{F_E}{A_t} + M_{X,t}\left(\frac{\tau q_{X,t}(\tilde{a}_{X,t})}{A_t\tilde{a}_{X,t}} + (1-\mu)\frac{F_X}{A_t}\right). \tag{25}$$

The first term is labor used in domestic production, the second is labor for entry, and the last two terms represent variable input and the domestic component of exporters' fixed costs.

For later quantitative analysis, I define aggregate variables: exports X_t, imports I_t, net exports NX_t, the capital account CA_t, and GDP GDP_t:[5]

$$\begin{aligned}
X_t &\equiv \frac{1}{1-G(\bar{a}_{\kappa,t})}\int_{\bar{a}_{\kappa,t}}^{\infty} p_{X,t}(a)q_{X,t}(a)M_{X,t}dG(a),\\
I_t &\equiv P_{I,t}^T C_{I,t}^T,\\
NX_t &\equiv X_t - I_t,\\
CA_t &\equiv P_t^T B_{t+1} - (1+r_t^*)P_t^T B_t,\\
GDP_t &\equiv P_t C_t + NX_t.
\end{aligned}$$

Then, a small open economy equilibrium is defined as follows.

Definition (Monopolistically competitive equilibrium)**.** *a) prices P_t, P_t^T, P_t^N, $P_{D,t}^T$, $p_{D,t}$, and $p_{X,t}$; b) wage rate W_t; c) consumption C_t, C_t^T, C_t^N, $C_{D,t}^T$, $C_{I,t}^T$, $q_{D,t}$, and $q_{I,t}$; d) bond holdings B_t; e) mutual fund share x_t; f) productivity cutoffs $\bar{a}_{X,t}$ and $\bar{a}_{\kappa,t}$; g) average productivity $\tilde{a}_D$ and $\tilde{a}_{X,t}$; h) average profit $\tilde{\pi}_{D,t}$, $\tilde{\pi}_{X,t}$, and $\tilde{\pi}_t$; i) value of mutual fund $\tilde{v}_t$; and j) mass*

[5] In this model, $NX_t \neq CA_t$ since part of export costs are paid to foreign agents. Specifically, $NX_t = CA_t + M_{X,t}\mu\frac{W_t^*}{A_t^*}F_X$. Alternatively, redefining $NX_t \equiv X_t - I_t - M_{X,t}\mu\frac{W_t^*}{A_t^*}F_X$ restores $NX_t = CA_t$.

of firms $M_{D,t}$, $M_{X,t}$, and $M_{E,t}$ such that 1) *a follows the definition of prices indices and the pricing rules of firms;* 2) *c, d, and e solve the household problem given a, b, h, i, and j;* 3) *c satisfies the definition of composite consumption;* 4) *f satisfies the definition of productivity cutoffs given a, b, and c;* 5) *g is defined by equation (20) and (21) given f;* 6) *h and i satisfy households' Euler equation for mutual funds given a and c;* 7) *a and j satisfy the free entry condition given b;* 8) *j evolves following equation (18) and (19); and* 9) *a and b clear markets given c and j.*

In Appendix A, I present some theoretical implications of the model in partial equilibrium including the effect of changes in the real exchange rate, home and foreign aggregate productivity, and price levels on the export productivity cutoff, the number of exporters and the average exporter profit.

3 Quantitative Analysis

In this section, I quantitatively solve the model to examine the economy's impulse responses to an aggregate productivity shock. I compare outcomes across different levels of financial development and find that financial frictions have only limited aggregate effects. Two mechanisms explain this result. First, the increase in average exporter productivity offsets the decline in the number of exporters, with the strength of this channel depending on the dispersion of firm productivity. Second, wage adjustment in general equilibrium further dampens the role of trade credit constraints, and the magnitude of this channel varies with the elasticity of labor supply.

3.1 Calibration

One model period corresponds to a quarter, and the baseline parameter values are summarized in Table 1. For preferences, I adopt standard values: a discount factor $\beta = 0.98$ and risk aversion $\gamma = 2$. The weight on tradables is set to $\omega = 0.5$ to match a 50% steady-state tradable share, following Lombardo and Ravenna (2012). For substitution elasticities, I use $\eta = 0.83$ between tradables and nontradables (a conservative value from Bianchi (2011)), $\xi = 1.5$ between domestic and imported goods (from Fattal Jaef and Lopez (2014)), and $\sigma = 6$ across varieties, consistent with Broda and Weinstein (2006), which implies a 20% markup. The bond adjustment cost parameter $\nu = 0.02$ targets a steady-state bond-to-GDP ratio of 10%, following Aguiar and Gopinath (2007).

Minimum productivity is normalized to $a_{\min} = 1$. The Pareto shape parameter is set to $\alpha = 5.6$, following Bernard et al. (2003) and Ghironi and Melitz (2005), to match the standard deviation of log U.S. plant sales (1.67). Iceberg trade costs are set to $\tau = 1.3$, in line with Ghironi and Melitz (2005) and Obstfeld and Rogoff (2000). Export fixed costs are $F_X = 0.005$, chosen to match an exporter share of 21% as in Bernard et al. (2003), together with foreign variables. The foreign labor share of fixed export costs is $\mu = 0.6$, the median of the 50–70% range estimated by Goldberg and Campa (2010). Entry costs are normalized to $F_E = 1$. The exogenous exit rate $\psi = 0.025$ targets 10% annual job destruction in U.S. data, as in Ghironi and Melitz (2005).

Financial frictions. In the baseline, I set $\kappa = 1$ as a frictionless benchmark and also consider $\kappa = 0.1$ to illustrate the effects of limited financial development.

Endowments. Labor L and the nontradable good Y^N are normalized to 1 and 10, respectively. Foreign variables are calibrated jointly with F_X to reproduce the 21% exporter share.

Aggregate productivity. A_t follows an AR(1) process:

$$A_{t+1} = A_t^{\rho_A} \exp^{\epsilon_{t+1}},$$

where ϵ_t is white noise with standard deviation σ_A. I set $\rho_A = 0.906$ and $\sigma_A = 0.00852$, following Backus et al. (1992).

Table 1: Baseline parameter values

Parameters	Values	Targets/Sources
Preferences	$\beta = 0.98$, $\gamma = 2$, $\omega = 0.5$	standard, 50% tradable share
Elasticity of substitution	$\eta = 0.83$, $\xi = 1.5$, $\sigma = 6$	standard, 20% mark-up
Bond adjustment costs	$\nu = 0.012$	10% bond to GDP
Productivity distribution	$a_{min} = 1$, $\alpha = 5.6$	1.67 std. dev. log sales of US firms
Exporting costs	$\tau = 1.3$, $F_X = 0.0032$, $\mu = 0.6$	standard, 21% proportion of exporters
Entry cost and exit probability	$F_E = 1$, $\psi = 0.025$	10% annual destruction rate
Financial constraint	$\kappa = 1$	baseline value
Home country endowments	$L = 1$, $Y^N = 10$	baseline values
Interest rates	$r^* = 0.04$	standard
Foreign variables	$P^* = 1$, $W^* = 10$, $A^* = 1$, $q_X^{rem} = 5$	21% proportion of exporters
Stochastic process	$\rho_A = 0.906$, $\sigma_A = 0.00852$	Backus et al. (1992)

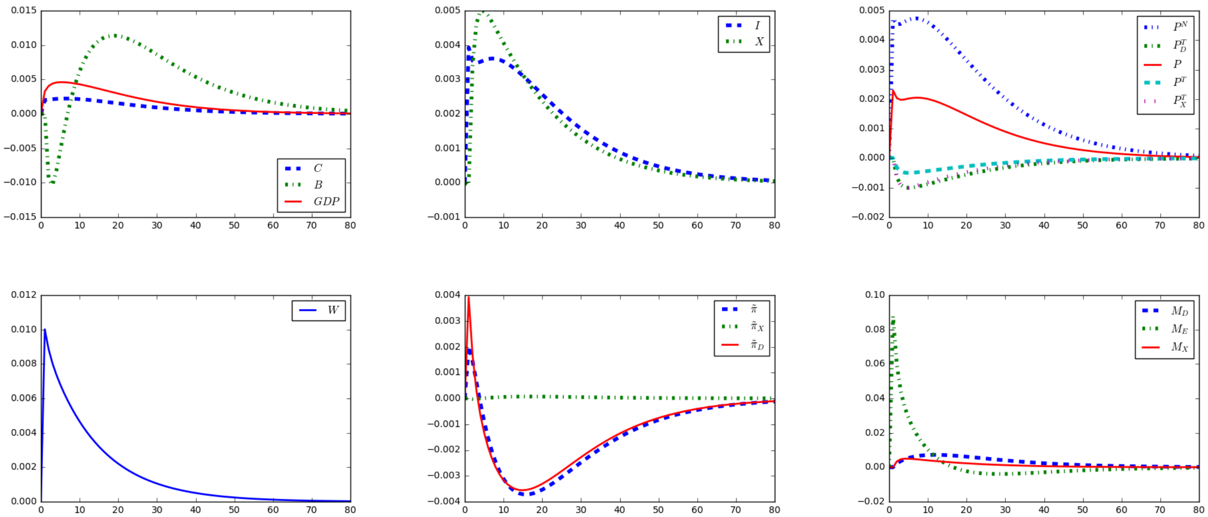
3.2 Impulse response functions

To compute impulse responses to an exogenous shock, I use a linear approximation following Klein (2000). Figure 1 plots the percentage deviations of endogenous variables from steady state after a 1% increase in home productivity A_t under the baseline with $\kappa = 1$. The shock generates non-monotonic dynamics.

On impact, higher productivity lowers production costs, reducing the price indices for domestically produced tradables (P_D^T) and exports (P_X^T) by about 0.1%. As home exports become more competitive abroad, exports X rise by 0.5% at their peak. At the same time, the profitability of entry increases: the mass of new entrants M_E jumps by nearly 9%, raising the total number of domestic firms and exporters. Average domestic profit $\tilde{\pi}_D$ rises by 0.4% with higher productivity, while the response of average export profit $\tilde{\pi}_X$ is muted. The reason is that the positive productivity effect is partly offset by a fall in the export cutoff $\bar{a}_\kappa$, which lowers average exporter productivity. Overall average profit $\tilde{\pi}$, the weighted sum of domestic and export profits, increases by 0.2%.

On the household side, higher dividends from the mutual fund boost consumption. Demand for the fixed-supply nontradable good rises, pushing its price P^N up by 0.5% and the overall price index P by over 0.2%. Labor demand also increases, raising the wage W by 1%. Initially, bond holdings B fall because imports rise faster than exports, but later recover: as exports

Figure 1: Responses to an A shock of 1% ($\kappa = 1$)



overtake imports, B peaks about 1.2% above steady state.

After roughly five quarters, the signs of profit responses reverse. This occurs for two reasons. First, the productivity shock decays more quickly than the rise in wages, raising production costs and compressing profits. Second, from the household's perspective, bond accumulation generates higher interest income, and labor income also grows, while consumption expenditure rises more moderately. For the household budget constraint to hold, dividend income—i.e., average firm profits—must decline.

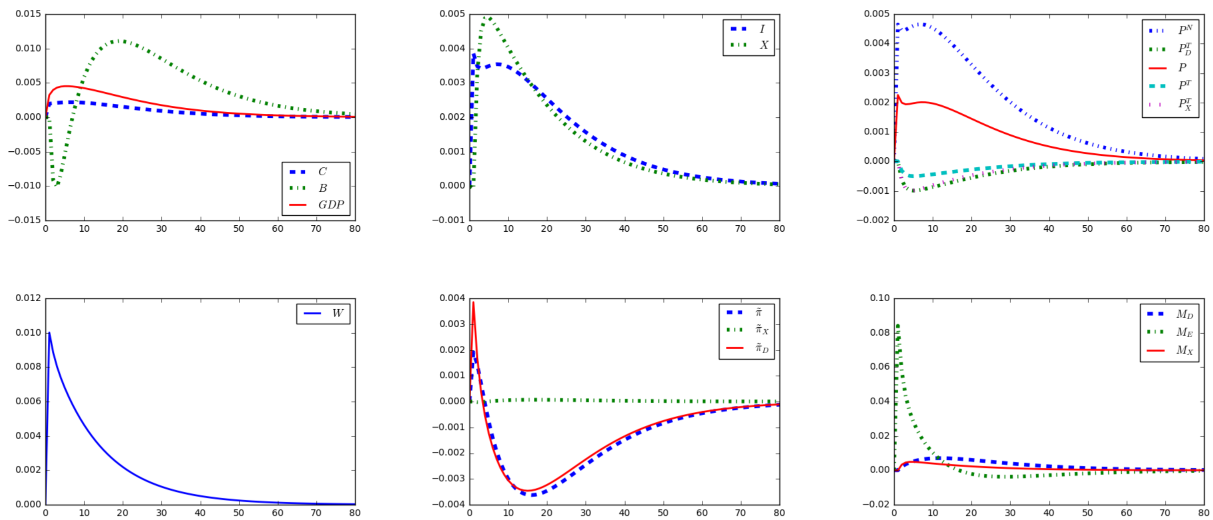
Figure 2 reports impulse responses for $\kappa = 0.1$, with all other parameters set to their baseline values. Strikingly, the responses are almost identical to the baseline, both qualitatively and quantitatively. To further highlight the role of financial development, Table 2 compares steady-state values under $\kappa = 1$ and $\kappa = 0.1$. Except for the average export profit $\tilde{\pi}_X$, the export cutoff $\bar{a}_\kappa$, and the exporter share $1 - G(\bar{a}_\kappa)$, most variables change little with κ. Notably, $\tilde{\pi}_X$ is more than ten times larger when $\kappa = 1$ than when $\kappa = 0.1$, while the exporter share is more than ten times larger when $\kappa = 0.1$ than when $\kappa = 1$.

It is also useful to examine level deviations from steady state rather than percentage changes. Figures C.1 and C.2 show responses to a one-unit productivity shock when $\kappa = 1$ and $\kappa = 0.1$, respectively. Although the units are not directly interpretable as in Figures 1

Table 2: Steady state values

Variables	Steady state values ($\kappa = 1$)	Steady state values ($\kappa = 0.1$)
Macro variables	$C = 8.62$, $C^T = 7.47$, $B = 1.6$, $I = 0.95$, $X = 0.95$, $GDP = 3.69$	$C = 8.60$, $C^T = 7.42$, $B = 1.6$, $I = 0.92$, $X = 0.91$, $GDP = 3.57$
Prices	$P = 0.42$, $P^N = 0.18$, $P^T = 0.25$, $W = 1.75$	$P = 0.42$, $P^N = 0.17$, $P^T = 0.25$, $W = 1.7$
Firm (average)	$\tilde{v} = 1.75$, $\tilde{\pi} = 0.08$	$\tilde{v} = 1.70$, $\tilde{\pi} = 0.08$
Firm (domestic)	$\tilde{\pi}_D = 0.04$, $M_D = 3.67$	$\tilde{\pi}_D = 0.04$, $M_D = 3.85$
Firm (exporter)	$\tilde{\pi}_X = 0.17$, $\tilde{a}_X = 2.05$, $1 - G(\bar{a}_\kappa) = 0.21$	$\tilde{\pi}_X = 1.98$, $\tilde{a}_X = 3.15$, $1 - G(\bar{a}_\kappa) = 0.02$

Figure 2: Responses to an A shock of 1% ($\kappa = 0.1$)



and 2, they provide insight into the insensitivity of macro variables to financial development. Even in levels, the responses are nearly invariant to κ, except for $\tilde{\pi}_X$ and the exporter mass M_X. When $\kappa = 0.1$, $\tilde{\pi}_X$ reacts more strongly, whereas with $\kappa = 1$, M_X responds more. Together with the steady-state comparison, these results suggest that trade credit constraints influence export profits and the extensive margin but have little effect on the economy at the aggregate level. The next subsection explores why lower financial development is largely neutralized in aggregate.

3.3 Intensive margin, extensive margin, and selection effect

In this subsection, I examine how total export profit, defined as $(1 - G(\bar{a}_\kappa))\tilde{\pi}_X$, responds to a productivity shock in order to understand why aggregate outcomes are largely insensitive to financial development. For convenience, I denote total export profit by $\tilde{\Pi}_X$.

The key point is that it suffices to study the behavior of $\tilde{\Pi}_X$ rather than the exporter share $1 - G(\bar{a}_\kappa)$ and the average export profit $\tilde{\pi}_X$ separately. Financial development κ first affects the export cutoff $\bar{a}_\kappa$ through the trade credit constraint. This in turn determines the exporter share, average exporter productivity $\tilde{a}_X$, and average export profit $\tilde{\pi}_X = \pi_X(\tilde{a}_X)$. These feed into aggregate firm profits via $\tilde{\pi} = \tilde{\pi}_D + (1 - G(\bar{a}_\kappa))\tilde{\pi}_X = \tilde{\pi}_D + \tilde{\Pi}_X$. This equation is the only equilibrium condition where both the exporter share and average export profit appear—and only in the combined form $\tilde{\Pi}_X$. Thus, to capture the first-order effect of κ on the aggregate economy, it is sufficient to analyze $\tilde{\Pi}_X$. Indirect general equilibrium effects of κ are considered in the next subsection.

Panel (d) of Figure 3 shows the response of $\tilde{\Pi}_X$ (expressed as level deviations from steady state normalized by steady-state GDP) to a 1% productivity shock under different values of κ. On impact, $\tilde{\Pi}_X$ rises by about 0.001% of steady-state GDP.[6] The dynamics are almost identical across κ, and the steady-state values are also close: 0.0387 when $\kappa = 1$ and 0.0389 when $\kappa = 0.1$. These results imply that $\tilde{\Pi}_X$ evolves in nearly the same way regardless of financial development, explaining why κ has little aggregate effect.

To probe further, I next decompose the response of $\tilde{\Pi}_X$ to a productivity shock, conditional

[6] Since steady-state GDP is nearly identical when $\kappa = 1$ and $\kappa = 0.1$ (see Table 2), this response can also be interpreted as the level deviation of $\tilde{\Pi}_X$ itself. The normalization simply aids interpretation.

on the wage W, into three components:

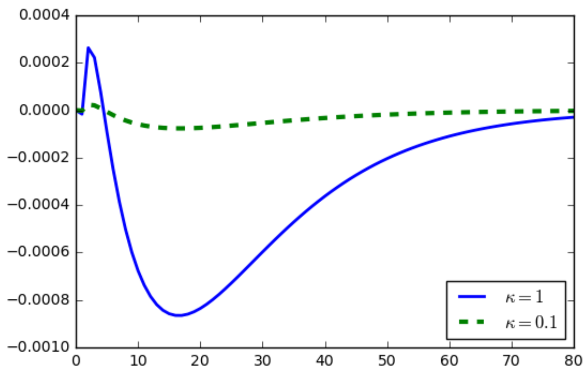
$$\frac{\partial\tilde{\Pi}_X}{\partial A} = \underbrace{-g(\bar{a}_\kappa)\tilde{\pi}_X\frac{\partial\bar{a}_\kappa}{\partial A}}_{\text{Extensive margin, >0}}$$
$$+\underbrace{(1-G(\bar{a}_\kappa))\left[\frac{\sigma-1}{\sigma}\left(\frac{p_X(\tilde{a}_X)}{P^*}\right)^{1-\sigma}\frac{q_X^{rem}}{A}+(1-\mu)\frac{WF_X}{A^2}\right]}_{\text{Intensive margin, >0}}$$
$$+\underbrace{(1-G(\bar{a}_\kappa))\left[\frac{\sigma-1}{\sigma}\left(\frac{p_X(\tilde{a}_X)}{P^*}\right)^{1-\sigma}\frac{q_X^{rem}}{\tilde{a}_X}\frac{\partial\tilde{a}_X}{\partial A}\right]}_{\text{Selection effect, <0}}. \tag{26}$$

The first component is the extensive margin, driven by changes in the export cutoff. Holding W fixed, a positive productivity shock raises the extensive margin by allowing more firms to export. The second component is the intensive margin, the response of profits for a representative exporter with productivity $\tilde{a}_X$. Given W, this margin increases directly with higher productivity. The third component is the selection effect, which reflects changes in the average productivity of exporters. As the export cutoff falls following a positive shock to A, lower-productivity firms enter, reducing the average productivity of exporters.

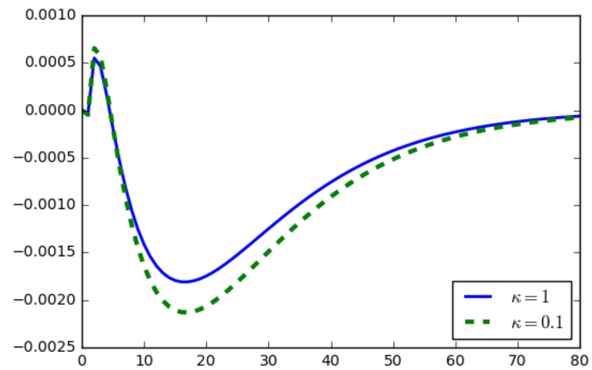
Figure 3 shows the responses of the extensive margin $(1-G(\bar{a}_\kappa))$, the intensive margin $(\pi_X(\tilde{a}_X^{ss}))$, the selection effect $(\tilde{a}_X)$, and total export profit $\tilde{\Pi}_X$ to a 1% increase in A. For interpretation, the intensive margin and total export profit are expressed as level deviations from steady state normalized by steady-state GDP; the selection effect is expressed relative to the average productivity of all firms $(\frac{\alpha}{\alpha-1})$; and the extensive margin is reported as the raw deviation from steady state.

Panel (a) shows that, on impact, the exporter share rises by about 0.02 percentage points when $\kappa = 1$, whereas the response is much weaker under $\kappa = 0.1$. Thus, the extensive margin is more responsive in financially developed economies. Panel (b) reports the intensive margin, defined as the profit of a firm with steady-state average export productivity when $\kappa = 0.1$

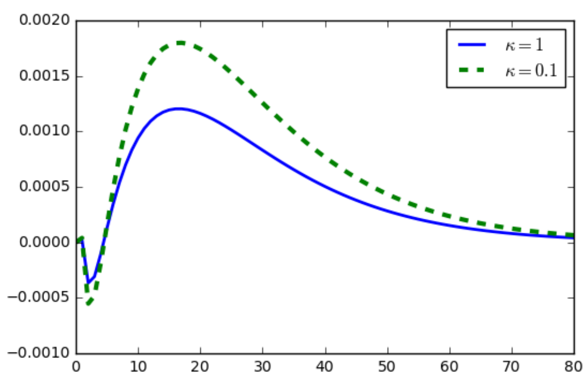
Figure 3: Responses of extensive margin, intensive margin, and selection ($\alpha = 5.6$)



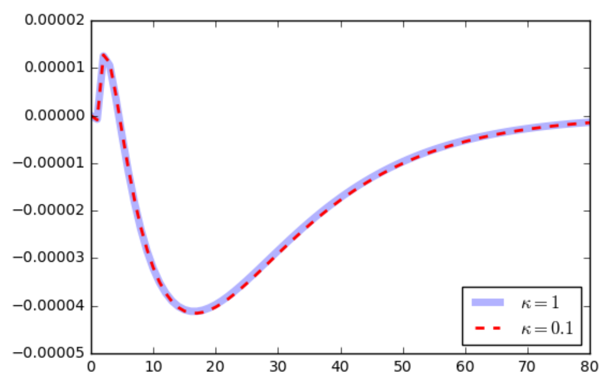
(a) Extensive margin ($1 - G(\bar{a}_{\kappa,t})$)



(b) Intensive margin ($\pi_{X,t}(\tilde{a}_X^{ss})$)



(c) Selection ($\tilde{a}_{X,t}$)



(d) Total export profit ($(1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{\kappa,t}$)

(denoted $\tilde{a}_X^{ss}$).[7] Here, profits rise by about 0.05% of steady-state GDP after three quarters when $\kappa = 1$, with a slightly stronger response when $\kappa = 0.1$. Panel (c) shows the selection effect: when $\kappa = 0.1$, average exporter productivity falls by more than 0.05% relative to the average domestic productivity, and its response is consistently larger than under $\kappa = 1$. Finally, panel (d) confirms that total export profit $\tilde{\Pi}_X$ evolves almost identically across κ, consistent with earlier results.

In summary, Figure 3 demonstrates that the extensive margin is more sensitive to productivity shocks when $\kappa = 1$, while the selection effect is less sensitive. Because the steady-state exporter share is higher at $\kappa = 1$ but average exporter productivity is higher at $\kappa = 0.1$, these offsetting sensitivities cancel out, leaving $\tilde{\Pi}_X$ virtually invariant to κ in both steady state and dynamics.

Three remarks are worth noting. First, throughout the paper, I emphasize the extensive margin and selection channels over the intensive margin channel. This is because κ directly affects the economy through adjustments in the export cutoff $\bar{a}_\kappa$, while the intensive margin operates only indirectly through general equilibrium and is thus a second-order effect.

Second, the responses in Figure 3 are general equilibrium outcomes, unlike the decomposition in equation (26). There, I held wages constant for analytical convenience. In general equilibrium, however, wages also adjust, creating a second-order effect on $\tilde{\Pi}_X$. This wage adjustment explains why the responses in Figure 3 are non-monotonic and even change sign over time. The general equilibrium role of wages is examined in Section 3.5.

Finally, the analysis focuses on responses of the three channels and total export profit in levels rather than in percentage deviations from steady state. The insensitivity of aggregate outcomes to κ arises because the level of $\tilde{\Pi}_X$ is quantitatively invariant to κ, even though both the exporter share and average productivity are highly sensitive to it, as shown here and in the steady-state comparison of the previous subsection.

By contrast, percentage deviations can be misleading. For instance, Figure C.3 reports

[7] This choice is innocuous since $\tilde{a}_X^{ss}$ always lies above the export cutoff $\bar{a}_{\kappa,t}$ after the shock.

percentage responses of the three channels, which appear invariant to κ. This, however, merely reflects that the steady-state values of these variables differ with κ. For this reason, Figure 3 normalizes responses by steady-state GDP or average firm productivity, providing meaningful economic interpretation. For all other aggregate variables, I follow convention and present responses as percentage deviations from steady state, as in Figures 1 and 2.

The next subsection investigates why the levels of the extensive margin, intensive margin, and selection effect respond differently to financial development κ, and relates this to the distribution of firm productivity.

3.4 Financial development and productivity dispersion

In this subsection, I show in two steps that the effect of κ on the aggregate economy through $\tilde{\Pi}_X$ is closely tied to the distribution of firm productivity. First, I examine how the level of $\tilde{\Pi}_X$ depends on κ, holding A and W fixed, while varying the dispersion of firm productivity. This sheds light on why steady-state values are largely insensitive to κ. Second, I analyze how κ shapes the response of $\tilde{\Pi}_X$ to a productivity shock, again depending on productivity dispersion, using the decomposition in equation (26). This explains the impulse response patterns shown in Figure 3.

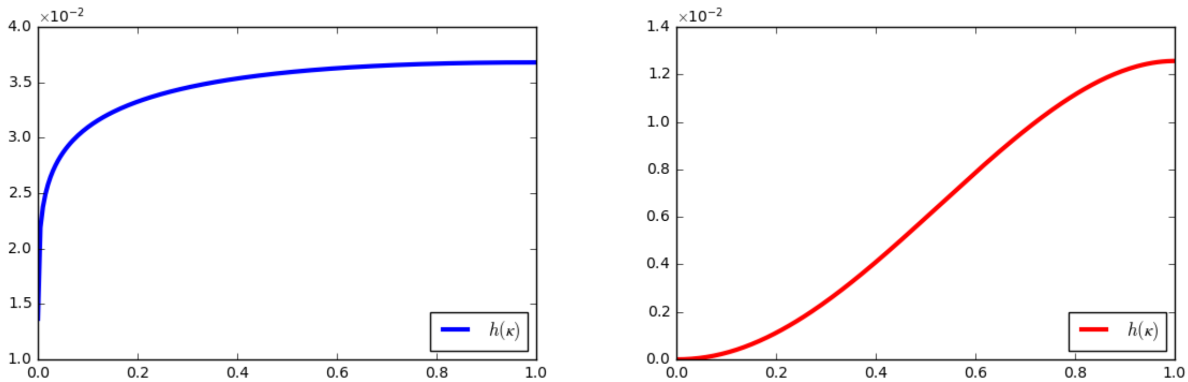
To start, consider why the level of $(1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t}$ is insensitive to κ in the baseline. For convenience, define $h(\kappa; \Theta) \equiv (1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t}$, where Θ is the set of A_t, W_t, and other model parameters. Thus, $h(\kappa)$ expresses total export profit as a function of κ given the environment. Similarly, define the extensive margin $h_{EM}(\kappa; \Theta) \equiv 1 - G(\bar{a}_{\kappa,t})$ and the selection effect $h_{SE}(\kappa; \Theta) \equiv \tilde{\pi}_{X,t}$.[8]

Suppressing Θ for simplicity, $h(\kappa)$ can be written as

$$h(\kappa) = \left(\frac{\sigma}{\sigma - 1}\frac{\tau W_t}{A_t}\right)^{-\alpha} \mathcal{F}_t \left(\frac{\sigma \mathcal{F}_t}{q_X^{rem} P_t^{*\sigma-1}}\right)^{-\frac{\alpha}{\sigma-1}} \left[\theta^{\sigma-1}\kappa^{\frac{\alpha-(\sigma-1)}{\sigma-1}} - \kappa^{\frac{\alpha}{\sigma-1}}\right], \tag{27}$$

[8]For this exercise, I hold A and W constant. Hence, the intensive margin for a given firm does not vary with κ, and differences in $\tilde{\pi}_X$ arise solely from the selection channel.

Figure 4: $h(\kappa)$ with different α



(a) $\alpha = 5.6$

(b) $\alpha = 15.6$

where $\theta = \left[\frac{\alpha}{\alpha-(\sigma-1)}\right]^{\frac{1}{\sigma-1}}$ and $\mathcal{F}_t = [(1-\mu)\frac{W}{A} + \mu\frac{W^*}{A^*}]F_X$, as defined earlier.

It is clear that the shape of $h(\kappa)$ depends primarily on the Pareto parameter α and the elasticity of substitution σ, which together determine the exponents on κ. Figure 4 illustrates $h(\kappa)$ under different values of α for a fixed σ.

Panel (a) shows the baseline with $\alpha = 5.6$, while panel (b) illustrates the case with $\alpha = 15.6$. The latter corresponds to a much lower dispersion of firm productivity—implying a log-sales standard deviation of 0.09 versus 1.67 in the baseline. With $\alpha = 5.6$, $h(\kappa)$ is concave in κ. By contrast, when α is higher, $h(\kappa)$ takes on an S shape. As a result, the gap between low-κ and high-κ values of h is larger in panel (b). [9]

To understand why the shape of h depends on α, it is useful to separate the extensive margin and selection components. Rearranging gives:

$$h_{EM}(\kappa) = \left(\frac{\sigma}{\sigma-1}\frac{\tau P_t w_t}{A_t}\right)^{-\alpha}\left(\frac{\sigma\mathcal{F}_t}{q_X^{rem}P_t^{*\sigma-1}}\right)^{-\frac{\alpha}{\sigma-1}}\kappa^{\frac{\alpha}{\sigma-1}}, \tag{28}$$

[9] Panel (a) is drawn using the steady-state values of P and W under the baseline calibration, while panel (b) uses an alternative calibration with $\nu = 0.02$, $F_X = 0.0175$, and $\alpha = 15.6$, chosen to match the baseline targets. Note that this is a partial-equilibrium illustration, since A and W are held fixed. In general equilibrium, κ also influences these variables, which shifts the scale of $h(\kappa)$. However, the shape of $h(\kappa)$ is governed mainly by the exponents on κ determined by α and σ.

$$h_{SE}(\kappa) = -\mathcal{F}_t + \mathcal{F}_t \frac{\alpha}{\alpha - (\sigma - 1)} \frac{1}{\kappa}. \tag{29}$$

The extensive margin h_{EM} rises with κ since higher financial development relaxes the trade credit constraint and allows more firms to export. By contrast, the selection component h_{SE} falls with κ: a lower export cutoff admits less productive firms, reducing average exporter productivity and profits. Crucially, α shapes the slopes of these curves. A higher α makes h_{EM} more convex, while flattening h_{SE}. Consequently, the product $h = h_{EM} \cdot h_{SE}$ shifts from being concave to more S-shaped as α increases.

The economic intuition behind the relationship between α and the shapes of h_{EM} and h_{SE} is as follows. Start from a very low level of financial development κ_0 with the corresponding cutoff $\bar{a}_{\kappa,0}$. If κ increases slightly to κ_1, the cutoff falls to $\bar{a}_{\kappa,1}$, and firms with productivity $a \in (\bar{a}_{\kappa,1}, \bar{a}_{\kappa,0})$ begin to export. Denote the mass of these new exporters by $M_{X,1}^{new}$, and repeat to obtain a sequence $\{M_{X,n}^{new}\}_{n=1}^{\infty}$.

As α increases, productivity dispersion $\frac{\alpha}{(\alpha-1)^2(\alpha-2)}$ falls and firms are concentrated closer to a_{min}. When α is high, the initial increases in $M_{X,n}^{new}$ near $\kappa = 0$ are very small. But as κ rises and the cutoff approaches a_{min}, where most firms are clustered, $M_{X,n}^{new}$ grows more quickly. This makes the h_{EM} function more convex in κ.

Turning to h_{SE}, recall that it captures the average productivity of exporters. With a given cutoff $\bar{a}_{\kappa}^{*}$, a higher α means that firms are more concentrated around $\bar{a}_{\kappa}^{*}$ within the region $[\bar{a}_{\kappa}^{*}, \infty)$. This lowers average exporter productivity, and hence average export profit, flattening the h_{SE} curve as α rises.

This logic explains why steady-state $\tilde{\Pi}_X$ remains similar across κ values, while the exporter share and average exporter productivity differ substantially (Table 2). Table 3 reports steady states with $\alpha = 15.6$. The exporter share differs by nearly 21 percentage points across κ, compared with a smaller gap in Table 2. The difference in average exporter productivity is 0.26—about 24% of average firm productivity (1.068)—versus 1.1, or 90%, when $\alpha = 5.6$. These results align with the analytical intuition: when productivity dispersion is low, the

Table 3: Steady state values

Variables	Steady state values ($\kappa = 1$)	Steady state values ($\kappa = 0.1$)
Macro variables	$C = 6.63$, $C^T = 4.54$, $B = 0.96$, $I = 0.55$, $X = 0.60$, $GDP = 2.12$	$C = 6.42$, $C^T = 4.28$, $B = 0.96$, $I = 0.40$, $X = 0.40$, $GDP = 1.61$
Prices	$P = 0.31$, $P^N = 0.09$, $P^T = 0.24$, $W = 1.04$	$P = 0.25$, $P^N = 0.07$, $P^T = 0.20$, $W = 0.81$
Firm (average)	$\tilde{v} = 1.04$, $\tilde{\pi} = 0.04$	$\tilde{v} = 0.81$, $\tilde{\pi} = 0.03$
Firm (domestic)	$\tilde{\pi}_D = 0.04$, $M_D = 2.58$	$\tilde{\pi}_D = 0.02$, $M_D = 3.76$
Firm (exporter)	$\tilde{\pi}_X = 0.05$, $\tilde{a}_X = 1.18$, $1 - G(\bar{a}_\kappa) = 0.21$	$\tilde{\pi}_X = 1.52$, $\tilde{a}_X = 1.44$, $1 - G(\bar{a}_\kappa) = 0.00$

extensive and selection effects interact so that κ can significantly affect $\tilde{\Pi}_X$.

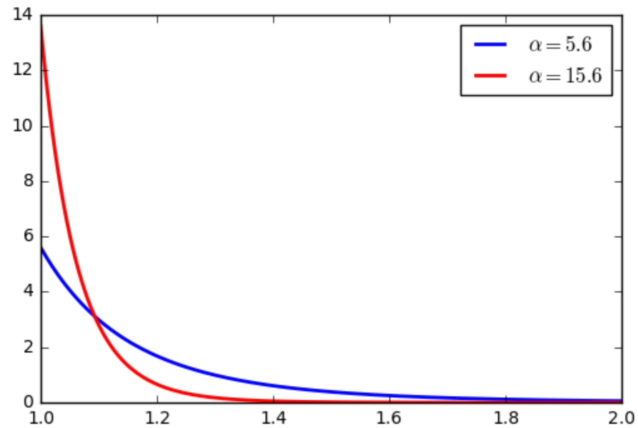
Consequently, when α is high, financial development has stronger aggregate effects. Economies with higher κ—and thus fewer trade credit constraints—enjoy higher consumption, exports, GDP, and wages than economies with low κ. This outcome is consistent with the standard view that financial frictions reduce efficiency and welfare.

I now examine how the responses of the extensive margin, intensive margin, selection effect, and total export profit to a productivity shock depend on financial development, using the decomposition in equation (26). Recall that the response of the extensive margin to a positive A shock is $-g(\bar{a}_\kappa)\tilde{\pi}_X \frac{\partial \bar{a}_\kappa}{\partial A}$ where its magnitude depends on the density of firms at the export cutoff, $g(\bar{a}_\kappa)$. Figure 5 plots the productivity density $g(a)$ under two different values of α.

Suppose there are two different values of κ and their corresponding export cutoffs. Since a lower κ implies a higher cutoff, the difference in the densities at the two cutoffs is larger when firms are more concentrated on the left tail of the distribution. Thus, the gap between the extensive-margin responses under $\kappa = 1$ and $\kappa = 0.1$ is greater when α is high.

The response of the selection effect can be understood by examining how average exporter productivity changes with the cutoff. Recall that average exporter productivity is $\tilde{a}_X \equiv \frac{1}{1-G(\bar{a}_\kappa)} \int_{\bar{a}_\kappa}^{\infty} a dG(a)$.

Figure 5: Productivity distribution $g(a)$



Differentiating yields

$$\begin{aligned}\frac{\partial \tilde{a}_X}{\partial \bar{a}_\kappa} &= \frac{g(\bar{a}_\kappa)}{1-G(\bar{a}_\kappa)}\left[\frac{1}{1-G(\bar{a}_\kappa)}\int_{\bar{a}_\kappa}^{\infty} adG(a) - \bar{a}_\kappa\right] \\ &= \frac{g(\bar{a}_\kappa)}{1-G(\bar{a}_\kappa)}\Bigg[\mathbb{E}[a|a \geq \bar{a}_\kappa] - \bar{a}_\kappa\Bigg]. \end{aligned} \tag{30}$$

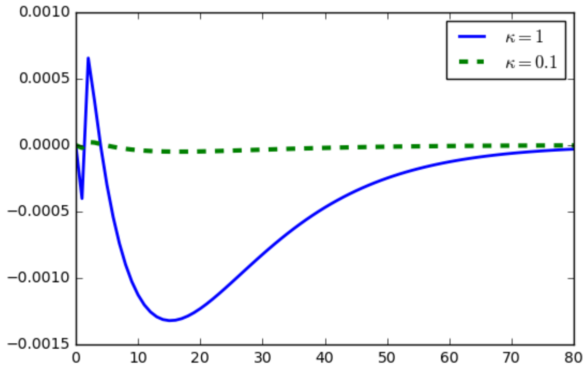
When α is high, firms are concentrated closer to $\bar{a}_\kappa$. In this case, the conditional expectation $\mathbb{E}[a|a \geq \bar{a}_\kappa]$ lies close to $\bar{a}_\kappa$, so the response of average exporter productivity to κ becomes less sensitive.

Figure 6 shows the responses of the extensive margin, intensive margin, selection effect, and total export profit when $\alpha = 15.6$, again reported in level deviations normalized as in Figure 3.[10]

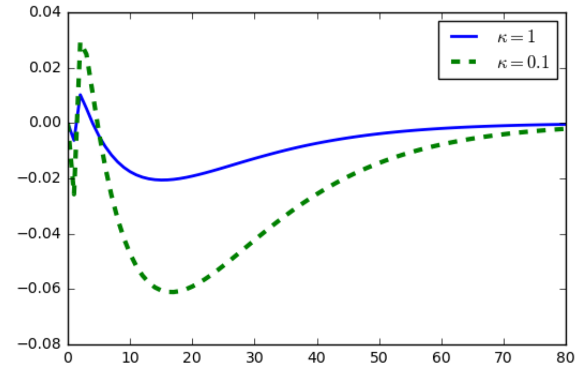
As predicted, the difference in extensive-margin responses between $\kappa = 1$ and $\kappa = 0.1$ is larger than in the baseline (Figure 3), while the selection effect response nearly vanishes. Consequently, the total export profit $\tilde{\Pi}_X$ responds differently across κ values, unlike in the baseline. The key lesson is that when productivity dispersion is low (high α), financial

[10] For the intensive margin and total export profit, normalization is less straightforward because steady-state GDP differs across κ values when $\alpha = 15.6$, unlike in the baseline. Figure 6 uses steady-state GDP from the $\alpha = 5.6$ baseline for comparability. Normalizing by each case's own steady-state GDP yields qualitatively similar patterns.

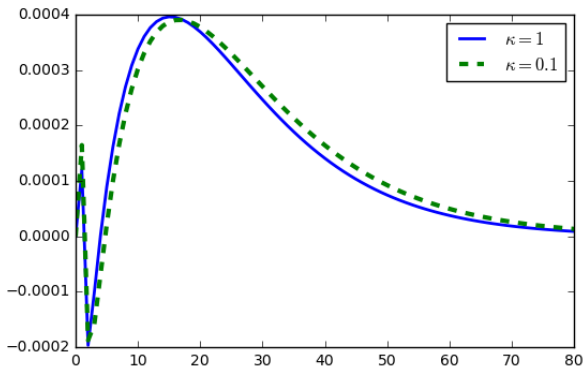
Figure 6: Responses of extensive margin, intensive margin, and selection ($\alpha = 15.6$)



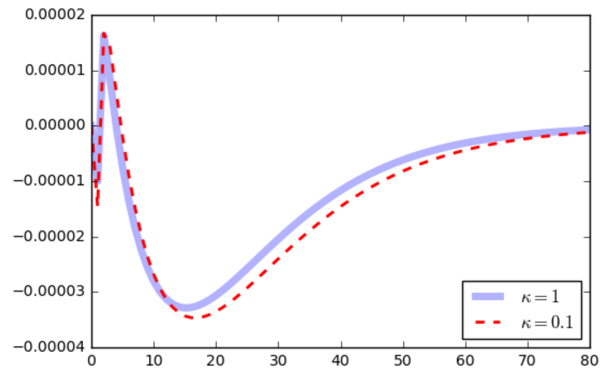
(a) Extensive margin ($1 - G(\bar{a}_{\kappa,t})$)



(b) Intensive margin ($\pi_{X,t}(\tilde{a}_X^{ss})$)



(c) Selection ($\tilde{a}_{X,t}$)



(d) Total export profit ($(1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t}$)

development matters more: it affects not only the level deviations but also the percentage deviations of the three channels and total export profit from steady state.

Figure C.4 shows percentage deviations from steady state. Unlike Figure C.3, where $\alpha = 5.6$, the percentage responses now vary significantly with κ. The selection effect is more sensitive when $\kappa = 1$, simply because the steady-state value of $\tilde{a}_X$ is much lower in that case. Total export profit $\tilde{\Pi}_X$ also responds more strongly when $\kappa = 1$, since the sensitivity of the extensive margin outweighs that of the selection effect. Put differently, with less dispersion in productivity, the influence of κ on selection weakens while its influence on the extensive margin strengthens. As a result, the effect of κ on $\tilde{\Pi}_X$ is driven mainly by the extensive margin, and this higher sensitivity carries over to other macro outcomes.

Figure 7 compares differential responses of key variables across κ and α. The left panels correspond to the baseline with $\alpha = 5.6$, while the right panels show the case with $\alpha = 15.6$. Unlike the baseline, financial development now matters for aggregate outcomes as well, which become more sensitive under $\kappa = 1$. That said, the degree of financial development does not alter the qualitative pattern of aggregate responses, and even the quantitative differences remain modest. This is notable given that the comparison relies on fairly extreme values ($\kappa = 0.1$ and $\alpha = 15.6$).

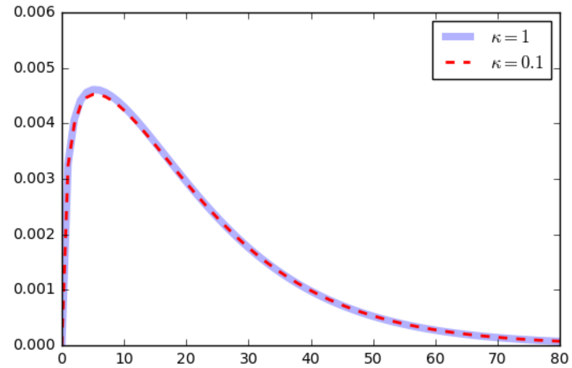
The main findings of this section are as follows. Limited financial development suppresses the extensive margin of exports. Yet, the accompanying rise in the average productivity of exporters offsets this effect, leaving aggregate outcomes largely unaffected by financial development. When productivity dispersion is low and firms cluster near the lower end, financial development can influence the aggregate economy. Still, with empirically reasonable dispersion, this effect remains quantitatively minor. In the next subsection, I examine why the differences are so small.

3.5 Understanding the general equilibrium effect

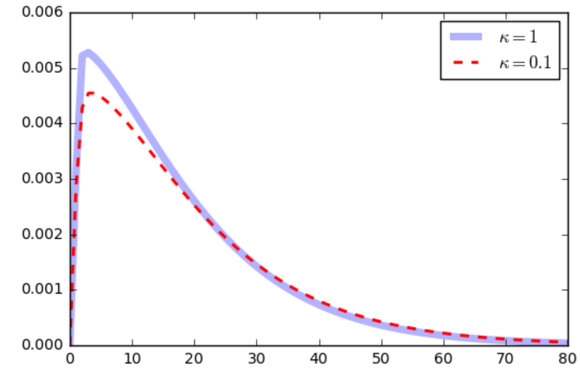
To further isolate the role of general equilibrium effects, I conduct an additional exercise in which the wage rate W is fixed at its steady state level. Figures 8 and 9 display the impulse responses (percentage deviations from steady state) of macro variables to a 1% positive productivity shock under this assumption. In this modified equilibrium, the labor market clearing condition is omitted. Figure 8 reports the results for $\kappa = 1$, while Figure 9 shows the case with $\kappa = 0.1$.

In both figures, the price indices and macro variables behave differently from the baseline case. By construction, the wage W is fixed, which raises the profitability of market entry and leads to a surge in new entrants. Because households must finance these entrants through investment in the mutual fund while labor income remains constant, they reduce consumption and imports. Consequently, price indices fall.

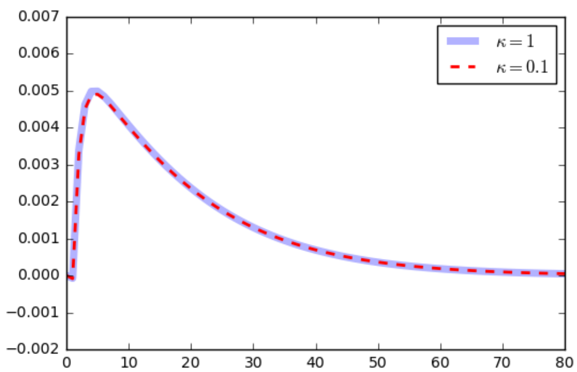
Figure 7: Impulse responses with different α and κ



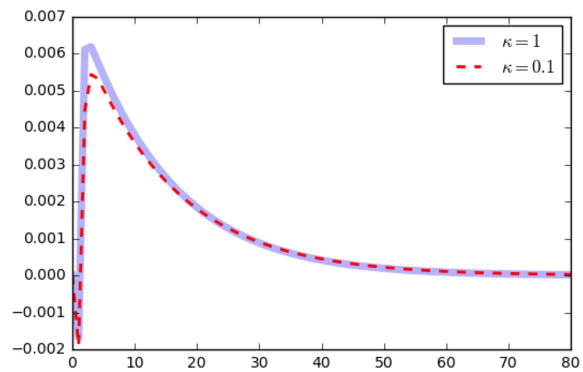
(a) GDP ($\alpha = 5.6$)



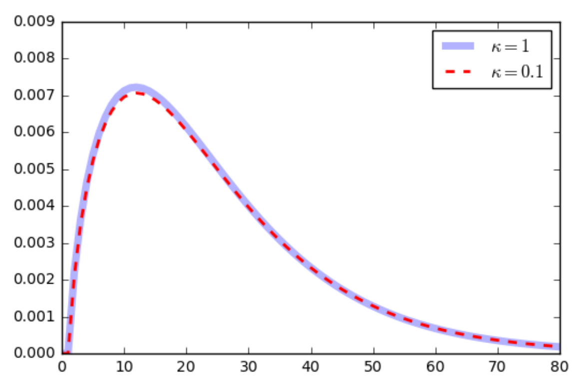
(b) GDP ($\alpha = 15.6$)



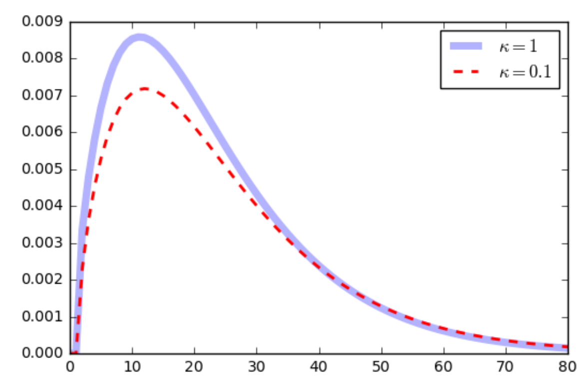
(c) X ($\alpha = 5.6$)



(d) X ($\alpha = 15.6$)

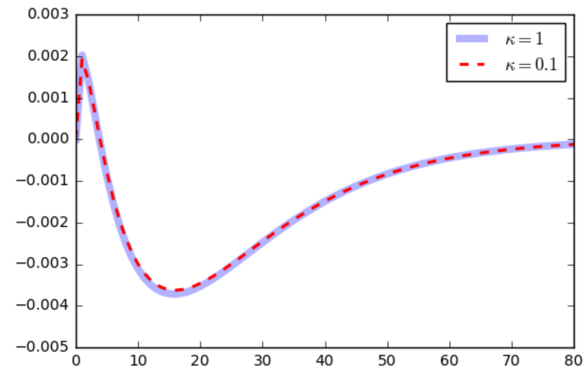


(e) M_D ($\alpha = 5.6$)

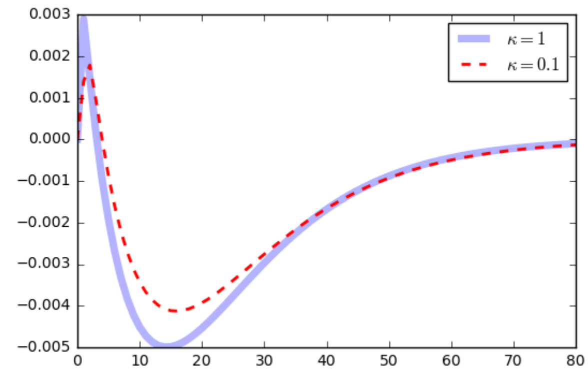


(f) M_D ($\alpha = 15.6$)

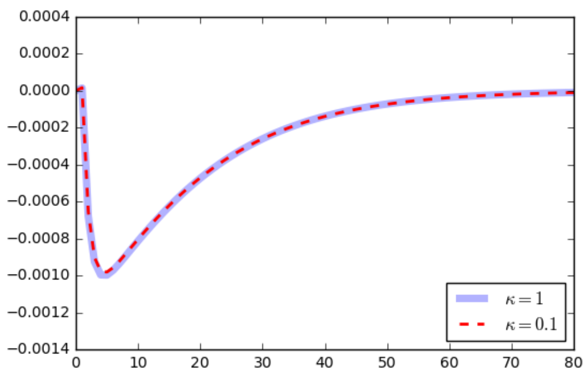
Figure 7 (continued): Impulse responses with different α and κ



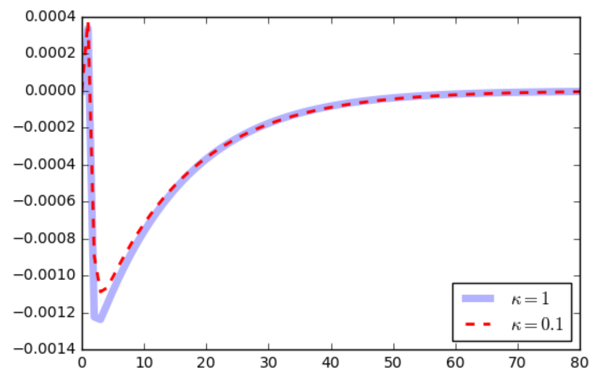
(g) $\tilde{\pi}$ ($\alpha = 5.6$)



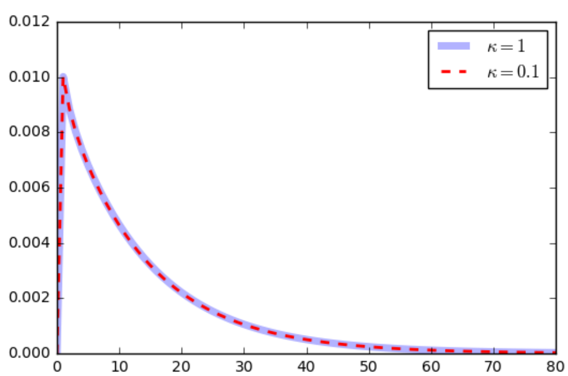
(h) $\tilde{\pi}$ ($\alpha = 15.6$)



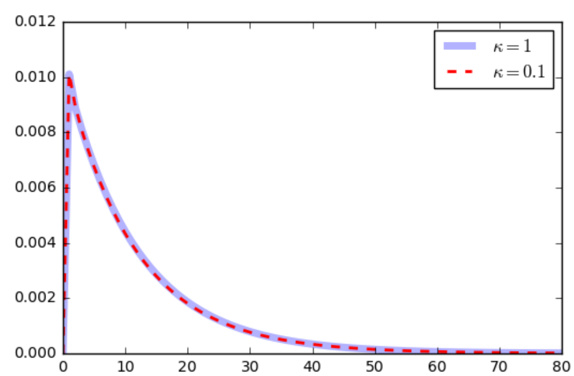
(i) P_X ($\alpha = 5.6$)



(j) P_X ($\alpha = 15.6$)



(k) W ($\alpha = 5.6$)



(l) W ($\alpha = 15.6$)

Figure 8: Responses to an A shock of 1% with constant W $(\kappa = 1)$

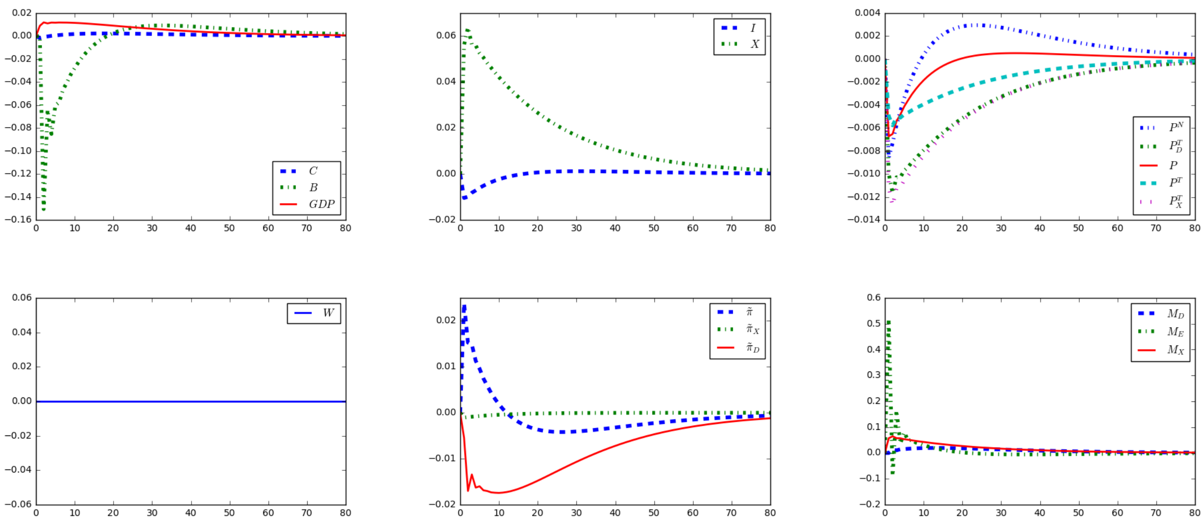
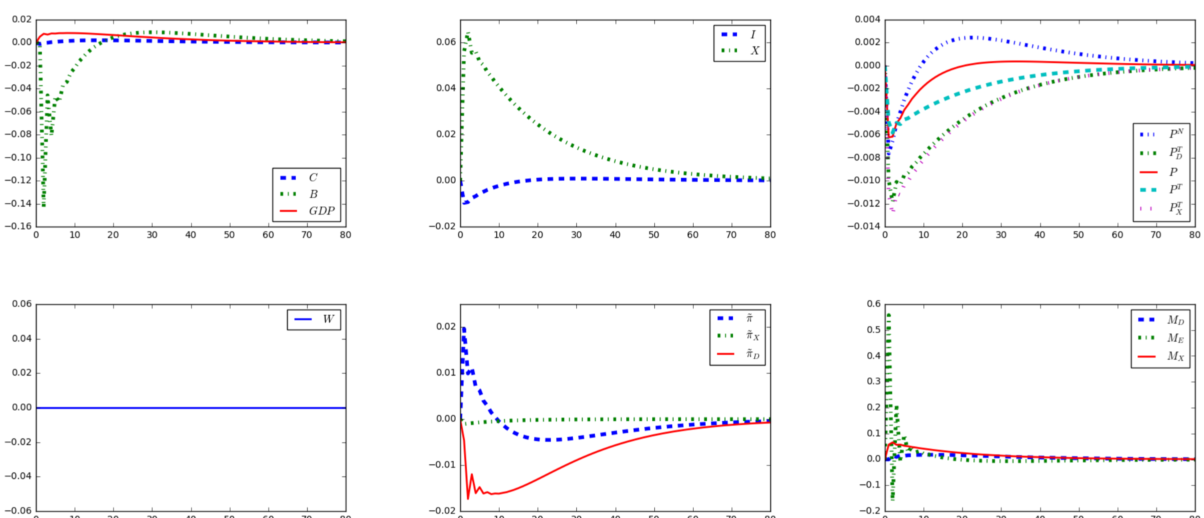


Figure 9: Responses to an A shock of 1% with constant W $(\kappa = 0.1)$



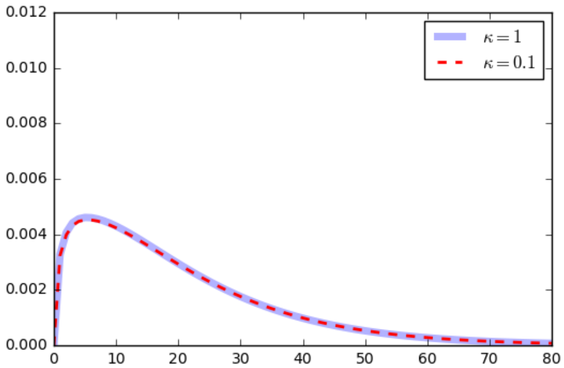
A second key observation is that aggregate variables respond differently depending on the degree of financial development κ, and this pattern is more pronounced in Figure 10. The figure compares the impulse responses (percentage deviations from steady state) of selected variables under general equilibrium and partial equilibrium. The left panels display the baseline results with flexible wage adjustment, while the right panels show outcomes when W is fixed. In partial equilibrium, variables respond more sensitively when $\kappa = 1$. This suggests that the baseline insensitivity of aggregate variables to financial development is closely tied to wage adjustment in general equilibrium.

Figure 11 confirms this by comparing the extensive margin, intensive margin, and selection effect when W is held constant. The responses are expressed as level deviations normalized in the same way as in Figure 3. As in the baseline, the extensive margin is more sensitive when $\kappa = 1$, while the selection effect is more sensitive when $\kappa = 0.1$. The intensive margin responds somewhat more when $\kappa = 0.1$, though this pattern is less pronounced than in the other two channels.

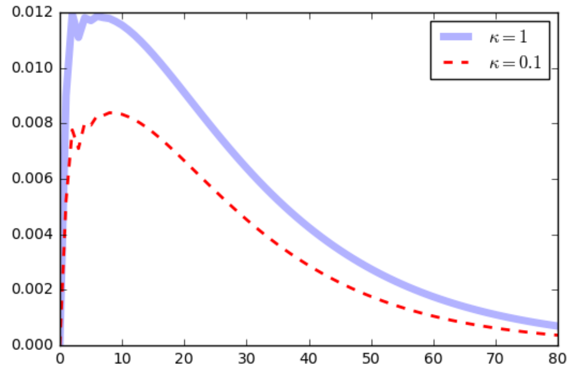
Importantly, the magnitude of all responses is much larger than in the baseline, because firms now benefit from the productivity gain without facing higher production costs. This amplifies the scale of the response in total export profit $\tilde{\Pi}_X$, which is the key driver of aggregate outcomes. Consequently, aggregate variables now differ quantitatively depending on κ, since the gap in total export profit across financial development levels is no longer negligible.

Figure 12 corroborates this point by showing how the response of $\tilde{\Pi}_X$ differs with κ across three cases: the baseline, the high-dispersion case with $\alpha = 15.6$, and the constant-wage case. In panel (c), where W is fixed, the gap between the responses reaches nearly 0.005% of steady state GDP at its peak—much larger than the corresponding gaps in panels (a) and (b) with different values of α in general equilibrium.

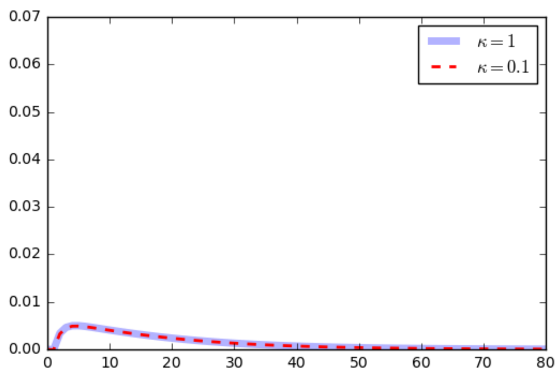
Figure 10: Impulse responses in general equilibrium (GE) and partial equilibrium (PE)



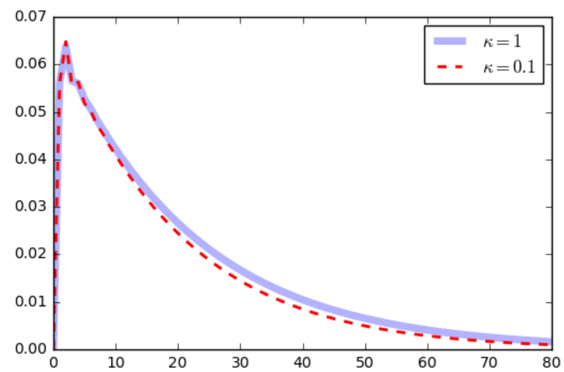
(a) GDP (GE)



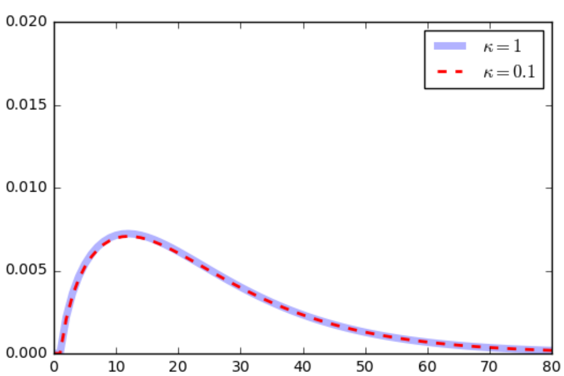
(b) GDP (PE)



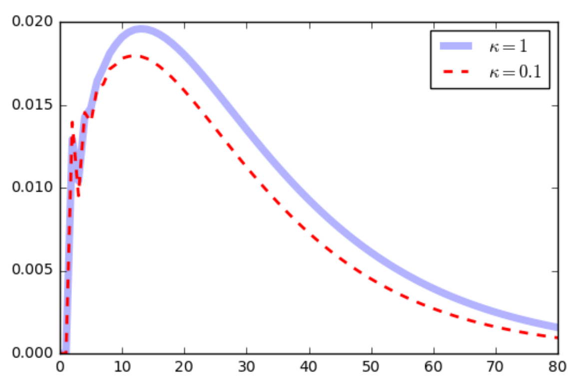
(c) X (GE)



(d) X (PE)

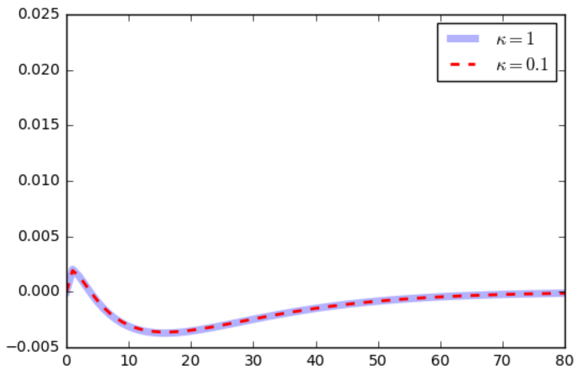


(e) M_D (GE)

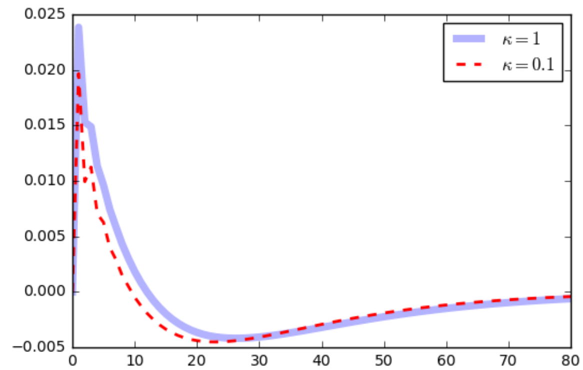


(f) M_D (PE)

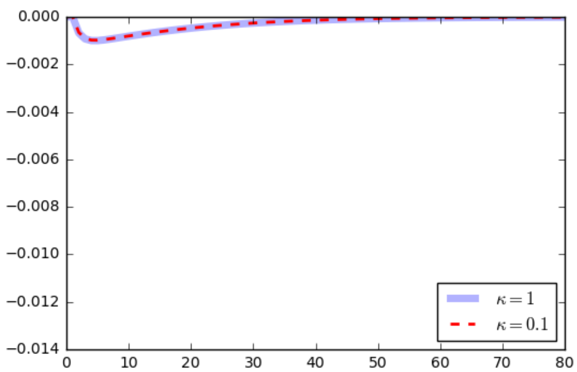
Figure 10 (continued): Impulse responses in general equilibrium (GE) and partial equilibrium (PE)



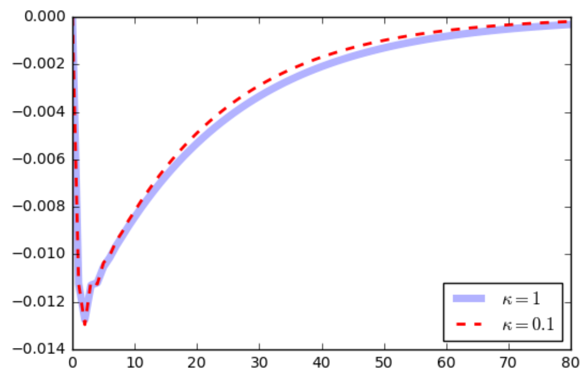
(g) $\tilde{\pi}$ (GE)



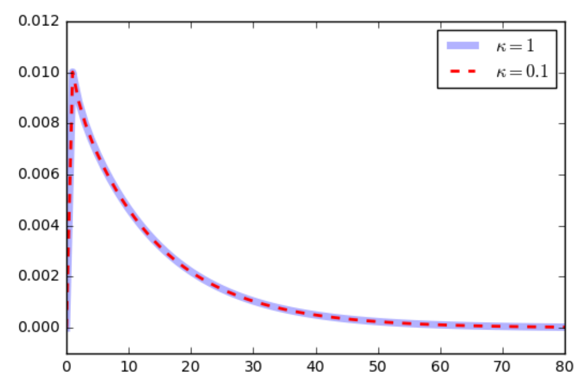
(h) $\tilde{\pi}$ (PE)



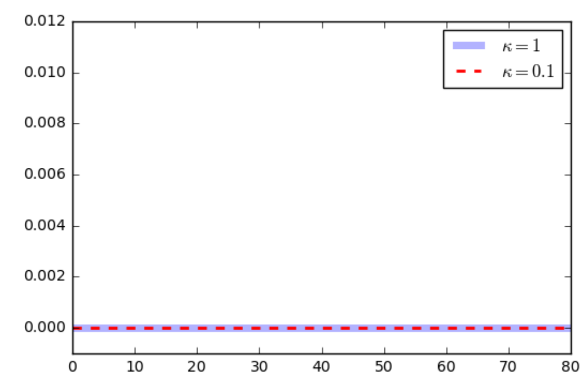
(i) P_X (GE)



(j) P_X (PE)

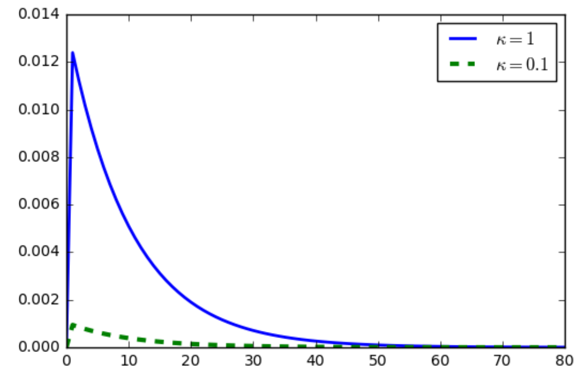


(k) W (GE)

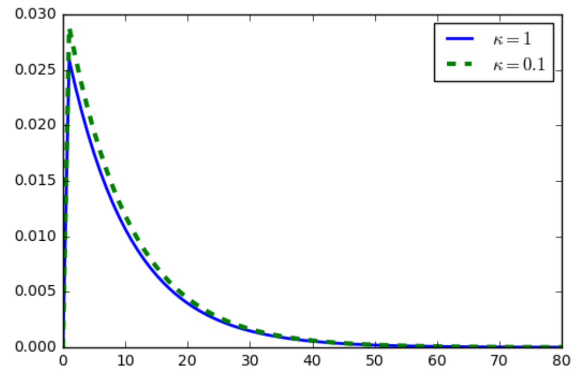


(l) W (PE)

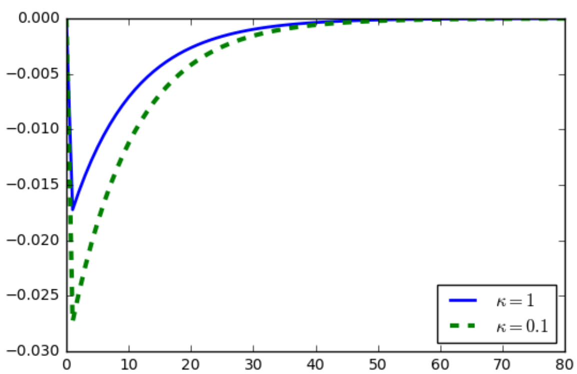
Figure 11: Responses of extensive margin, intensive margin, and selection (constant W)



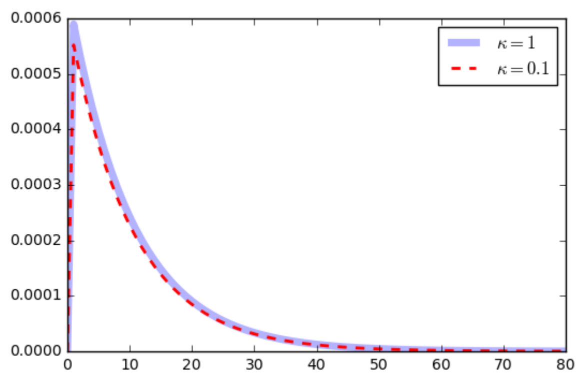
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

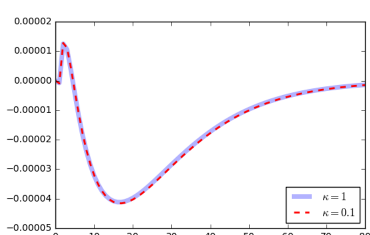


(c) Selection $(\tilde{a}_{X,t})$

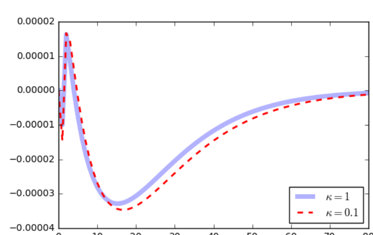


(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

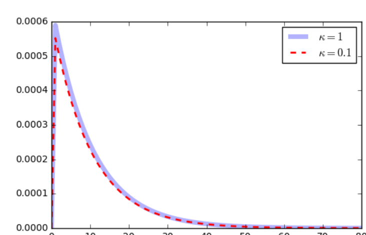
Figure 12: Response of $\tilde{\Pi}_X$ to a productivity shock



(a) $\alpha = 5.6$



(b) $\alpha = 15.6$



(c) Constant W

This result can also be understood analytically. Recall that

$$\begin{aligned}\frac{\partial\tilde{\Pi}_X}{\partial A} = & \underbrace{-g(\bar{a}_\kappa)\tilde{\pi}_X\frac{\partial\bar{a}_\kappa}{\partial A}}_{\text{Extensive margin, }>0} \\ & + \underbrace{(1-G(\bar{a}_\kappa))\left[\frac{\sigma-1}{\sigma}\left(\frac{p_X(\tilde{a}_X)}{P^*}\right)^{1-\sigma}\frac{q_X^{rem}}{A}+(1-\mu)\frac{WF_X}{A^2}\right]}_{\text{Intensive margin, }>0} \\ & + \underbrace{(1-G(\bar{a}_\kappa))\left[\frac{\sigma-1}{\sigma}\left(\frac{p_X(\tilde{a}_X)}{P^*}\right)^{1-\sigma}\frac{q_X^{rem}}{\tilde{a}_X}\frac{\partial\tilde{a}_X}{\partial A}\right]}_{\text{Selection effect, }<0}.\end{aligned}$$

Now, consider the partial derivative of the total export profit with respect to the wage:

$$\begin{aligned}\frac{\partial\tilde{\Pi}_X}{\partial W} = & \underbrace{-g(\bar{a}_\kappa)\tilde{\pi}_X\frac{\partial\bar{a}_\kappa}{\partial W}}_{\text{Extensive margin, }<0} \\ & + \underbrace{(1-G(\bar{a}_\kappa))\left[-\frac{\sigma-1}{\sigma}\left(\frac{p_X(\tilde{a}_X)}{P^*}\right)^{1-\sigma}\frac{q_X^{rem}}{W}-(1-\mu)\frac{F_X}{A}\right]}_{\text{Intensive margin, }<0} \\ & + \underbrace{(1-G(\bar{a}_\kappa))\left[\frac{\sigma-1}{\sigma}\left(\frac{p_X(\tilde{a}_X)}{P^*}\right)^{1-\sigma}\frac{q_X^{rem}}{\tilde{a}_X}\frac{\partial\tilde{a}_X}{\partial W}\right]}_{\text{Selection effect, }>0}.\end{aligned} \tag{31}$$

This decomposition mirrors the earlier case with respect to productivity A, but note that the signs of each channel are reversed. The extensive and intensive margins now exert negative effects, while the selection effect turns positive. Hence, in general equilibrium, when the wage W rises following a positive productivity shock, the overall magnitudes of the extensive margin, intensive margin, and selection responses are dampened. This analytical insight is consistent with the patterns observed in Figures 11 and 12. The key lesson from this subsection is that, in response to a productivity shock, wage adjustment in general equilibrium dampens the responses of the extensive margin, intensive margin, and selection. This dampening allows the three channels to offset one another, keeping $\tilde{\Pi}_X$ quantitatively insensitive to the degree of financial development.

3.6 Financial development and labor supply

As shown in the previous subsection, wage adjustment plays a central role in shaping the effect of financial development on the aggregate economy in general equilibrium. In the baseline setup, labor supply is perfectly inelastic and fixed at L. Consequently, any increase in labor demand translates one-for-one into a higher wage rate. This extreme assumption likely drives the near-complete insensitivity of macro variables to financial development observed in the baseline exercise.

However, even if labor supply is not perfectly inelastic, the key mechanism remains: wage adjustment in general equilibrium dampens the effect of productivity shocks on the extensive margin, intensive margin, and selection effect, provided that a positive productivity shock raises wages. The extent to which wage adjustment offsets the influence of trade credit constraints depends on the labor market structure, and in particular on the elasticity of labor supply. To verify this and to generalize the baseline results, I now endogenize labor supply and repeat the exercises under different elasticities. In addition, I demonstrate that the role of firm productivity dispersion identified earlier continues to operate in this richer labor market setting.

Specifically, I replace the baseline assumption of constant relative risk aversion preferences with Greenwood–Hercowitz–Huffman (GHH) preferences (Greenwood et al., 1988), which deliver the following household problem:

$$\max_{C_t, L_t, B_{t+1}, x_{t+1}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\gamma} \left(C_t - \rho \frac{L_t^{1+\frac{1}{\lambda}}}{1+1/\lambda} \right)^{1-\gamma}$$

subject to

$$\begin{aligned} & P_t C_t + P_t^T B_{t+1} + \frac{\nu}{2} P_t^T B_{t+1}^2 + \tilde{v}_t (M_{D,t} + M_{E,t}) x_{t+1} \\ = & W_t L_t + P_t^N Y^N + (1 + r_t^*) P_t^T B_t + (\tilde{v}_t + \tilde{\pi}_t) M_{D,t} x_t + T_t \end{aligned}$$

and

$$0 \leq L_t \leq 1.$$

Households now also choose how much labor to supply, L_t, in each period. The first-order condition for L_t yields the labor supply schedule:

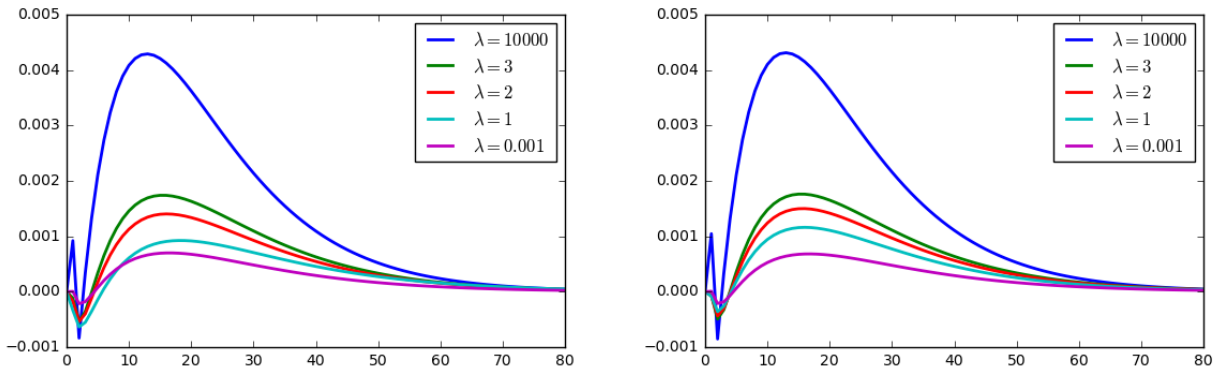
$$L_t = \rho^\lambda \left(\frac{W_t}{P_t} \right)^\lambda . \tag{32}$$

The elasticity of labor supply is thus equal to λ. When $\lambda \to 0$, labor supply is perfectly inelastic, reproducing the baseline case.

Figures C.31–C.35 show impulse responses of aggregate variables, extensive and intensive margins, the selection effect, and the total export profit across values of κ when λ is set to 0.001. All responses closely resemble those in the baseline with exogenous labor supply, confirming the robustness of the main results.

In the previous subsection, I highlighted the importance of wage adjustment by contrasting the baseline results with an extreme case where W is held fixed. I now generalize this result by linking it to the elasticity of labor supply, λ. Figure 13 shows the responses of the effective marginal cost of production, W/A, to a 1% increase in A across values of λ and κ. A lower λ corresponds to a less elastic labor supply and thus a steeper labor supply curve. Consequently, as λ increases, wages respond less strongly to a productivity shock for both values of κ. This translates into a higher sensitivity of the effective marginal cost W/A when λ is high. In turn, this implies that the mitigating role of wage adjustment on the extensive margin, intensive

Figure 13: Response of $\frac{W}{A}$ with different λ



(a) $\kappa = 1$

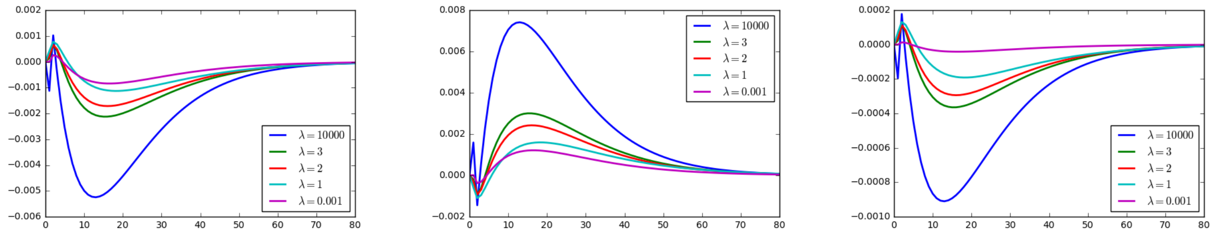
(b) $\kappa = 0.1$

margin, and selection effect becomes weaker as labor supply becomes more elastic.

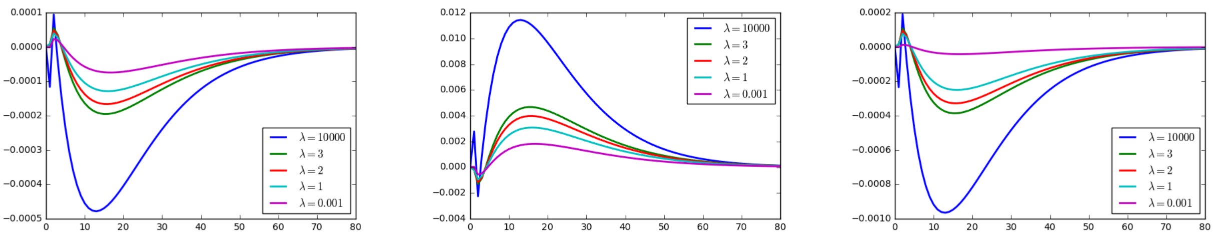
Figure 14 presents the responses of the extensive margin, selection effect, and total export profit across different values of λ and κ. The figure confirms that the magnitude of these responses increases as labor supply becomes more elastic, since wage adjustment is then more limited. Consequently, when labor supply is highly elastic, the difference in total export profits across degrees of trade credit constraints becomes sufficiently large to spill over into aggregate outcomes.

Next, I show that the effect of lower dispersion in firm productivity generalizes to an environment with a more flexible labor market. As established earlier, when firm productivity is less dispersed, the difference in the extensive margin across values of κ becomes larger, while the difference in the selection effect becomes smaller. This mechanism continues to operate when labor supply is endogenously determined in general equilibrium. Figure **??** confirms this, presenting the responses of the extensive margin, the selection effect, and total export profits by α when $\lambda = 1$.

Figure 14: Responses of the extensive margin, selection, and total export profit by λ

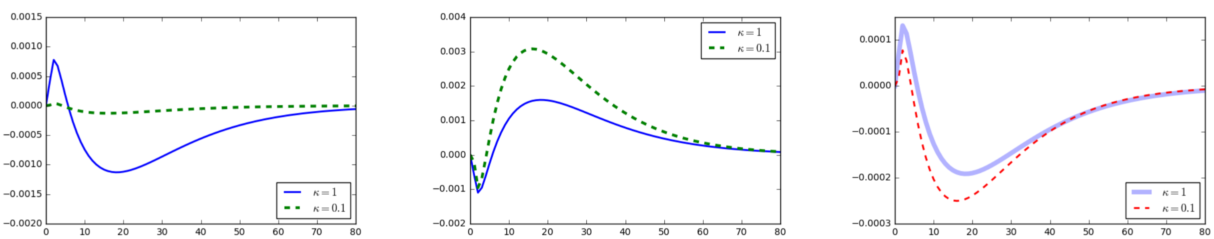


(a) $1 - G(\bar{a}_\kappa)$ ($\kappa = 1$) (b) $\tilde{a}_X$ ($\kappa = 1$) (c) $\tilde{\Pi}_X$ ($\kappa = 1$)

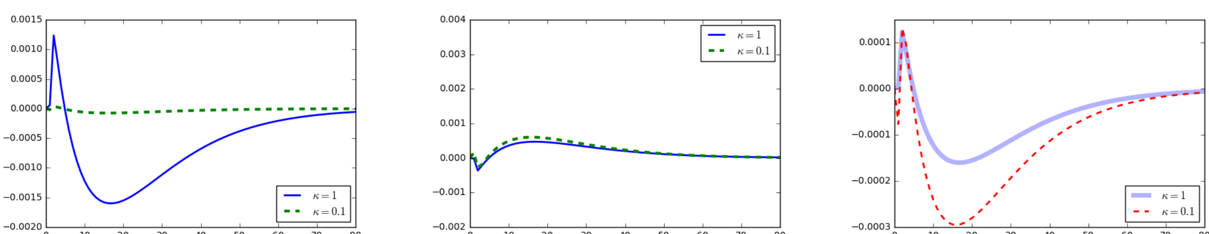


(d) $1 - G(\bar{a}_\kappa)$ ($\kappa = 0.1$) (e) $\tilde{a}_X$ ($\kappa = 0.1$) (f) $\tilde{\Pi}_X$ ($\kappa = 0.1$)

Figure 15: Responses of the extensive margin, selection, and total export profit when $\lambda = 1$



(a) $1 - G(\bar{a}_\kappa)$ ($\alpha = 5.6$) (b) $\tilde{a}_X$ ($\alpha = 5.6$) (c) $\tilde{\Pi}_X$ ($\alpha = 5.6$)



(d) $1 - G(\bar{a}_\kappa)$ ($\alpha = 15.6$) (e) $\tilde{a}_X$ ($\alpha = 15.6$) (f) $\tilde{\Pi}_X$ ($\alpha = 15.6$)

3.7 Robustness checks and additional exercises

This subsection reports a series of robustness tests of the main findings. I examine the sensitivity of results to alternative values of the elasticity of substitution between varieties, the type of shock, capital account openness, the presence of the non-tradable sector, and alternative calibrations for κ and foreign demand. Across all cases, the main results remain intact.

Small σ.—The elasticity of substitution between varieties σ varies across studies. In the baseline, I set $\sigma = 6$ following Broda and Weinstein (2006), while other papers, including Bernard et al. (2003), report lower estimates (e.g., $\sigma = 3.8$). As a robustness check, I set $\sigma = 2.5$, which corresponds to a 67% markup, and recalibrate other parameters to match the same key moments. In this case, α is set to 2.1 to replicate the standard deviation of log U.S. plant sales. Figures C.5–C.6 show the responses of macro variables when $\kappa = 1$ and $\kappa = 0.1$. Consistent with the baseline, κ has no significant impact.

Figures C.7–C.8 display the extensive margin, intensive margin, selection effect, and total export profit, both in level and percentage deviations. The main results remain: in level deviations, the extensive margin is more sensitive when $\kappa = 1$, the selection effect when $\kappa = 0.1$, and $\tilde{\Pi}_X$ is quantitatively invariant to κ.

When α is increased (Figure C.9), the gap in the extensive margin widens while that in the selection effect narrows, making $\tilde{\Pi}_X$ more sensitive to κ. Figure C.10 confirms that aggregate variables also become more responsive when α is high. Hence, the baseline findings are robust to different calibrations of σ.

P^* *shock.*—I also test whether results hinge on the nature of the shock. Instead of a 1% productivity shock, I consider a 1% increase in the foreign price index P^*. Figures C.11–C.12 show the responses of macro variables, and Figures C.13–C.14 show the three channels and $\tilde{\Pi}_X$. The patterns are consistent with the baseline: in level deviations, the extensive margin is more sensitive when $\kappa = 1$, the selection effect when $\kappa = 0.1$, and $\tilde{\Pi}_X$ is unchanged by κ. In percentage deviations, κ again has little effect. Thus, the main findings are not shock-specific.

Zero capital account.—The results also hold when the capital account is effectively shut. I simulate with an extremely high bond adjustment cost ($\nu = 10000$). Figures C.15–C.16 show that exports and imports move together since unbalanced trade is prohibitively costly. Still, the results for financial development are robust. The channels and $\tilde{\Pi}_X$ (Figures C.17–C.18) behave in line with the baseline.

Exclusion of the non-tradable sector.—To test whether results depend on the non-tradable sector, I repeat the analysis setting $\omega = 1$ (implemented as $\omega = 0.9999$). Figures C.19–C.22 confirm that the main findings hold without the non-tradable sector.

Intermediate κ.—I also consider an intermediate value of $\kappa = 0.55$, the midpoint of the baseline extremes (0.1 and 1). Figures C.23–C.26 show that the main results are unchanged.

Foreign demand.—Finally, I test robustness to the calibration of foreign demand. In the baseline, $q_X^{rem} = 5$. Setting $q_X^{rem} = 15$ yields results summarized in Figures C.27–C.30, which remain consistent with the baseline.

4 Conclusion

This paper develops a small open economy general equilibrium model with trade credit constraints. In the model, exporting requires firms to pay upfront fixed costs—partly in domestic and partly in foreign labor—by borrowing from international lenders. The amount they can borrow depends on the degree of financial development in the home country. As long as financial markets are imperfect, some firms that would profitably export in a frictionless economy are excluded.

The quantitative exercises reveal that in general equilibrium, weaker financial development reduces the extensive margin of exports, but this effect is largely offset by an increase in the average productivity of exporters. As a result, aggregate outcomes such as GDP, consumption, and wages remain broadly insensitive to the degree of financial development. Only when firm productivity is very concentrated at low levels does financial development matter at the aggregate level—and even then, the effect is modest. Moreover, wage adjustment in general equilibrium further mutes the role of trade credit constraints: higher wages erode the profitability gains from productivity shocks, dampening both the extensive margin and selection channels. The strength of this dampening mechanism depends on the elasticity of labor supply: the lower the elasticity, the stronger the wage response and the weaker the aggregate effect of trade credit constraints.

The quantitative results should be interpreted with caution, since the model abstracts from channels such as the use of firm assets as collateral (Chaney, 2016) or dynamic accumulation of internal capital. Nonetheless, the key insights are robust: (i) the extensive margin and selection channels offset each other, (ii) productivity dispersion shapes the balance between them, (iii) wage adjustment in general equilibrium systematically reduces their aggregate impact, and (iv) such general equilibrium channel through wage adjustment becomes stronger as labor supply becomes less elastic. These results suggest that while trade credit constraints are critical for firm-level outcomes, their aggregate consequences are muted by offsetting mechanisms in general equilibrium.

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A Partial Equilibrium Implications

Before moving on to the quantitative analysis, it is useful to look analytically at some of the partial equilibrium implications.

A.1 Export cutoffs and the RER

In this subsection, I first look at how exchange rate depreciation affects the extensive margin of exports. Recall that the export cutoff $\bar{a}_{\kappa,t}$ is determined by the trade credit constraint cutoff condition. For ease of notation, let's define the remaining part of export demand as $q_{X,t}^{rem} \equiv \omega^{\eta}\left(\frac{P_t^{T*}}{P_t^*}\right)^{\xi-\eta}\left(\frac{P_{I,t}^{T\ *}}{P_t^*}\right)^{\sigma-\xi} P_t^* C_t^*$ so that $q_{X,t} = p_{X,t}(a)^{-\sigma} P_t^{*\sigma-1} q_{X,t}^{rem}$ and $q_{X,t}^{rem}$ is exogenous. I further assume that $q_{X,t}^{rem}$ is constant.[11] Also, let $\mathcal{F}_t \equiv (1-\mu)\frac{W_t}{A_t}F_X + \mu\frac{W_t^*}{A_t^*}F_X$, and let $w_t \equiv \frac{W_t}{P_t}$ and $w_t^* \equiv \frac{W_t^*}{P_t^*}$ denote the wage rates denominated in units of the final consumption bundle in home and foreign countries. Then, the export cutoff $\bar{a}_{\kappa,t}$ is obtained as

$$\bar{a}_{\kappa,t} = \left(\frac{\sigma\mathcal{F}_t}{q_{X,t,}^{rem}}\frac{1}{\kappa}\right)^{\frac{1}{\sigma-1}} \frac{\sigma}{\sigma-1}\frac{\tau w_t}{A_t}\frac{P_t}{P_t^*}. \tag{33}$$

Define the RER as $e_t \equiv \frac{P_t^*}{P_t}$. An increase in RER corresponds to exchange rate depreciation. In the following, I first look at the effect of an increase in P_t and P_t^* separately and then the effect of an increase in e_t (RER depreciation).

First, given A_t, A_t^*, w_t, w_t^*, and P_t^*, the partial derivative of the export cutoff with respect to P_t is given as

$$\frac{\partial\bar{a}_{\kappa,t}}{\partial P_t} = \frac{\bar{a}_{\kappa,t}}{P_t}\left[1 + \frac{1}{\sigma-1}\frac{(1-\mu)\frac{P_t w_t}{A_t}}{(1-\mu)\frac{P_t w_t}{A_t} + \mu\frac{P_t^* w_t^*}{A_t^*}}\right] > 0. \tag{34}$$

The first term in the brackets corresponds to the the traditional price competitiveness effect through the marginal cost of production. The second term arises from the increased burden of fixed costs. Both channels negatively affect the profitability of exporters and increase the export cutoff. The size of the second term is increasing in the domestic input share of the fixed cost. Also, note that $\bar{a}_{\kappa,t} = \left(\frac{\sigma\mathcal{F}_t}{q_{X,t,}^{rem}}\frac{1}{\kappa}\right)^{\frac{1}{\sigma-1}} \frac{\sigma}{\sigma-1}\frac{\tau w_t}{A_t}\frac{P_t}{P_t^*}$. A fall in κ, which implies a less-developed financial market, amplifies the effect of changes in P_t on $\bar{a}_{\kappa,t}$.

Next, given A_t, A_t^*, w_t, w_t^*, and P_t, the partial derivative of the export cutoff with respect

[11] This formulation of $q_{X,t}^{rem}$ is similar to that in Demidova and Rodríguez-Clare (2009) and Demidova and Rodriguez-Clare (2013). However, I also assume that P_t^{T*}, $P_{I,t}^{T\ *}$, and C_t^* proportionally adjust so that $q_{X,t}^{rem}$ is constant regardless of P_t^*. On the contrary, $p_{X,t}(a)$ does not automatically change in proportion to P_t^* to offset its effect on $q_{X,t}$. This can be justified under the small open economy assumption that domestic firms cannot affect price indices in foreign countries. This assumption allows a tractable analytical analysis on the effect of changes in P_t^* on the domestic variables.

to P_t^* is given as

$$\frac{\partial \bar{a}_{\kappa,t}}{\partial P_t^*} = \frac{\bar{a}_{\kappa,t}}{P_t^*}\left[-1 + \frac{1}{\sigma-1}\frac{\mu\frac{P_t^* w_t^*}{A_t^*}}{(1-\mu)\frac{P_t w_t}{A_t} + \mu\frac{P_t^* w_t^*}{A_t^*}}\right]. \tag{35}$$

Similarly to the P_t case, the first term in the brackets is the traditional price competitiveness effect. In this case, its sign is negative since an increase in the foreign price means an increased price competitiveness of domestic products. However, the sign of the second term, which is the effect through the fixed cost, is positive because some fraction (μ) of the fixed cost should be paid in foreign labor and a higher P_t^* increases the burden of it. The size of this effect depends on the foreign share of the fixed cost μ, and as long as $\mu > 0$, it has a negative effect on the profitability of an exporter. As a result, unlike $\frac{\partial \bar{a}_{\kappa,t}}{\partial P_t}$, the sign of $\frac{\partial \bar{a}_{\kappa,t}}{\partial P_t^*}$ is ambiguous and depends on the relative strength of the two channels. Again, a lower κ amplifies the magnitude of the overall effect, but it does not affect the sign.

Now, consider a more general case where the RER (e_t) changes. Given A_t, A_t^*, w_t, and w_t^*, the derivative of the export cutoff with respect to the RER is given as

$$\frac{\partial \bar{a}_{\kappa,t}}{\partial e_t} = \frac{\bar{a}_{\kappa,t}}{e_t}\left[-2 + \frac{P_t}{\sigma-1}\frac{F_X}{\mathcal{F}_t}\left(-(1-\mu)\frac{w_t}{A_t} + \mu\frac{w_r^*}{A_t^*}e_t\right)\right]. \tag{36}$$

It can be rewritten as[12]

$$\frac{\partial \bar{a}_{X\kappa,t}}{\partial e_t} = \frac{\sigma}{\sigma-1}\frac{\tau w_t}{A_t}\left(\frac{\sigma \mathcal{F}_t}{q_{X,t}^{rem}}\right)^{\frac{1}{\sigma-1}}\left(\frac{1}{\kappa}\right)^{\frac{1}{\sigma-1}}\frac{1}{e_t^2}\left[\underbrace{-2}_{\text{price competitiveness effect}} + \underbrace{\frac{P_t}{\sigma-1}\frac{F_X}{\mathcal{F}_t}\left(-(1-\mu)\frac{w_t}{A_t} + \mu\frac{w_r^*}{A_t^*}e_t\right)}_{\text{fixed cost valuation effect}}\right]. \tag{37}$$

The effect of RER depreciation can be decomposed into two components. The first term inside the brackets corresponds to the classic price competitiveness effect of currency depreciation. RER depreciation increases home country exporters' price competitiveness abroad and lets less productive firms start exporting, thereby decreasing the export cutoff. The second term is the fixed cost valuation effect, and it arises since the export fixed cost consists of both home country and foreign country labor. Note that if foreign labor does not enter the export fixed cost ($\mu = 0$), only the price competitiveness effect is present and RER depreciation surely leads to a decrease in the export cutoff. If the share of foreign labor cost is large enough, RER depreciation can lead to a heavier fixed cost burden, which has a tightening effect on the trade credit constraint. The sign of the overall effect depends on the relative strength of the two channels. Moreover, a lower degree of financial development κ amplifies the magnitude of the overall effect. The results are summarized in the following proposition.[13]

[12] For the derivation, see Appendix B.2

[13] In the model of Chaney (2016), there are two productivity cutoffs, and only either the price competitiveness effect or the fixed cost valuation effect appears in each cutoff. In my model, there is only one export cutoff, and the two effects both affect the same cutoff.

Proposition A.1. Given A_t, A_t^*, w_t^*, and w_t^*,

1. if $\mu \leq \frac{\frac{w_t}{A_t}}{\frac{w_t}{A_t}+e_t\frac{w_t^*}{A_t^*}}$, $\frac{\partial \bar{a}_{\kappa,t}}{\partial e_t} < 0$;

2. if $\mu > \frac{\frac{w_t}{A_t}}{\frac{w_t}{A_t}+e_t\frac{w_t^*}{A_t^*}}$, an increase in e_t has a positive fixed cost valuation effect on $\bar{a}_{\kappa,t}$, and the sign of $\frac{\partial \bar{a}_{\kappa,t}}{\partial e_t}$ is ambiguous;

3. and a lower κ increases $|\frac{\partial \bar{a}_{\kappa,t}}{\partial e_t}|$ but does not affect the sign of $\frac{\partial \bar{a}_{\kappa,t}}{\partial e_t}$.

Intuitively, if the foreign input share of the fixed cost is small, the traditional price competitiveness effect of RER depreciation dominates and an exporter's profitability will increase. In contrast, if the foreign share is large enough, the overall effect of RER depreciation will depend on the relative strength of the price competitiveness channel and the fixed cost valuation channel. In addition, lower financial development amplifies these effects.

A.2 Export cutoff and production cost

Now consider how the export cutoff responds to the domestic wage given A_t, A_t^*, P_t, P_t^*, and w_t^*. The partial derivative of export cutoff with respect to the real wage is given as

$$\frac{\partial \bar{a}_{\kappa,t}}{\partial w_t} = \frac{\bar{a}_{\kappa,t}}{w_t}\left[1+\frac{1}{\sigma-1}\frac{(1-\mu)\frac{P_t w_t}{A_t}}{(1-\mu)\frac{P_t w_t}{A_t}+\mu\frac{P_t^* w_t^*}{A_t^*}}\right] > 0. \tag{38}$$

Note that an increase in w_t has a similar price competitiveness effect and fixed cost effect to those of P_t. Intuitively, this is because a change in the production cost w_t is directly translated into a change in the price P_t. For a similar reason, a change in the foreign wage w_t^* has a similar effect on the domestic export cutoff to that of P_t^*. Moreover, lower κ has a similar amplifying effect without affecting the sign. Also, the response of the cutoff to a change in W_t can be easily obtained as $\frac{\partial \bar{a}_{\kappa,t}}{\partial W_t} = \frac{\partial \bar{a}_{\kappa,t}}{\partial w_t} = \frac{\partial \bar{a}_{\kappa,t}}{\partial w_t}\frac{1}{P_t}$.

Meanwhile, given P_t, P_t^*, w_t, and w_t^*, an increase in the aggregate productivity A_t lowers the production cost, and the export cutoff falls according to

$$\frac{\partial \bar{a}_{\kappa,t}}{\partial A_t} = -\frac{\bar{a}_{\kappa,t}}{A_t}\left[1+\frac{1}{\sigma-1}\frac{(1-\mu)\frac{P_t w_t}{A_t}}{(1-\mu)\frac{P_t w_t}{A_t}+\mu\frac{P_t^* w_t^*}{A_t^*}}\right] < 0. \tag{39}$$

A.3 Export cutoff, extensive margin, and average export profit

The extensive margin of exports in the economy is given as $M_{D,t}(1-G(\bar{a}_{\kappa,t}))$, where $M_{D,t}$ is the mass of firms and G is the productivity distribution's cumulative distribution function. Given $M_{D,t}$, an increase in the export cutoff leads to a fall in the extensive margin of exports as

$$\frac{\partial(1-G(\bar{a}_{\kappa,t}))}{\partial \bar{a}_{\kappa,t}} = -\alpha\left(\frac{1}{\bar{a}_{\kappa,t}}\right)^{\alpha+1} < 0.$$

In addition, given A_t, A_t^*, P_t, P_t^*, w_t, and w_t^*, the average export profit of exporters $\tilde{\pi}_{X,t}$ responds to an increase in the export cutoff according to

$$\frac{\partial \tilde{\pi}_{X,t}}{\partial \bar{a}_{\kappa,t}} = \frac{\sigma - 1}{\sigma} \left(\frac{p_X(\tilde{a}_{X,t})}{P_t^*} \right)^{1-\sigma} \frac{q_{X,t}^{rem}}{\bar{a}_{\kappa,t}} > 0. \tag{40}$$

A.4 General equilibrium implications

In this section, I analytically showed how the export cutoff responds to a change in P_t, P_t^*, e_t, w_t or A_t; how the responses depend on the degree of financial development κ; and how the extensive margin of exports and the average export profit respond to a change in the export cutoff in partial equilibrium where other variables are held fixed. However, in general equilibrium, P_t, e_t, and w_t are all equilibrium outcomes and interact with each other. For example, in partial equilibrium, an increase in A_t lowers the cutoff, while an increase in W_t increases the cutoff. If an increase in A_t leads to an increase in W_t, the response of the export cutoff would be determined by the relative strength of the two competing forces in general equilibrium. Hence, it is a quantitative question of how the exports, and ultimately other macro variables including consumption and saving, respond to exogenous shocks in A_t or P_t^* in general equilibrium, and how the responses interact with financial development.

B Derivation of equations

B.1 Derivation of equation (17) from equation (10)

$$
\begin{aligned}
\tilde{v}_t &= \beta(1-\psi)\mathbb{E}_t\left[\frac{P_t}{P_{t+1}}\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}(\tilde{v}_{t+1}+\tilde{\pi}_{t+1})\right] \\
&= \beta(1-\psi)\mathbb{E}_t\left[\frac{P_t}{P_{t+1}}\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma}\tilde{\pi}_{t+1}\right] + \beta^2(1-\psi)^2\mathbb{E}_t\left[\mathbb{E}_{t+1}\left[\frac{P_t}{P_{t+2}}\left(\frac{C_{t+2}}{C_t}\right)^{-\gamma}\tilde{\pi}_{t+2}\right]\right] \\
&\quad + \beta^2(1-\psi)^2\mathbb{E}_t\left[\mathbb{E}_{t+1}\left[\frac{P_t}{P_{t+2}}\left(\frac{C_{t+2}}{C_t}\right)^{-\gamma}\tilde{v}_{t+2}\right]\right] \\
&= \mathbb{E}_t\sum_{s=0}^{\infty}[\beta(1-\psi)]^s\frac{P_t}{P_{t+s}}\left(\frac{C_{t+s}}{C_t}\right)^{-\gamma}\tilde{\pi}_{t+s}.
\end{aligned}
$$

B.2 Derivation of equaiton (31)

Total-differentiate equation (27) to get

$$
\begin{aligned}
d\bar{a}_{\kappa,t} &= \frac{\sigma}{\sigma-1}\frac{\tau w_t}{A_t}\left(\frac{\sigma\mathcal{F}_t}{q_{X,t}^{rem}}\right)^{\frac{1}{\sigma-1}}\left(\frac{1}{\kappa}\right)^{\frac{1}{\sigma-1}}\left[\frac{1}{P_t^*}dP_t - \frac{P_t}{P_t^{*2}}dP_t^*\right. \\
&\qquad \left. + \frac{P_t}{P_t^*}\frac{F_X}{(\sigma-1)\mathcal{F}_t}\left((1-\mu)\frac{w_t}{A_t}dP_t + \mu\frac{w_t^*}{A_t^*}dP_t^*\right)\right] \\
&\approx \frac{\sigma}{\sigma-1}\frac{\tau w_t}{A_t}\left(\frac{\sigma\mathcal{F}_t}{q_{X,t}^{rem}}\right)^{\frac{1}{\sigma-1}}\left(\frac{1}{\kappa}\right)^{\frac{1}{\sigma-1}}\left[\frac{1}{P_t^*}\left(-\frac{P_t^2}{P_t^*}de_t\right) - \frac{P_t}{P_t^{*2}}P_t de_t\right. \\
&\qquad \left. + \frac{P_t}{P_t^*}\frac{F_X}{(\sigma-1)\mathcal{F}_t}\left((1-\mu)\frac{w_t}{A_t}\left(-\frac{P_t^2}{P_t^*}de_t\right) + \mu\frac{w_t^*}{A_t^*}P_t de_t\right)\right].
\end{aligned}
$$

Rearranging the equation gives

$$
\frac{\partial\bar{a}_{\kappa,t}}{\partial e_t} = \frac{\sigma}{\sigma-1}\frac{\tau w_t}{A_t}\left(\frac{\sigma\mathcal{F}_t}{q_{X,t}^{rem}}\right)^{\frac{1}{\sigma-1}}\left(\frac{1}{\kappa}\right)^{\frac{1}{\sigma-1}}\left[-\frac{2}{e_t^2} + \frac{P_t}{e_t^2(\sigma-1)}\frac{F_X}{\mathcal{F}_t}\left(-(1-\mu)\frac{w_t}{A_t} + \mu\frac{w_r^*}{A_t^*}e_t\right)\right].
$$

C Additional impulse response functions

Figure C.1: Responses (level deviation from steady state) to an A shock of 1 unit ($\kappa = 1$)

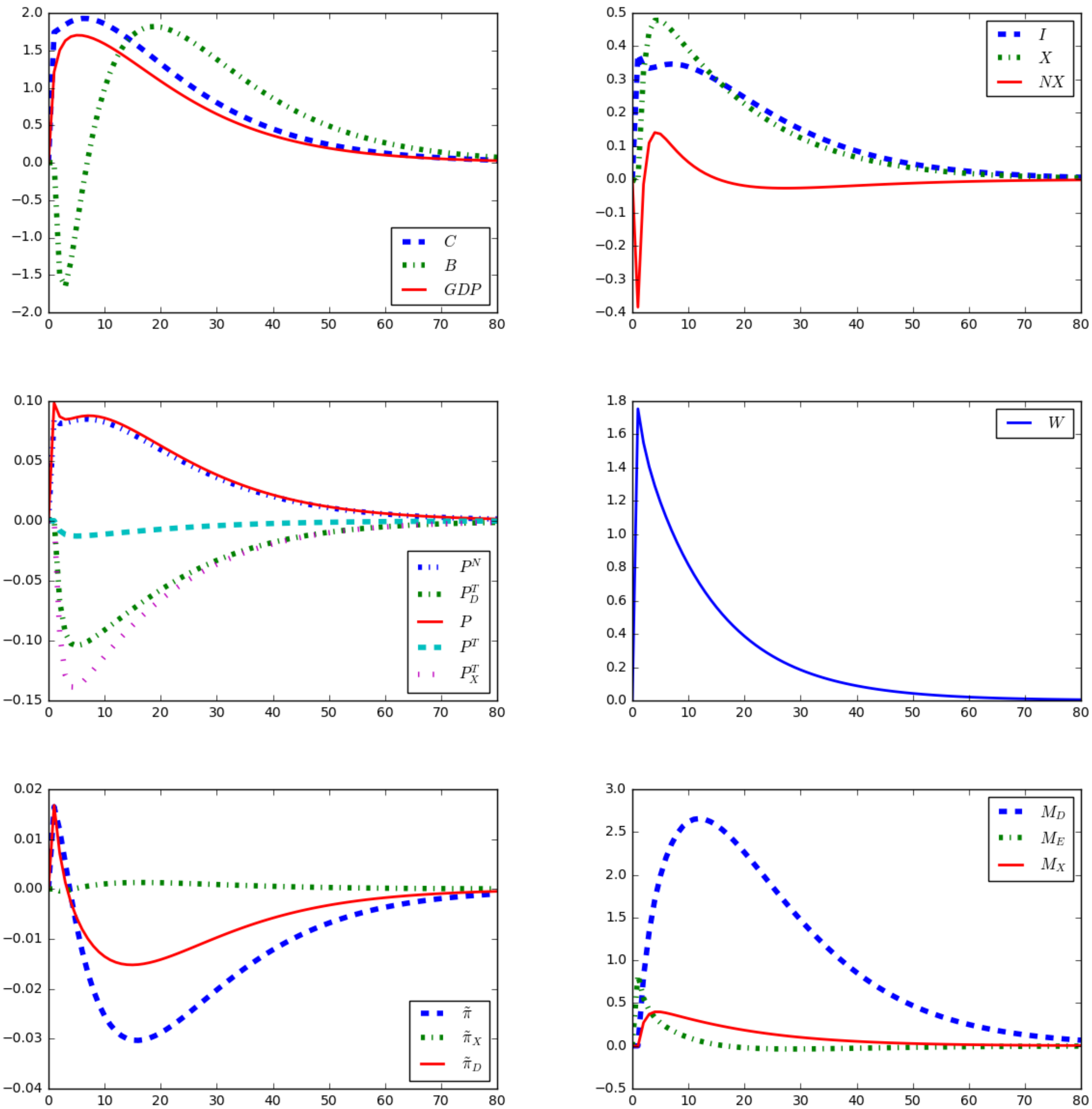


Figure C.2: Responses (level deviation from steady state) to an A shock of 1 unit ($\kappa = 0.1$)

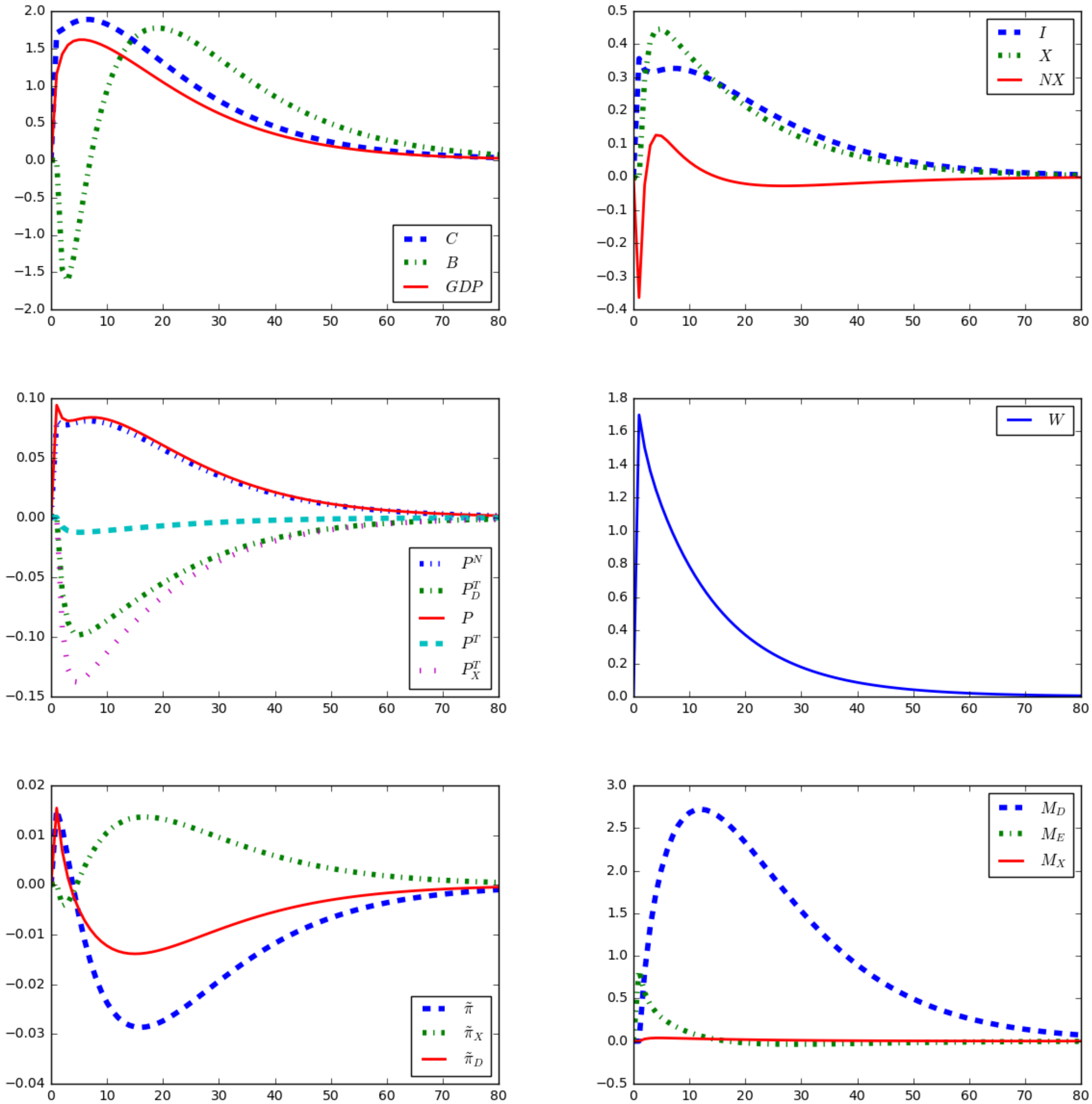
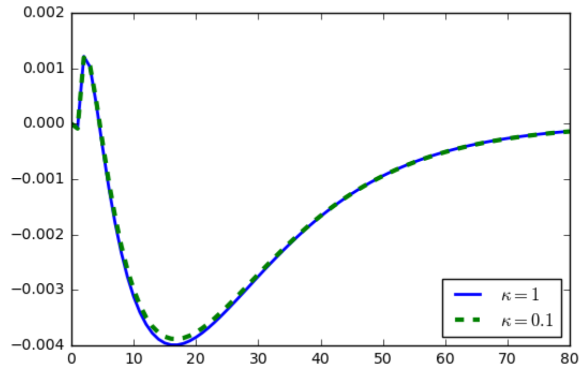
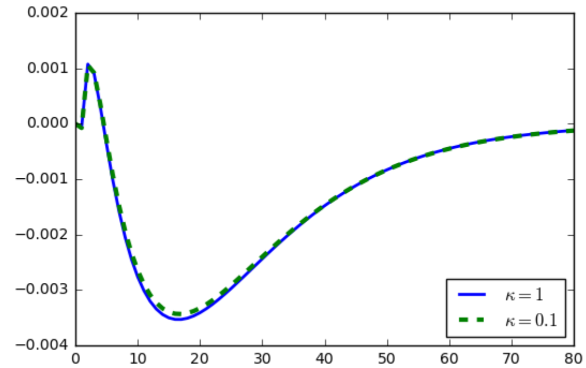


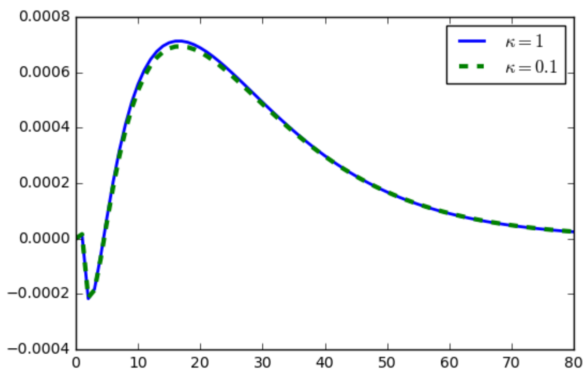
Figure C.3: Responses (percentage deviation from steady state) of extensive margin, intensive margin, and selection



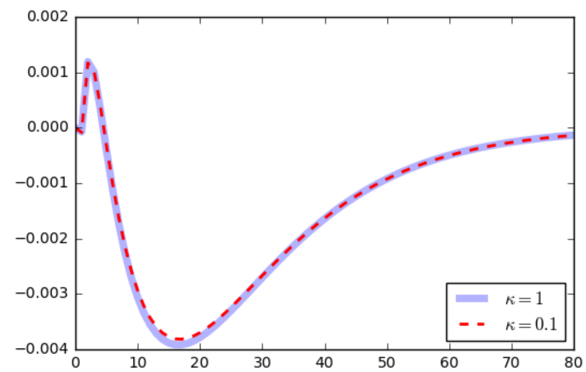
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

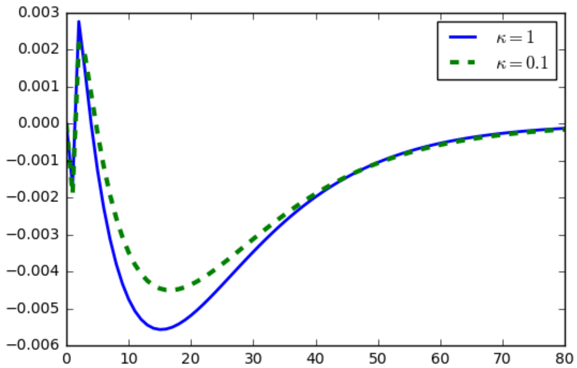


(c) Selection $(\tilde{a}_{X,t})$

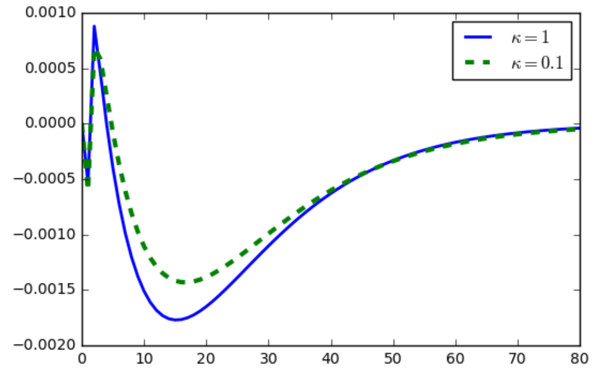


(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

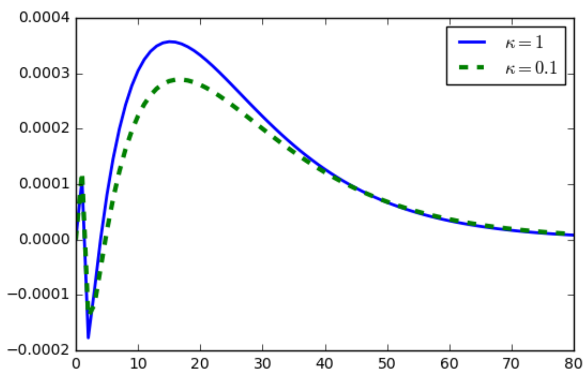
Figure C.4: Responses (percentage deviation) of extensive margin, intensive margin, and selection ($\alpha = 15.6$)



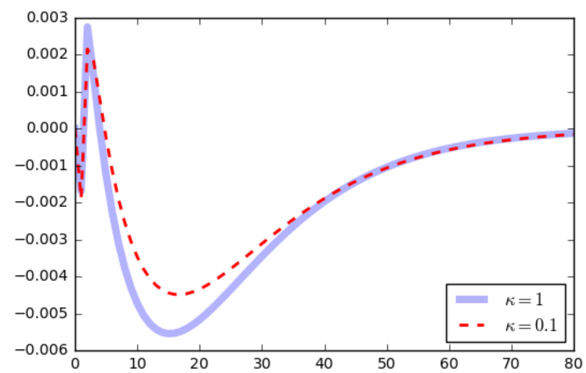
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$



(c) Selection $(\tilde{a}_{X,t})$



(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

Figure C.5: Response to an A shock of 1% ($\sigma = 2.5$, $\kappa = 1$)

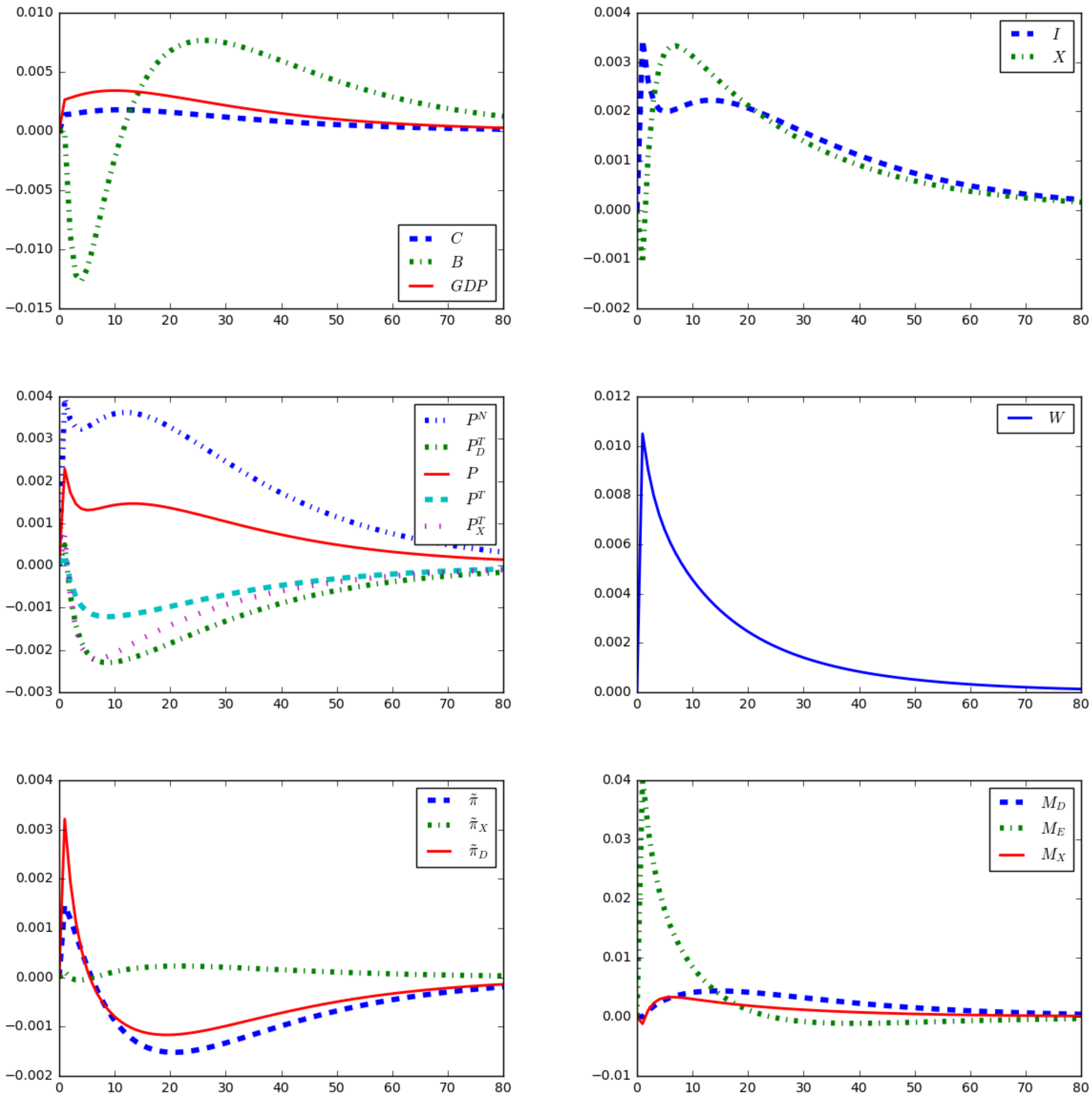


Figure C.6: Responses to an A shock of 1% ($\sigma = 2.5$, $\kappa = 0.1$)

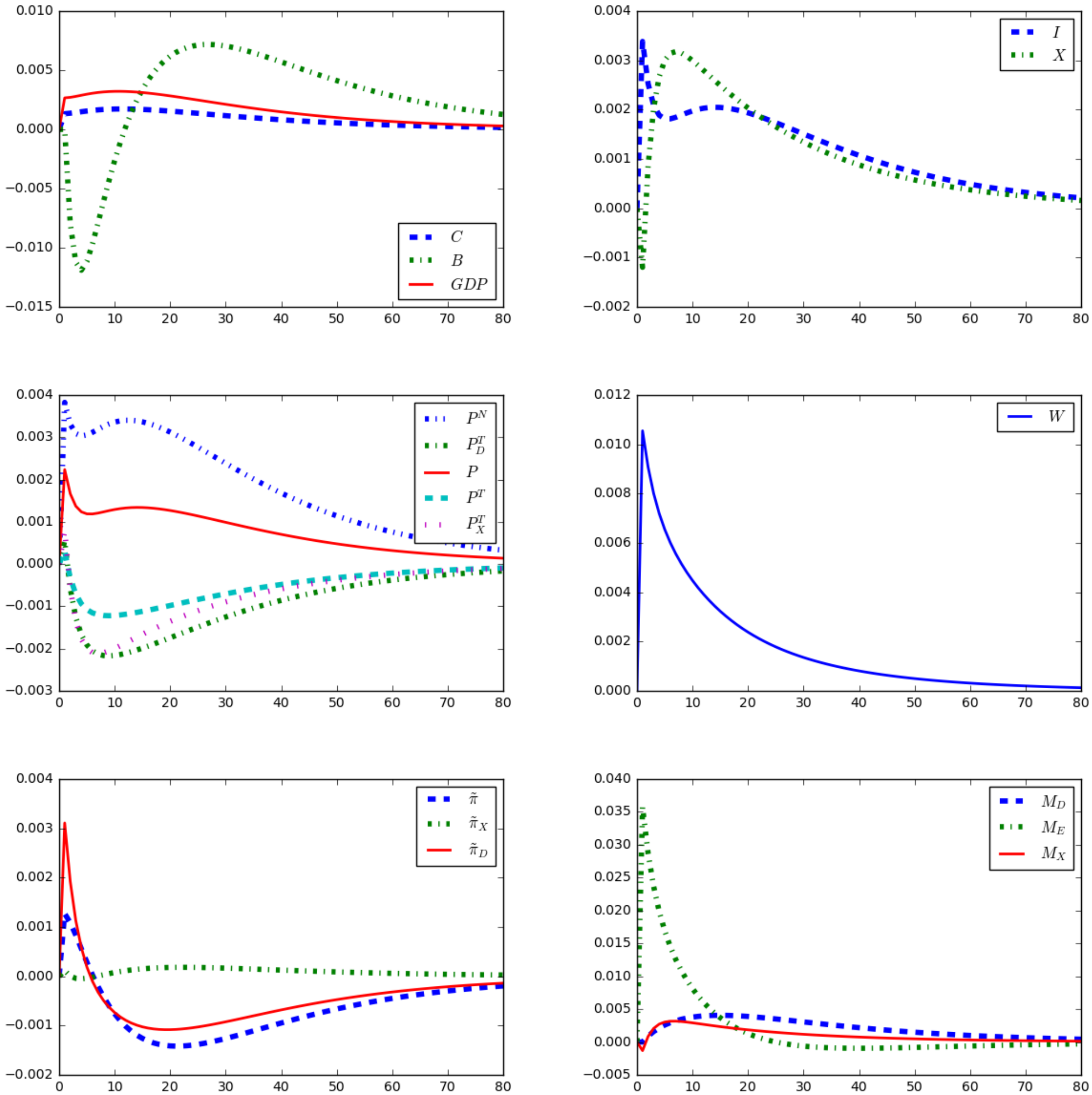
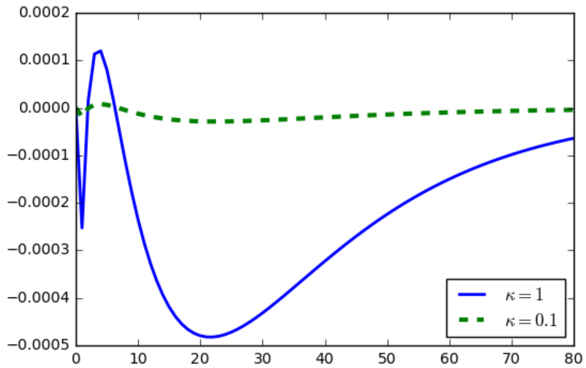
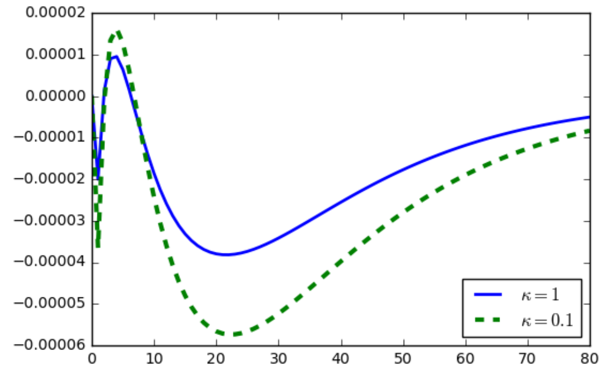


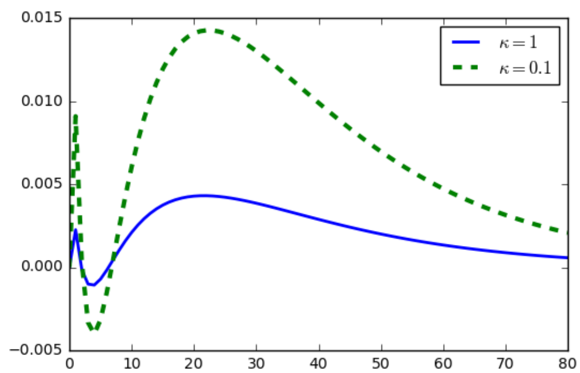
Figure C.7: Responses (level deviation) of extensive margin, intensive margin, and selection ($\sigma = 2.5$)



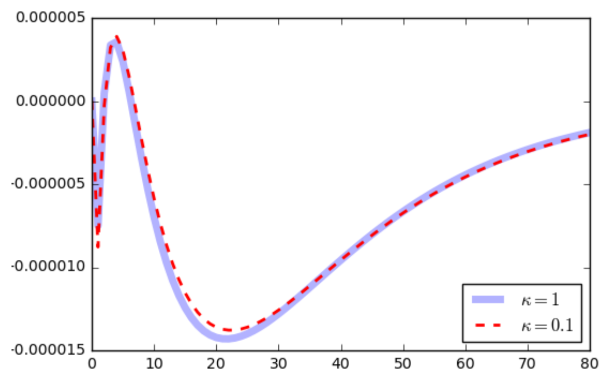
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

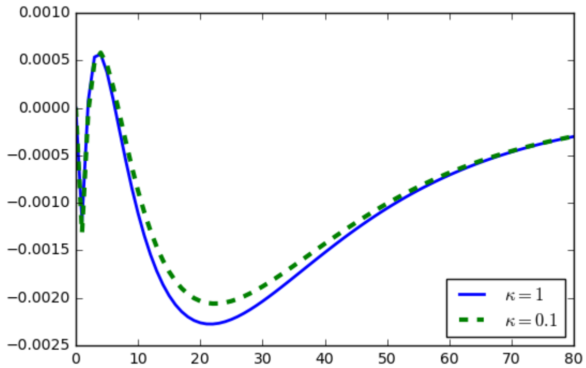


(c) Selection $(\tilde{a}_{X,t})$

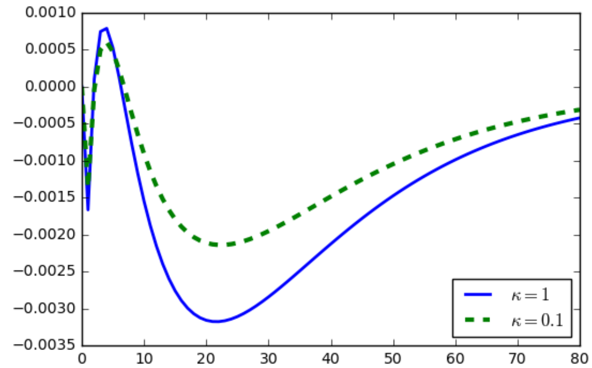


(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

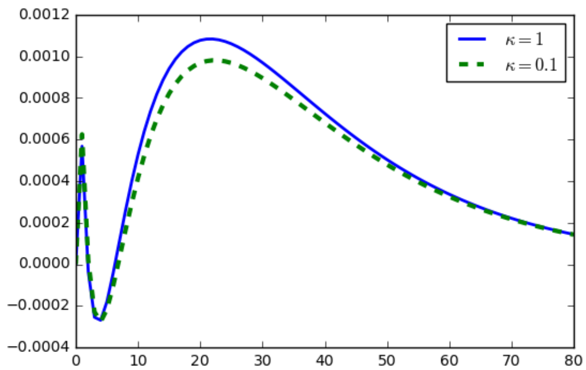
Figure C.8: Responses (percentage deviation) of extensive margin, intensive margin, and selection ($\sigma = 2.5$)



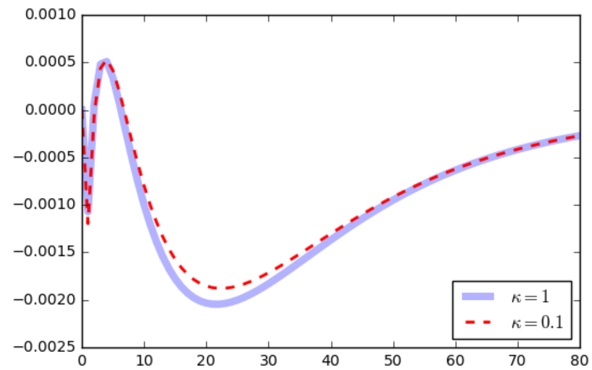
(a) Extensive margin ($1 - G(\bar{a}_{\kappa,t})$)



(b) Intensive margin ($\pi_{X,t}(\tilde{a}_X^{ss})$)

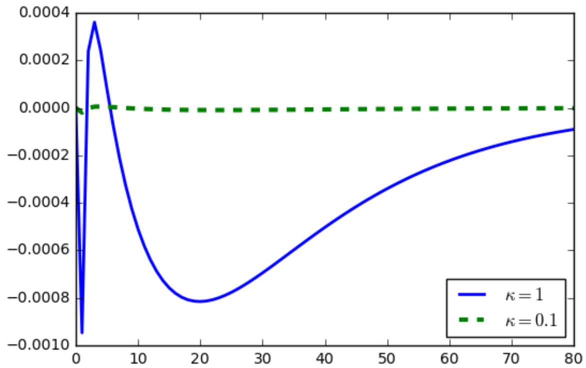


(c) Selection ($\tilde{a}_{X,t}$)

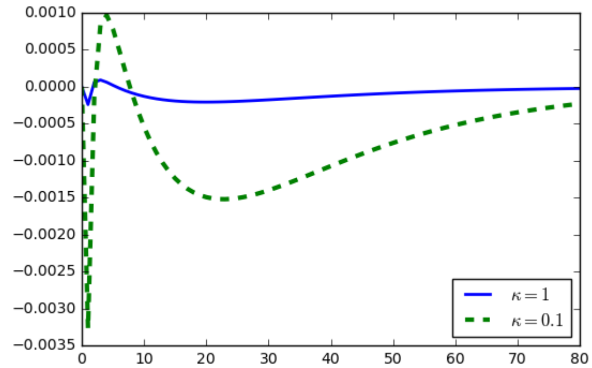


(d) Total export profit ($(1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t}$)

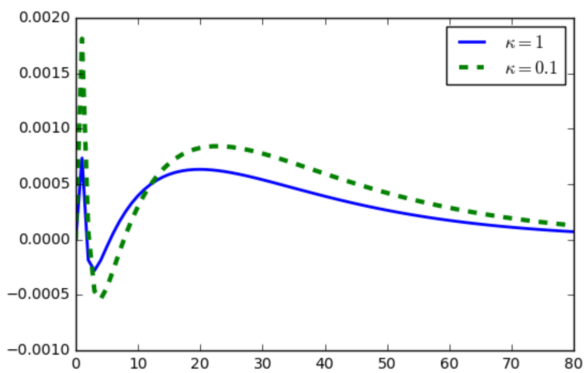
Figure C.9: Responses (level deviation) of extensive margin, intensive margin, and selection ($\sigma = 2.5$, $\alpha = 7.1$)



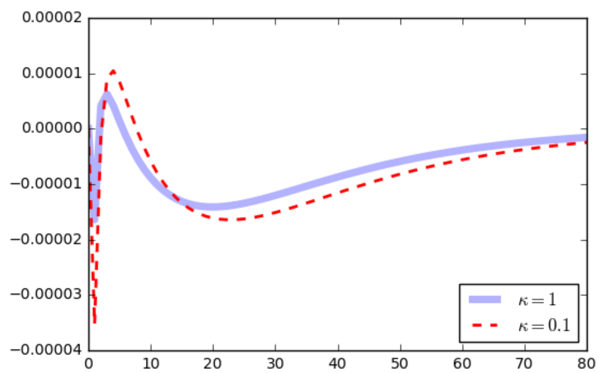
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

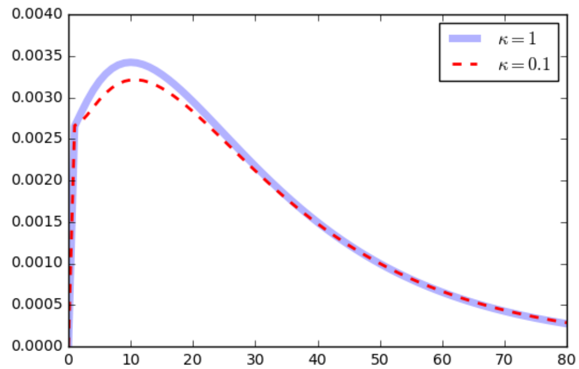


(c) Selection $(\tilde{a}_{X,t})$

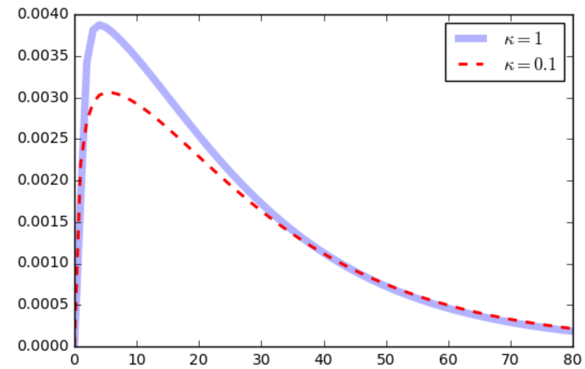


(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

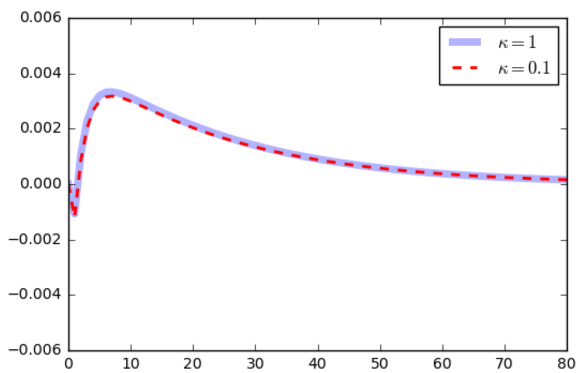
Figure C.10: Impulse responses with different α and κ ($\sigma = 2.5$)



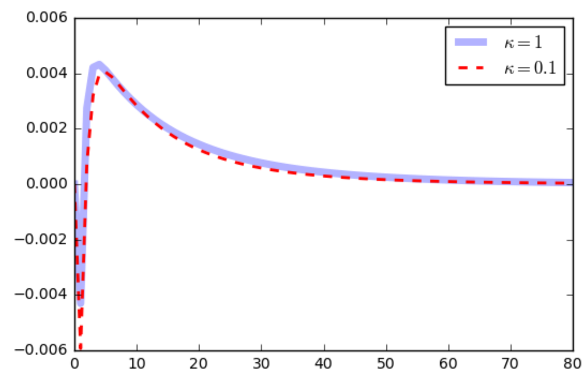
(a) GDP ($\alpha = 2.1$)



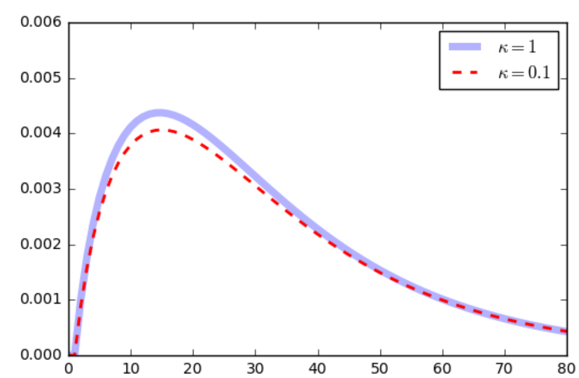
(b) GDP ($\alpha = 7.1$)



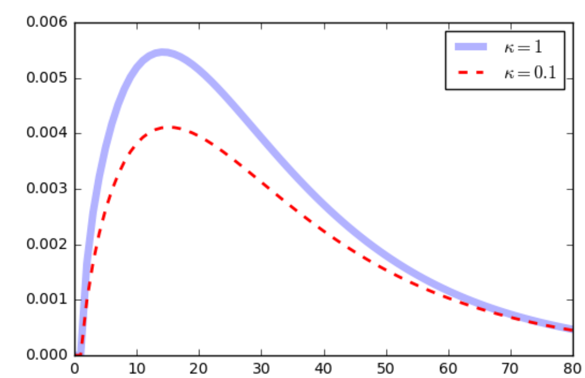
(c) X ($\alpha = 2.1$)



(d) X ($\alpha = 7.1$)

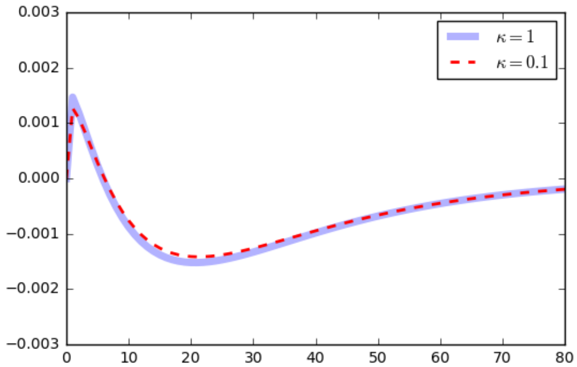


(e) M_D ($\alpha = 2.1$)

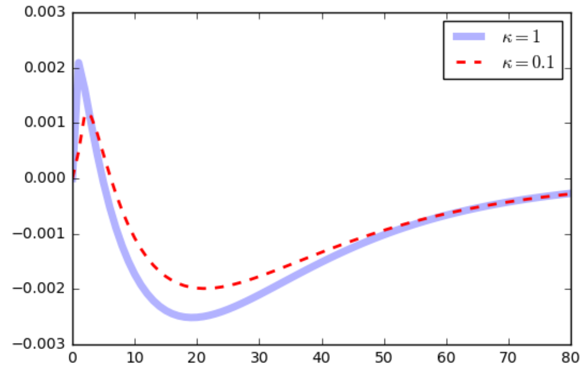


(f) M_D ($\alpha = 7.1$)

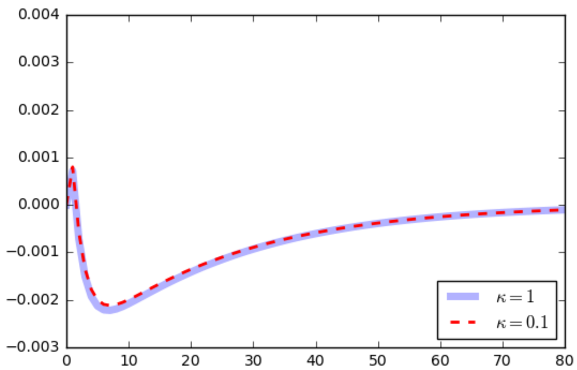
Figure A.10 (continued): Impulse responses with different α and κ ($\sigma = 2.5$)



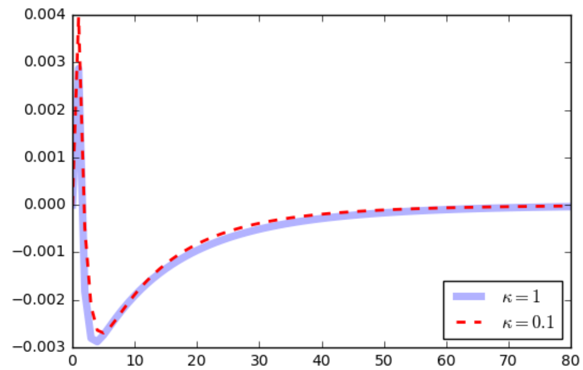
(g) $\tilde{\pi}$ ($\alpha = 2.1$)



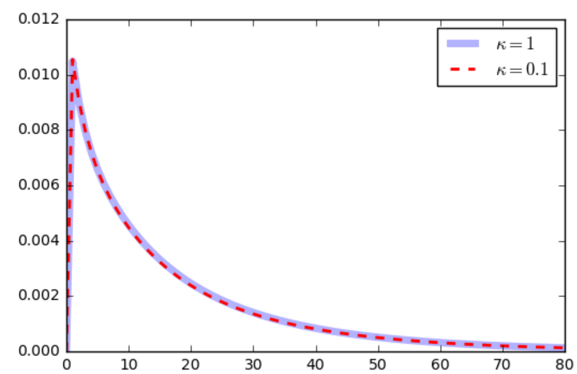
(h) $\tilde{\pi}$ ($\alpha = 7.1$)



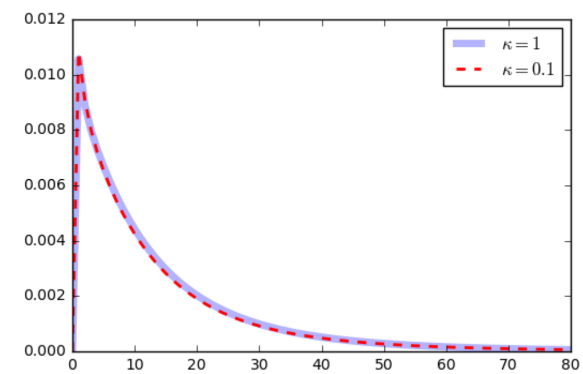
(i) P_X ($\alpha = 2.1$)



(j) P_X ($\alpha = 7.1$)



(k) W ($\alpha = 2.1$)



(l) W ($\alpha = 7.1$)

Figure C.11: Responses to a P^* shock of 1% ($\kappa = 1$)

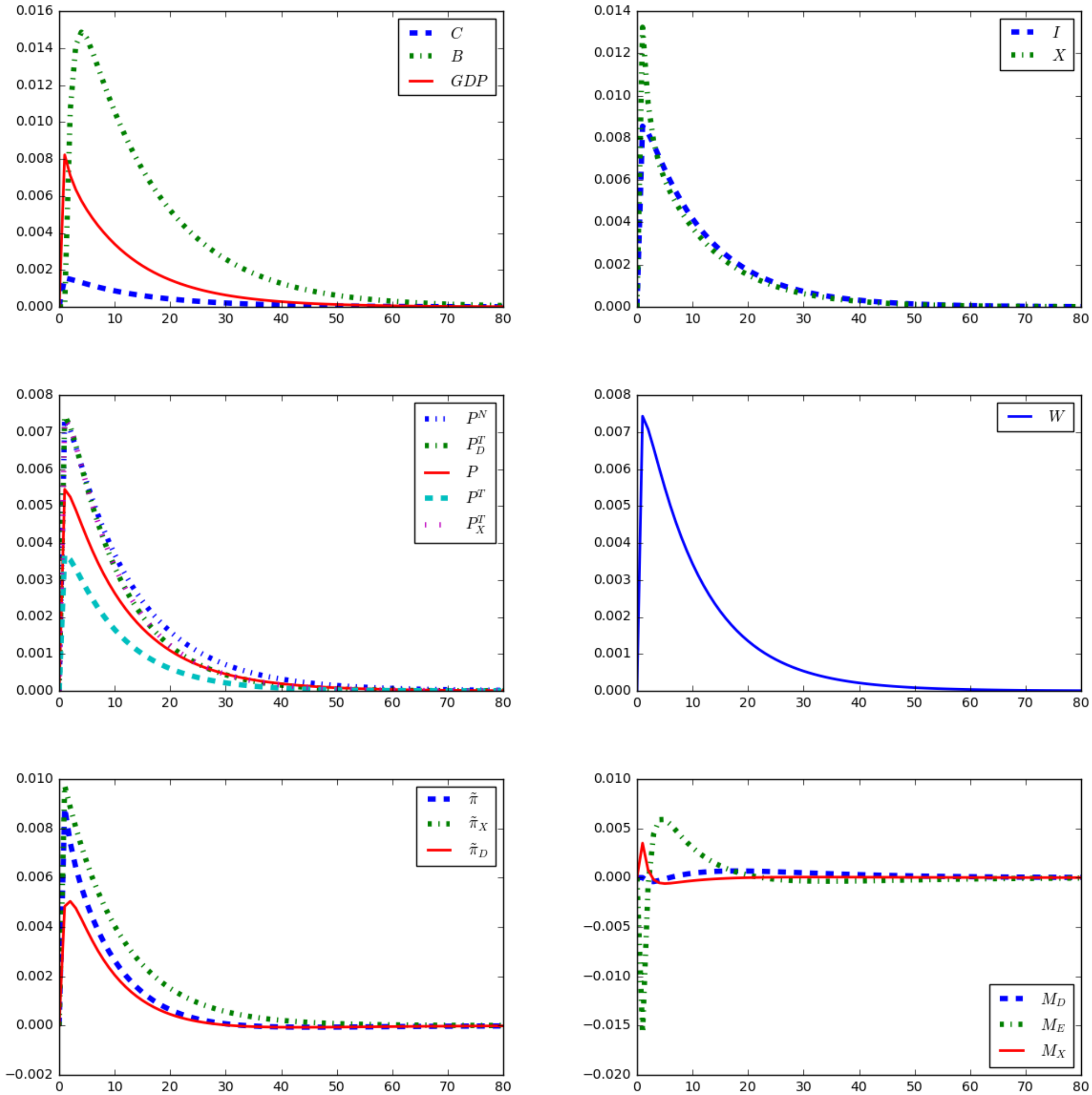


Figure C.12: Responses to a P^* shock of 1% ($\kappa = 0.1$)

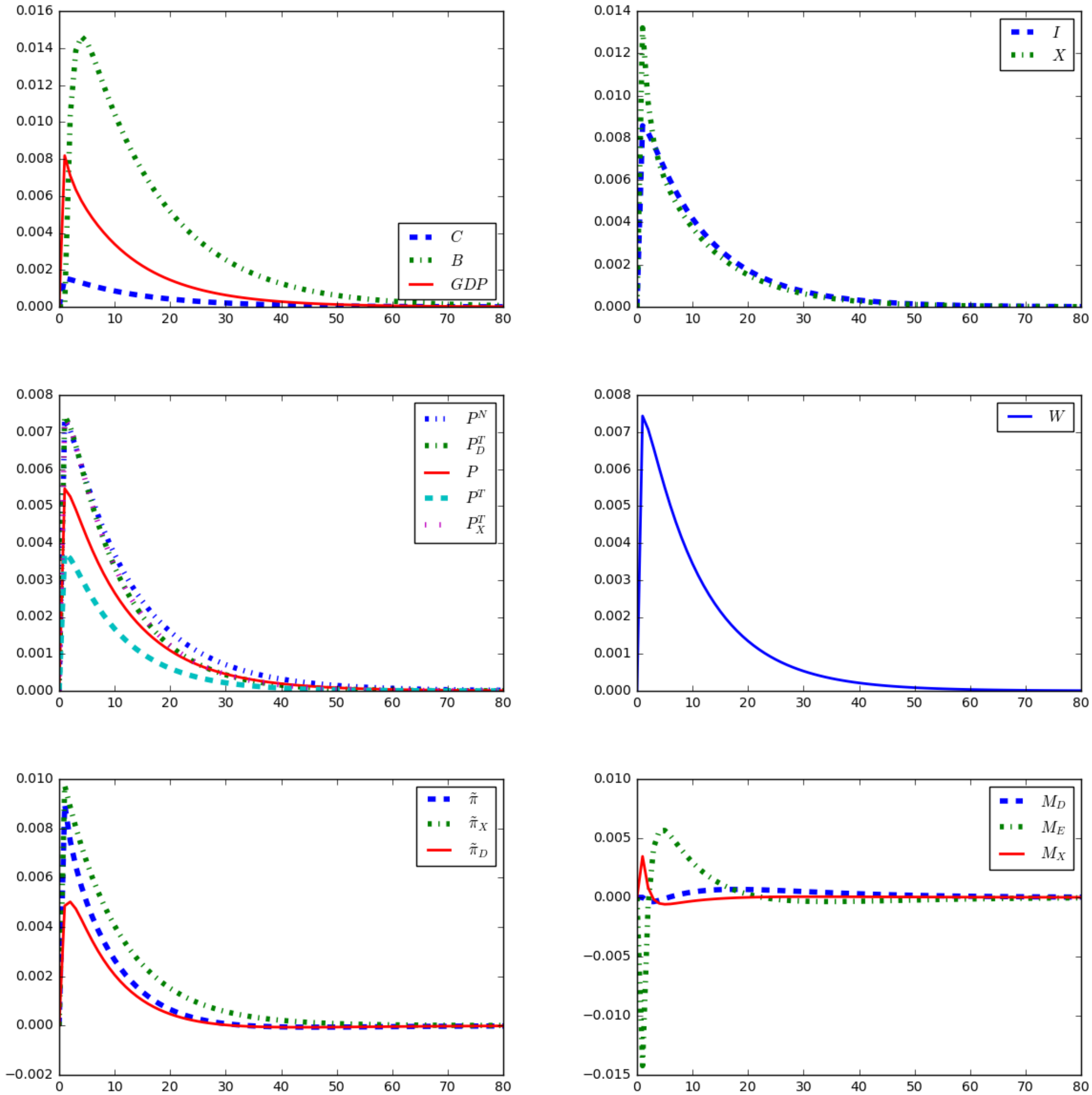
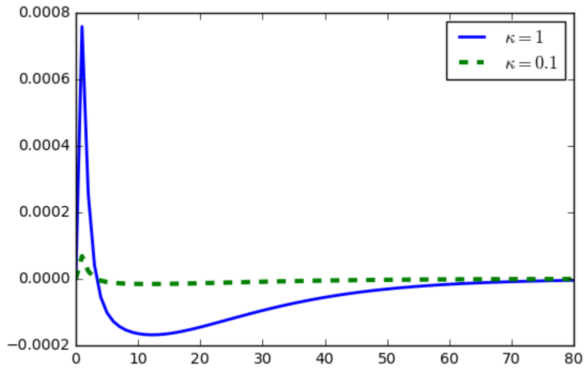
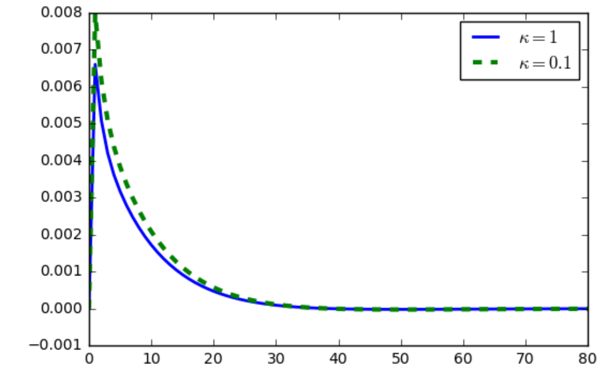


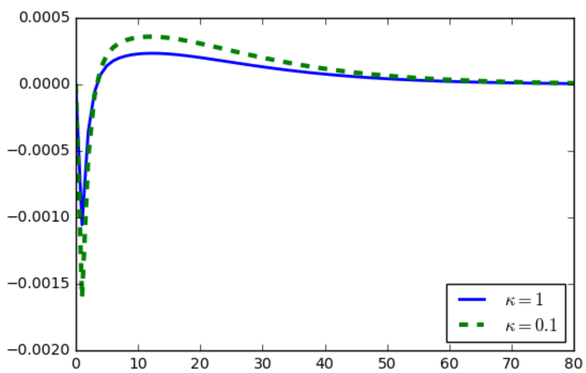
Figure C.13: Responses (level deviation) of extensive margin, intensive margin, and selection (P^* shock)



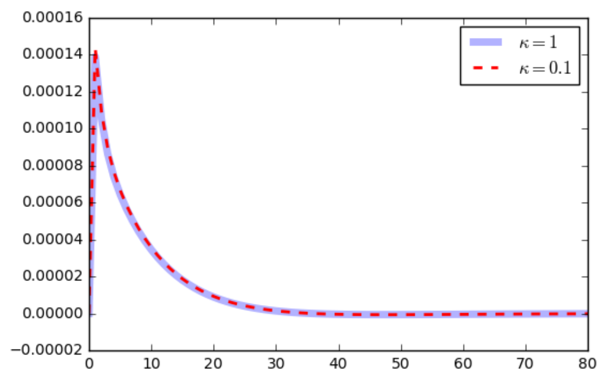
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

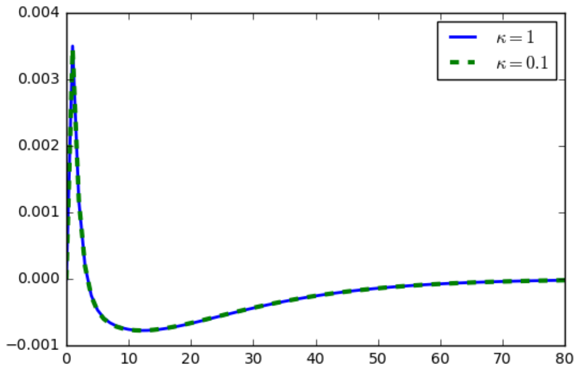


(c) Selection $(\tilde{a}_{X,t})$

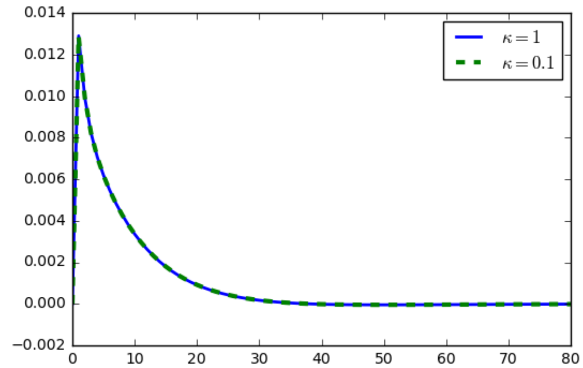


(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

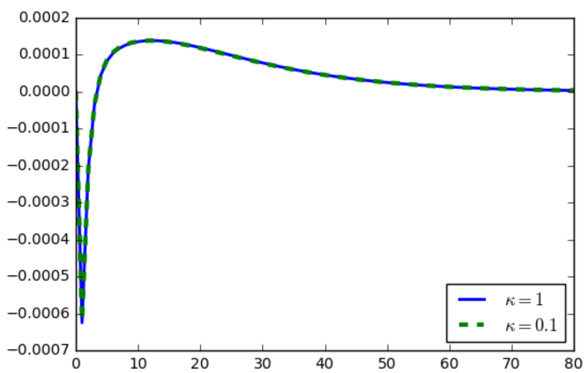
Figure C.14: Responses (percentage deviation) of extensive margin, intensive margin, and selection (P^* shock)



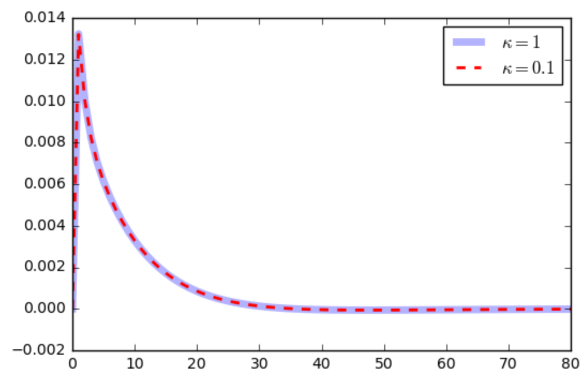
(a) Extensive margin ($1 - G(\bar{a}_{\kappa,t})$)



(b) Intensive margin ($\pi_{X,t}(\tilde{a}_X^{ss})$)



(c) Selection ($\tilde{a}_{X,t}$)



(d) Total export profit ($(1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t}$)

Figure C.15: Responses to an A shock of 1% with zero CA ($\kappa = 1$)

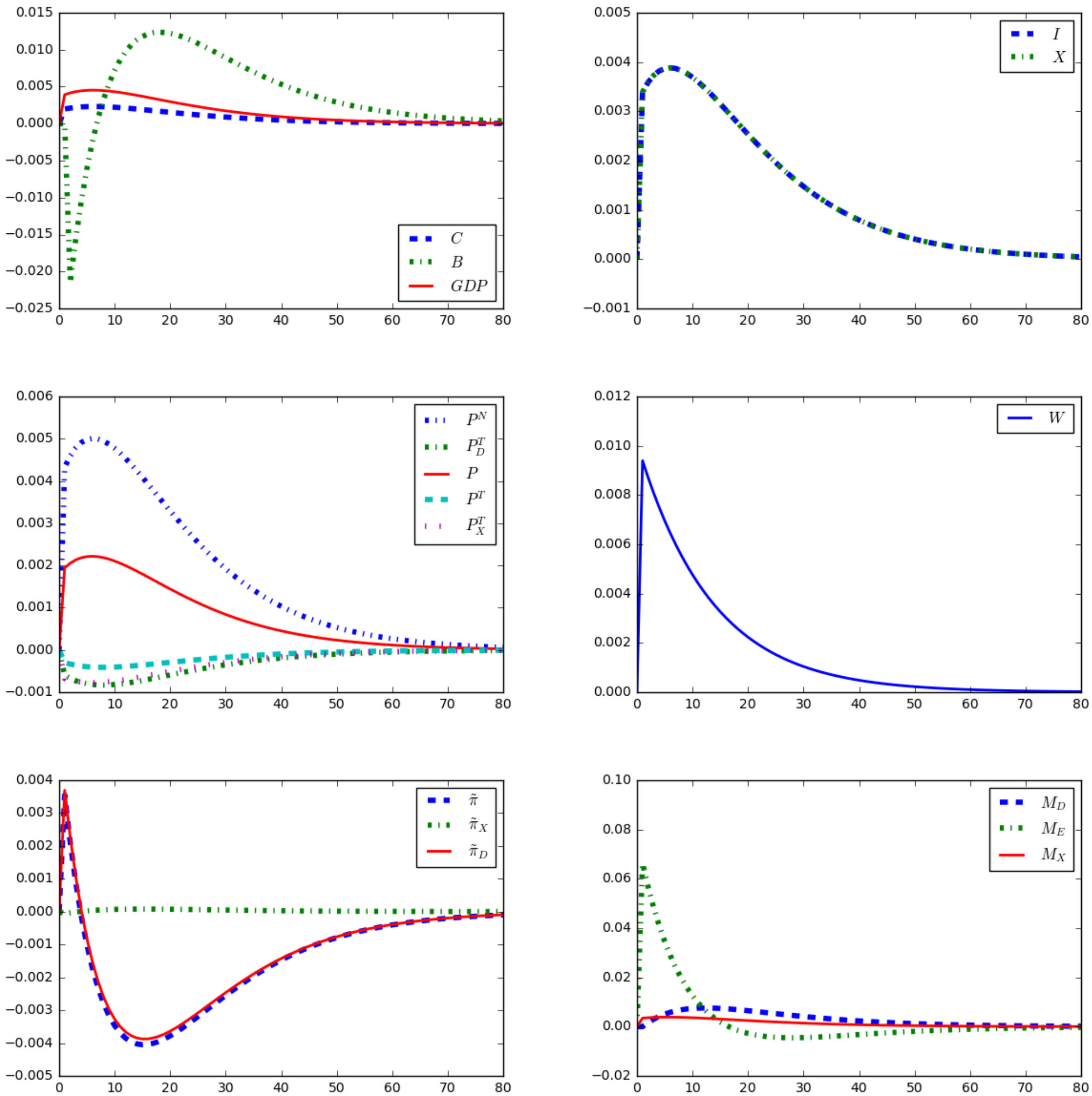


Figure C.16: Responses to an A shock of 1% with zero CA ($\kappa = 0.1$)

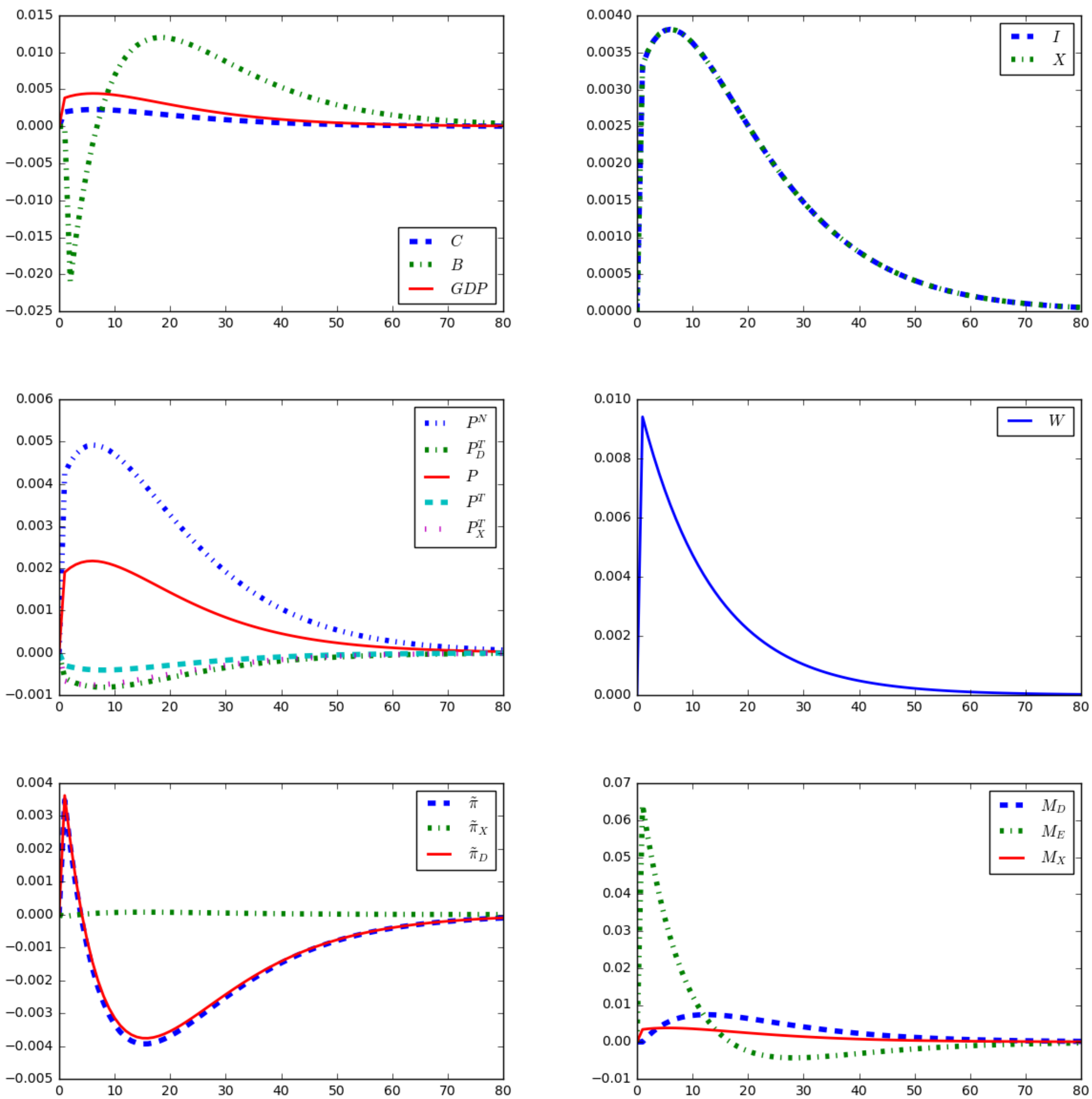
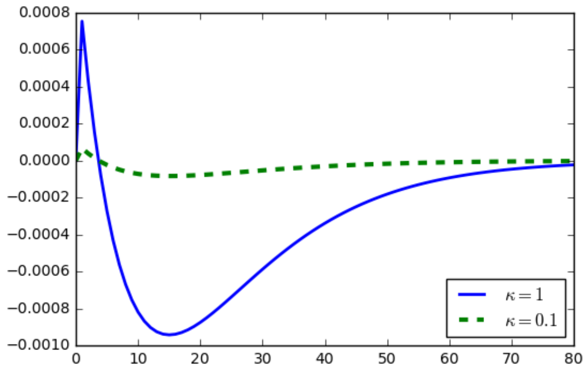
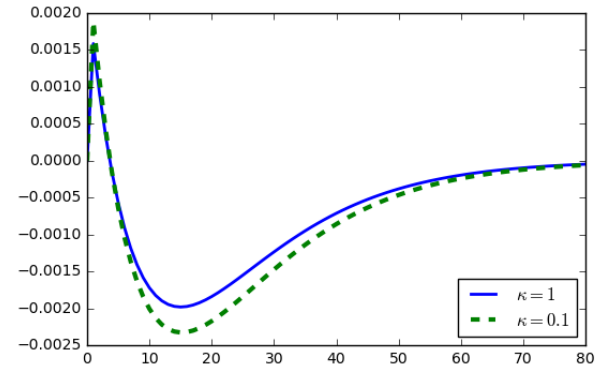


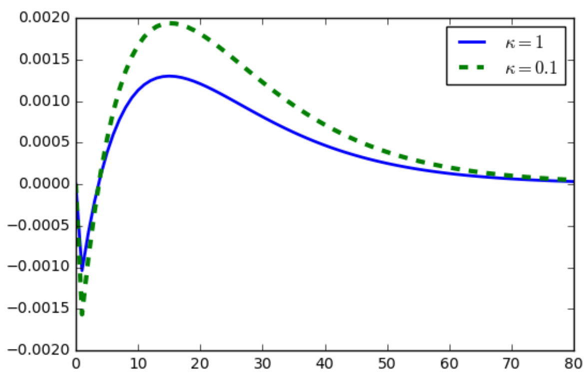
Figure C.17: Responses (level deviation) of extensive margin, intensive margin, and selection (zero CA)



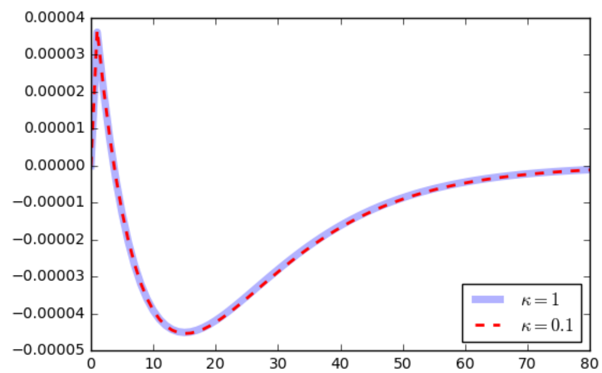
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

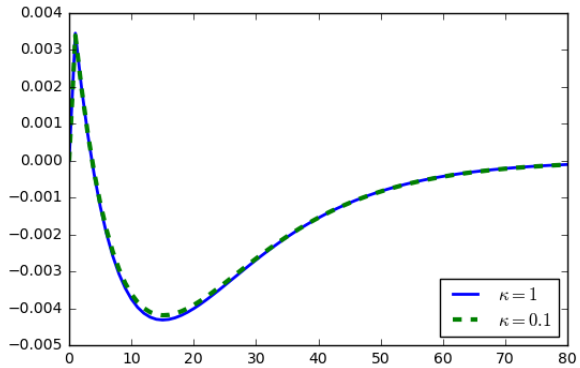


(c) Selection $(\tilde{a}_{X,t})$

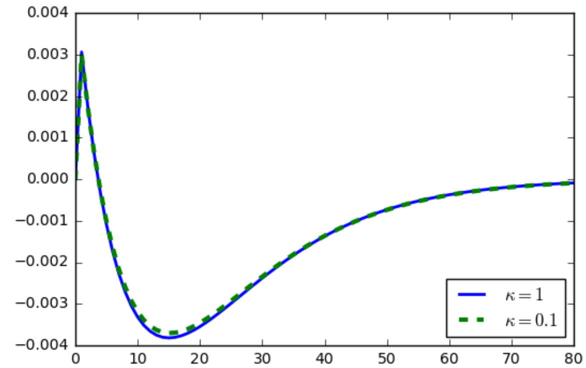


(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

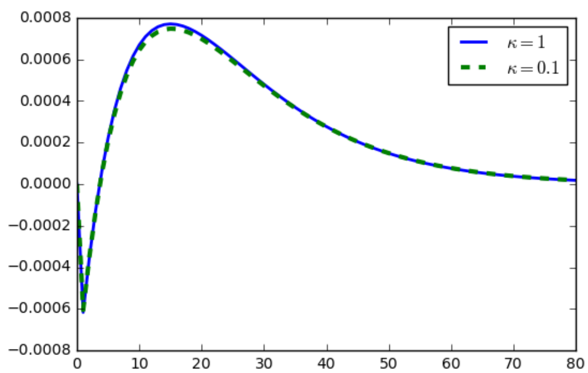
Figure C.18: Responses (percentage deviation) of extensive margin, intensive margin, and selection (zero CA)



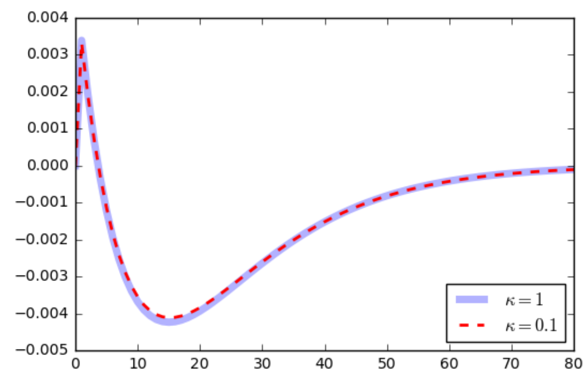
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$



(c) Selection $(\tilde{a}_{X,t})$



(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

Figure C.19: Responses to an A shock of 1% without the nontradable sector ($\kappa = 1$)

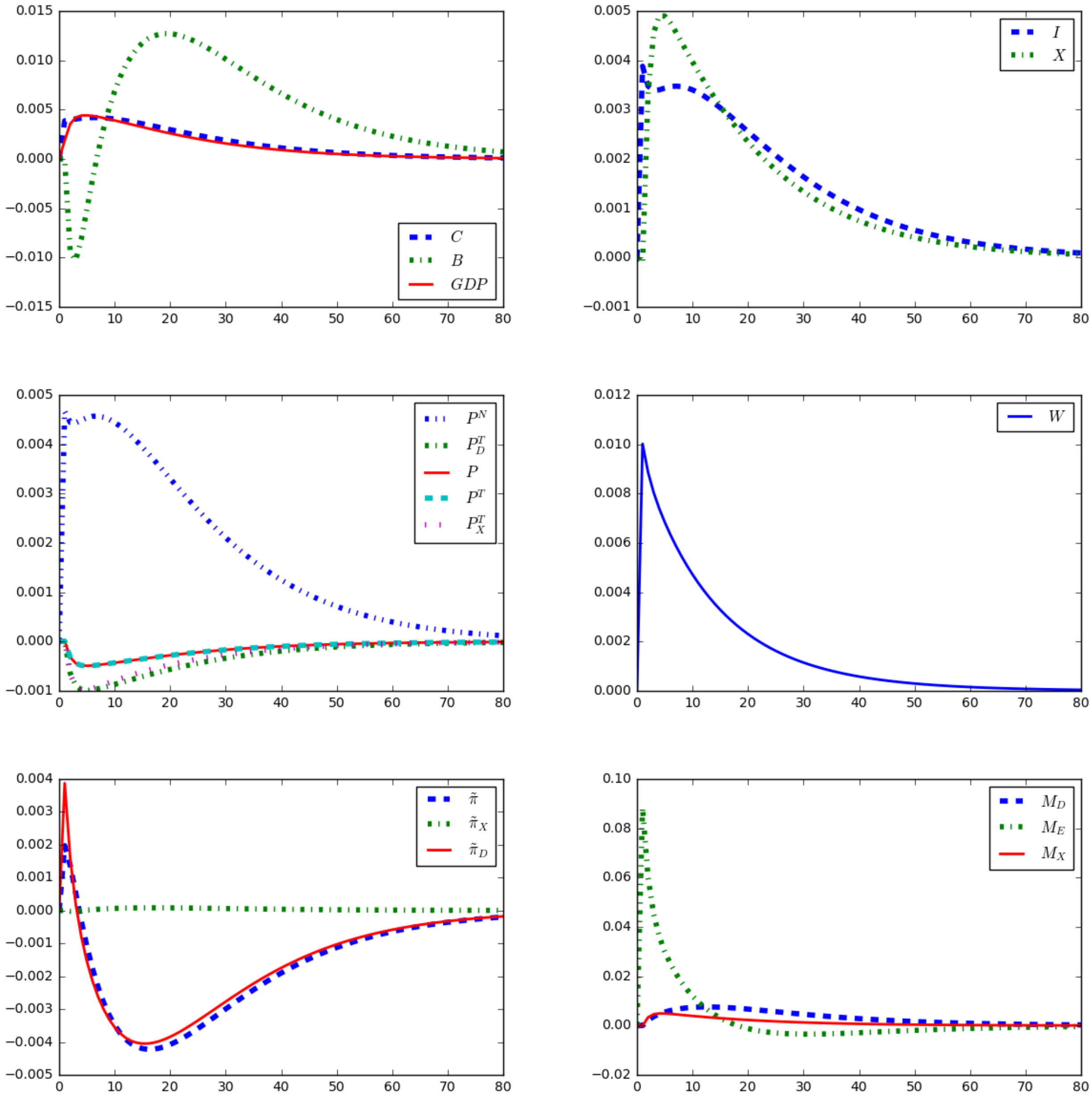


Figure C.20: Responses to an A shock of 1% without the nontradable sector ($\kappa = 0.1$)

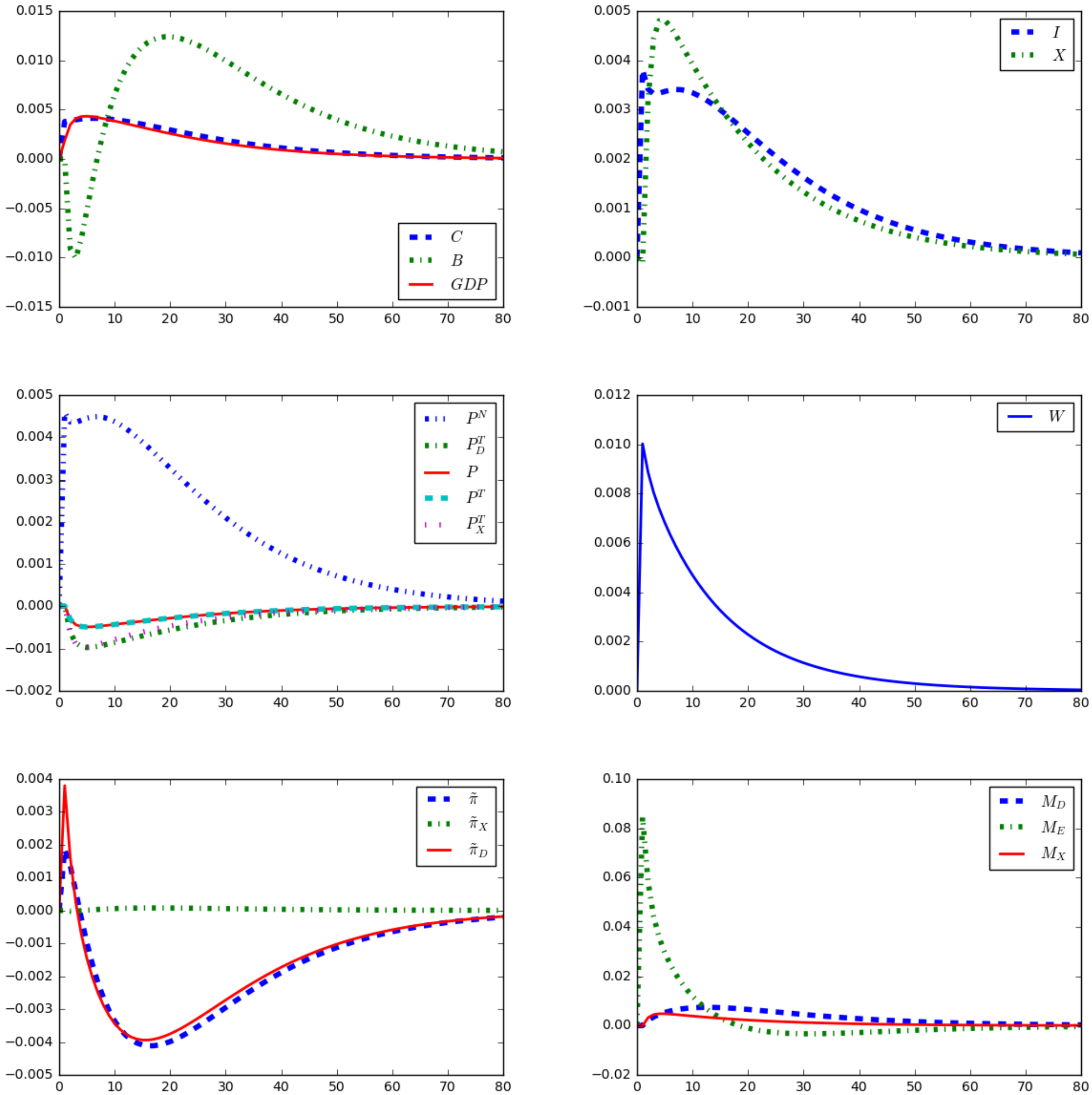
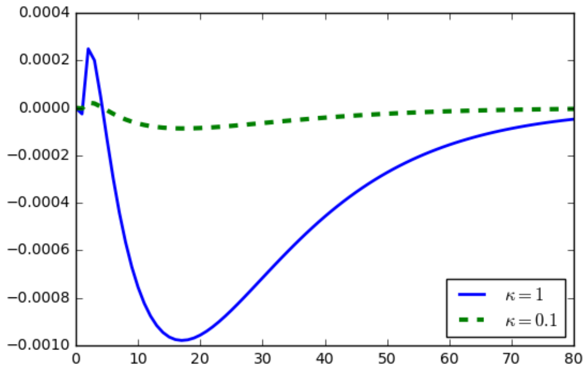
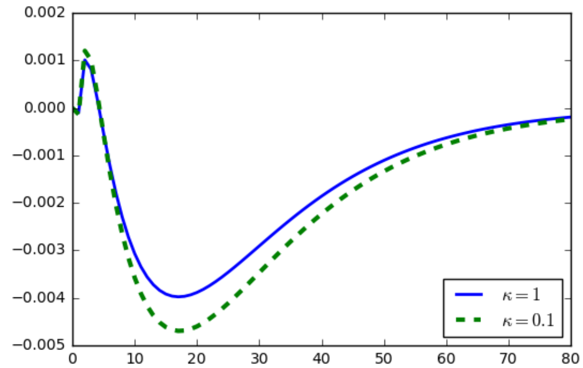


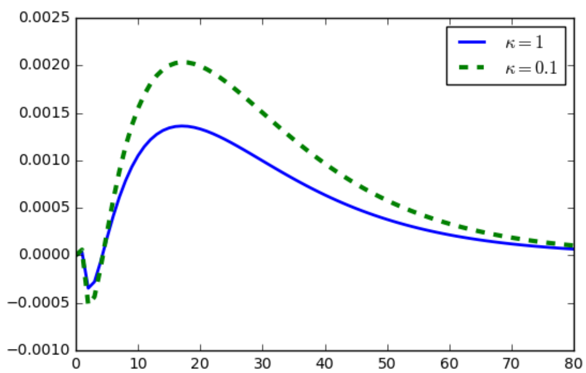
Figure C.21: Responses (level deviation) of extensive margin, intensive margin, and selection (without nontradables)



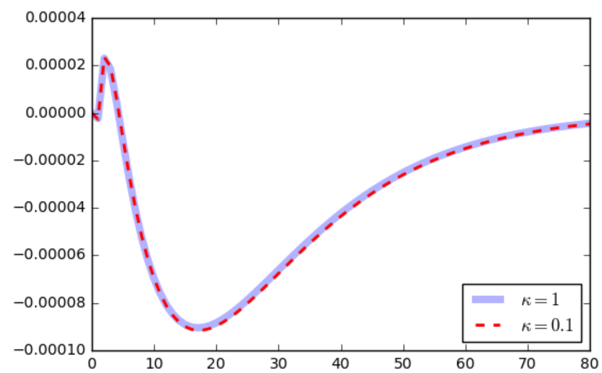
(a) Extensive margin $(1-G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

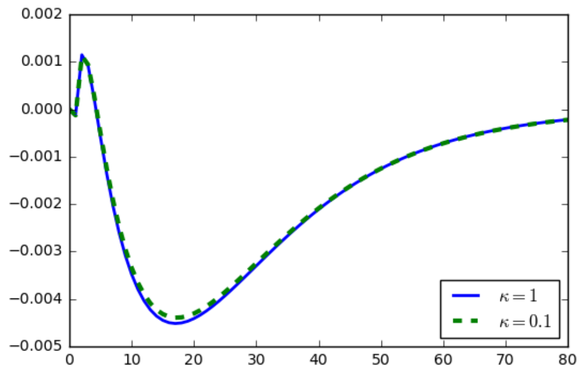


(c) Selection $(\tilde{a}_{X,t})$

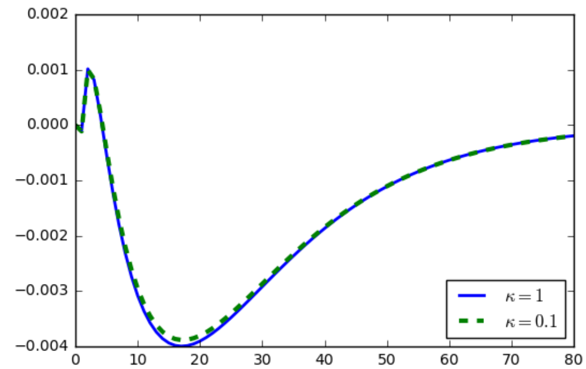


(d) Total export profit $((1-G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

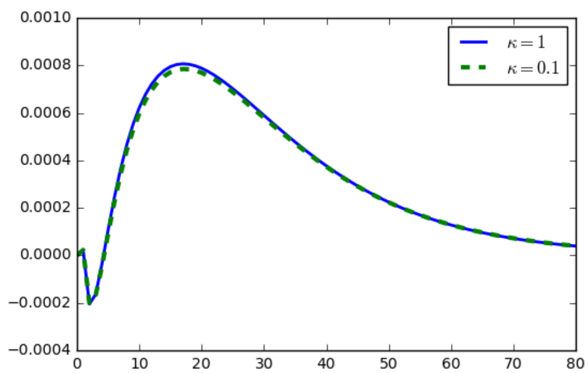
Figure C.22: Responses (percentage deviation) of extensive margin, intensive margin, and selection (without nontradables)



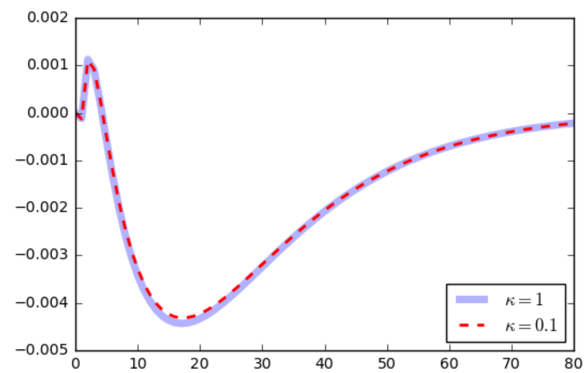
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$



(c) Selection $(\tilde{a}_{X,t})$



(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

Figure C.23: Responses to an A shock of 1% ($\kappa = 1$)

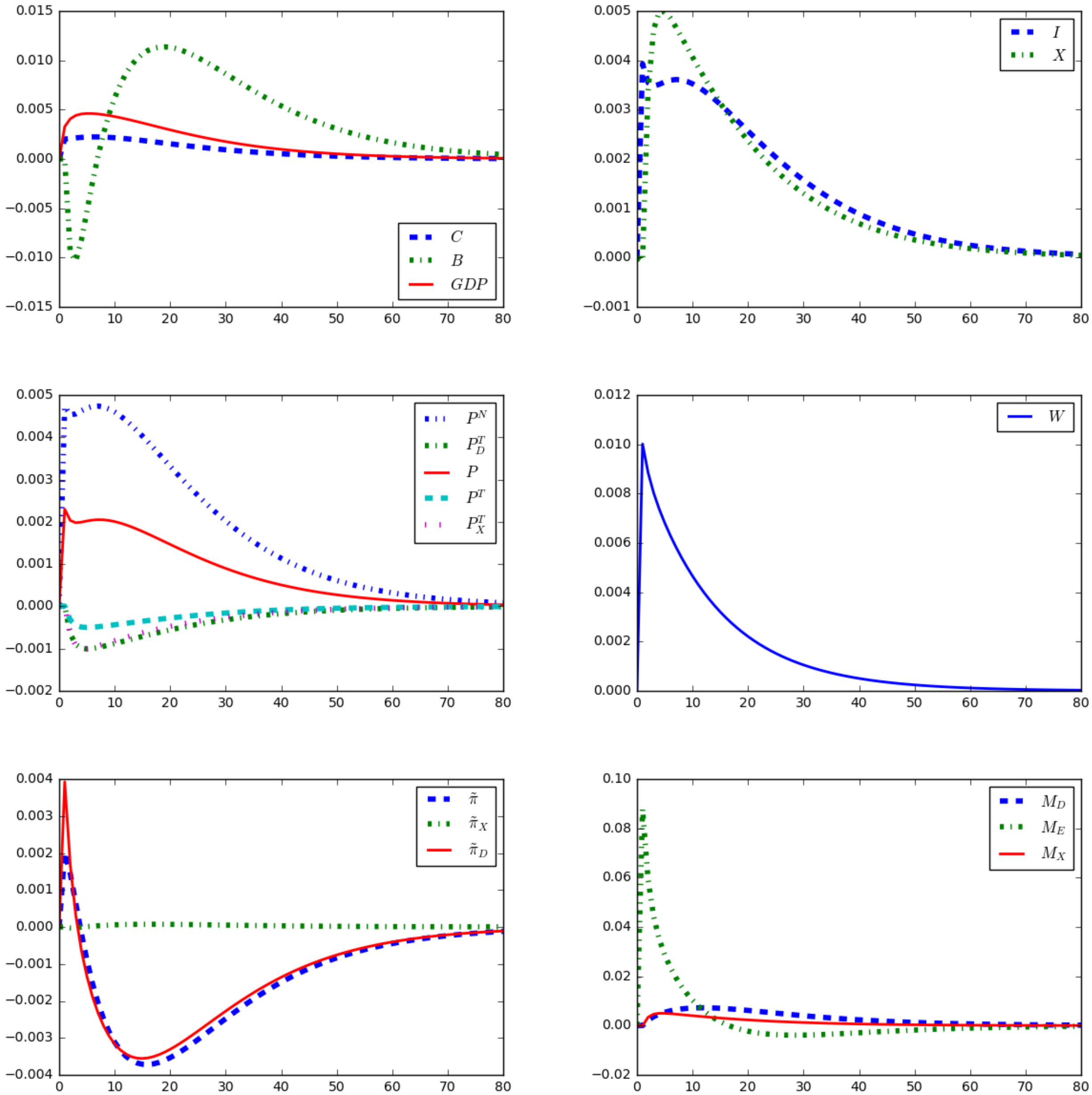


Figure C.24: Response to an A shock of 1% ($\kappa = 0.55$)

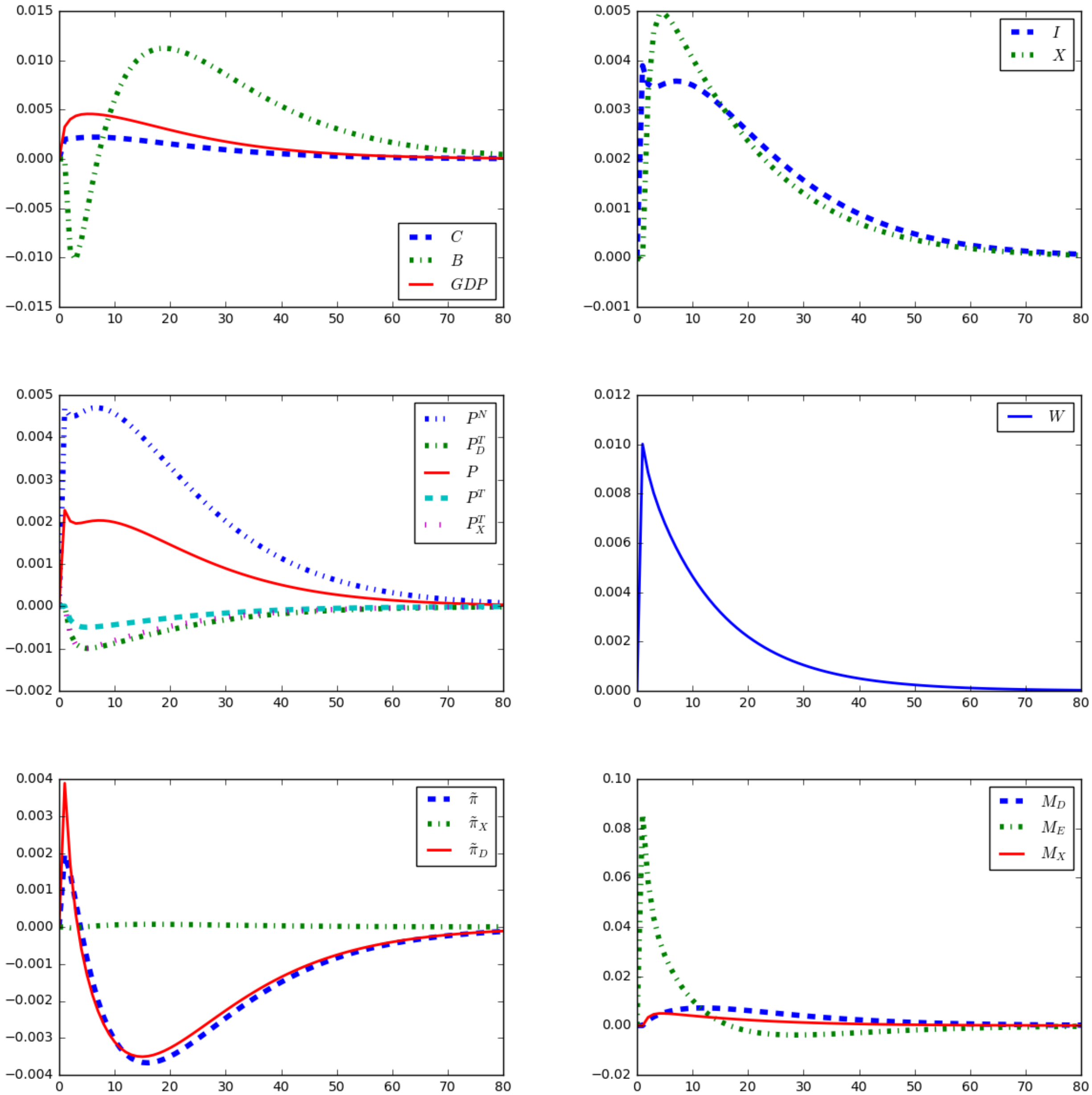
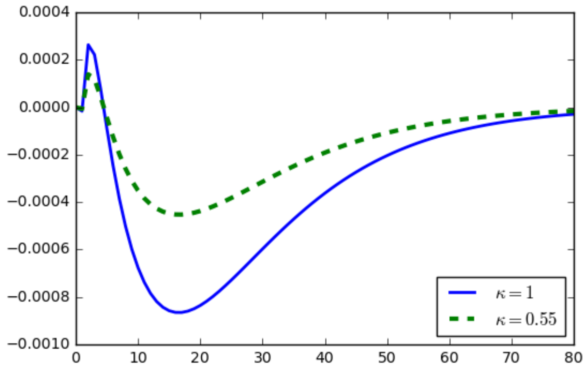
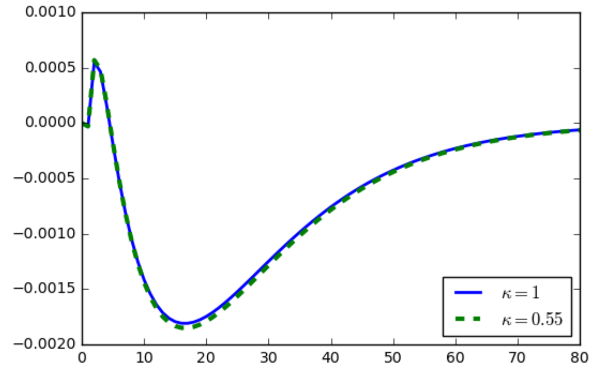


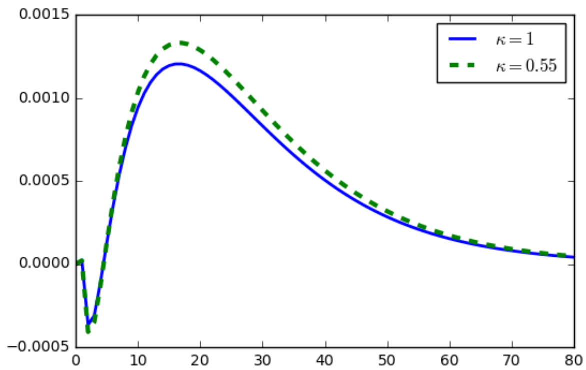
Figure C.25: Responses (level deviation) of extensive margin, intensive margin, and selection



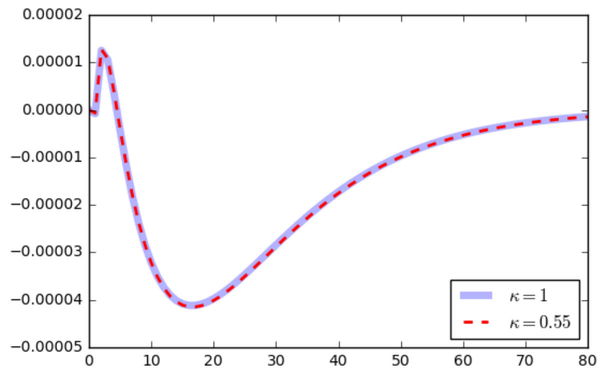
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

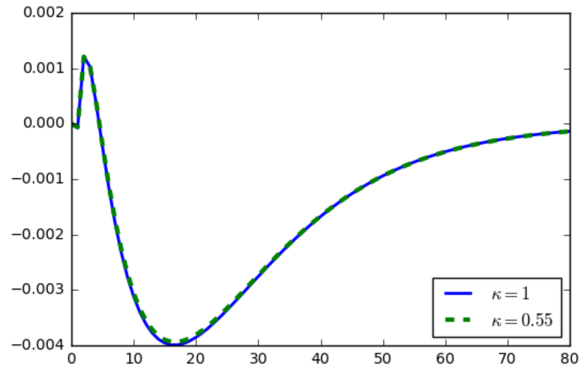


(c) Selection $(\tilde{a}_{X,t})$

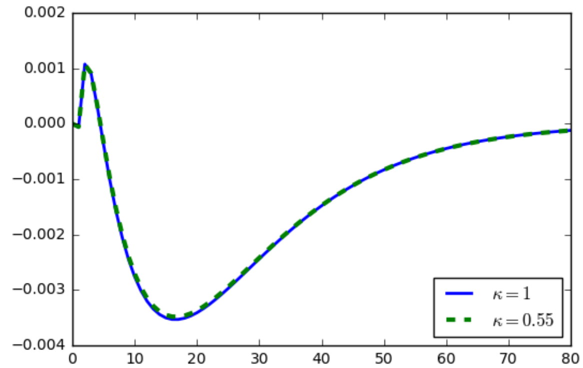


(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

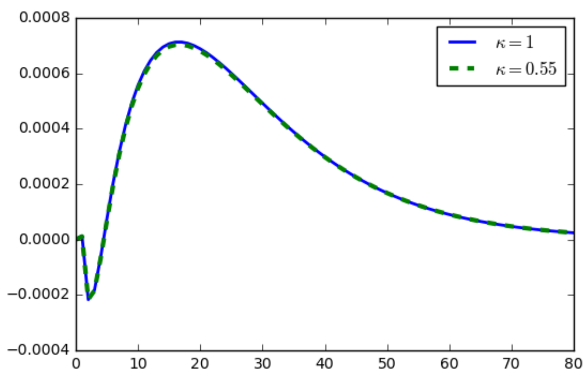
Figure C.26: Responses (percentage deviation) of extensive margin, intensive margin, and selection



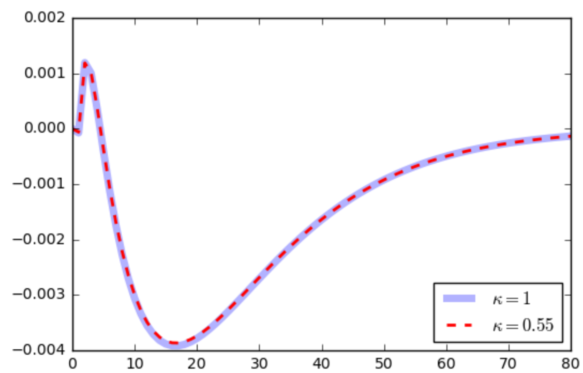
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$



(c) Selection $(\tilde{a}_{X,t})$



(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

Figure C.27: Responses to an A shock of 1% ($\kappa = 1$, $q_X^{rem} = 15$)

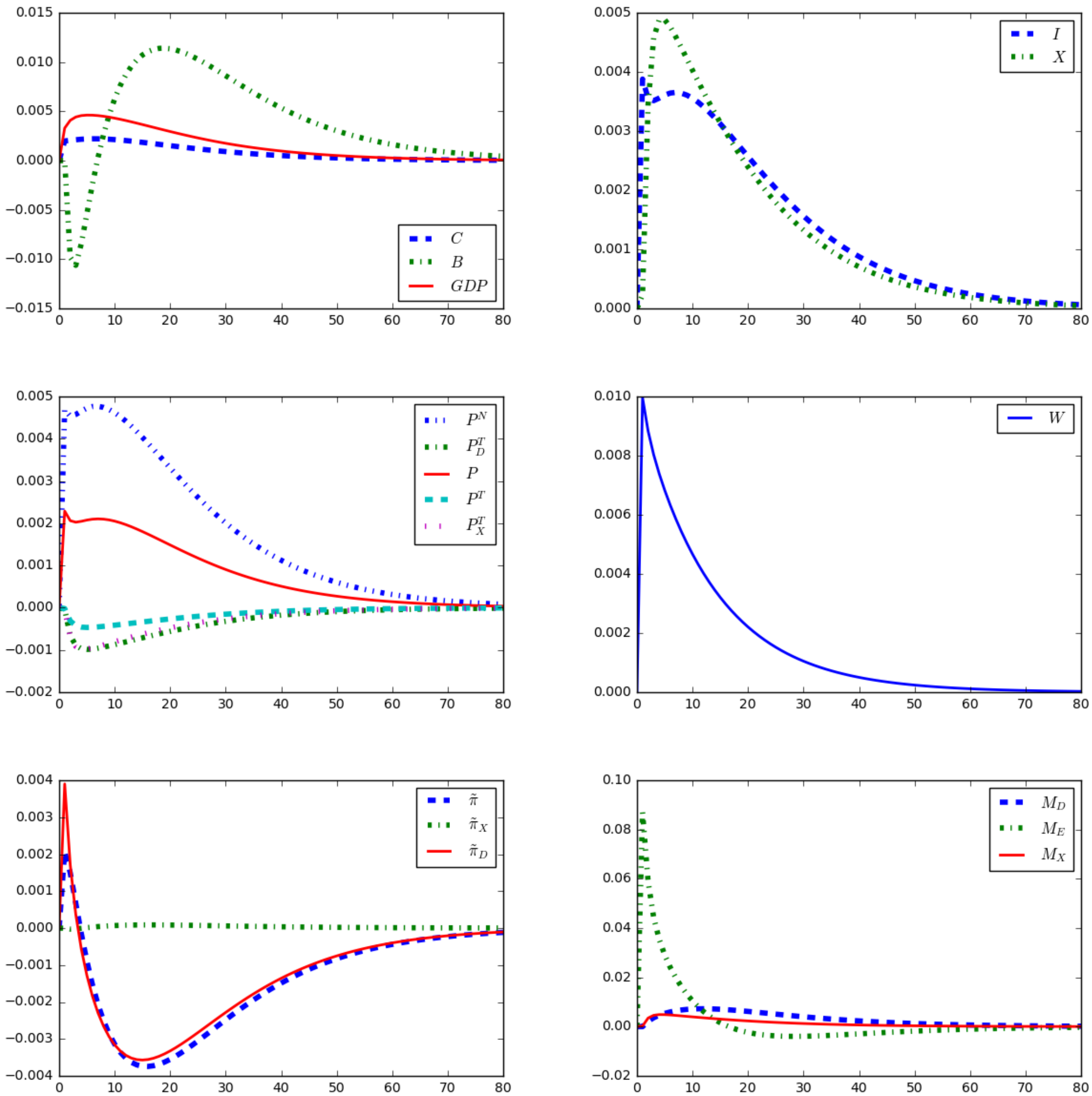


Figure C.28: Responses to an A shock of 1% ($\kappa = 0.1$, $q_X^{rem} = 15$)

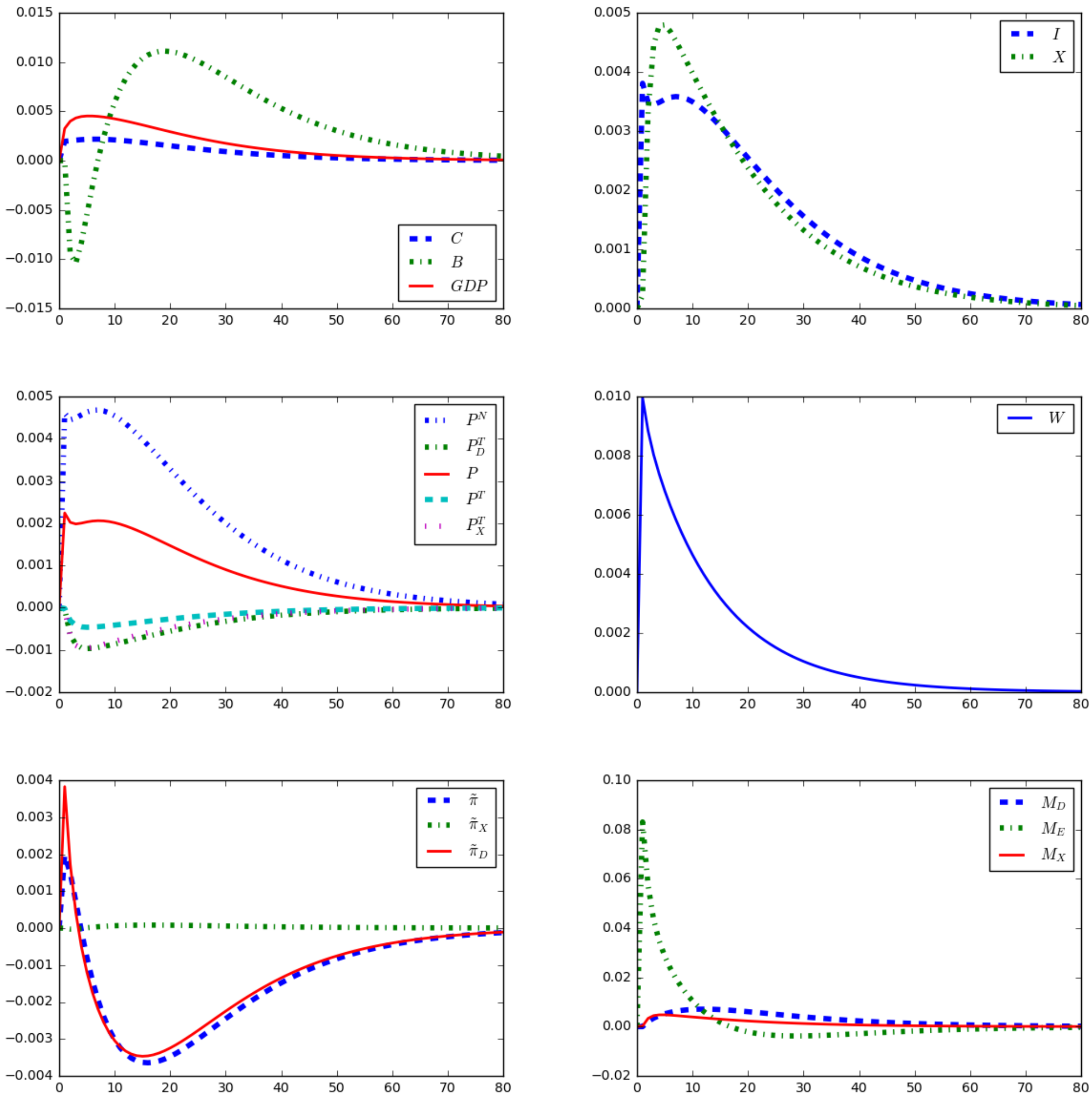
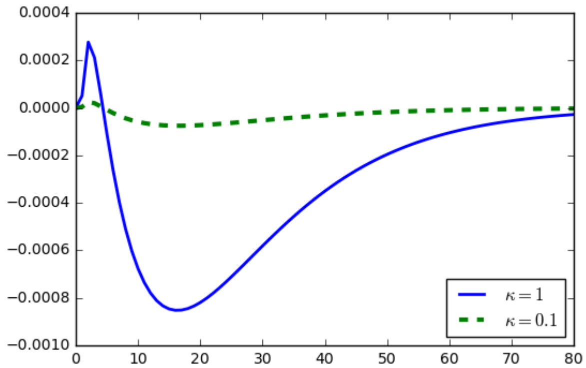
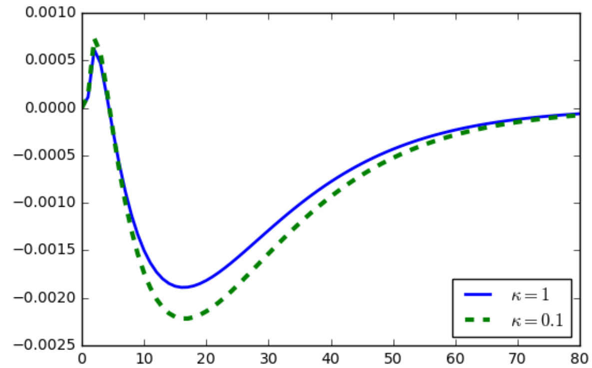


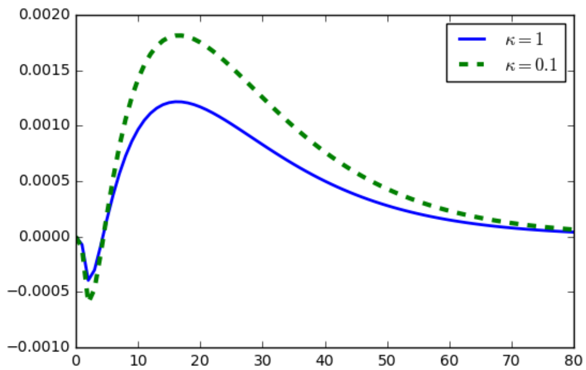
Figure C.29: Responses (level deviation) of extensive margin, intensive margin, and selection ($q_X^{rem} = 15$)



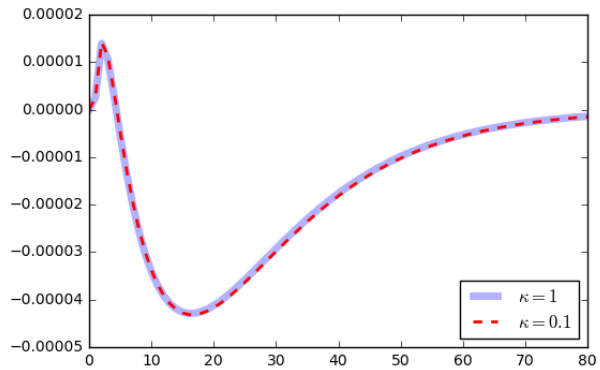
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

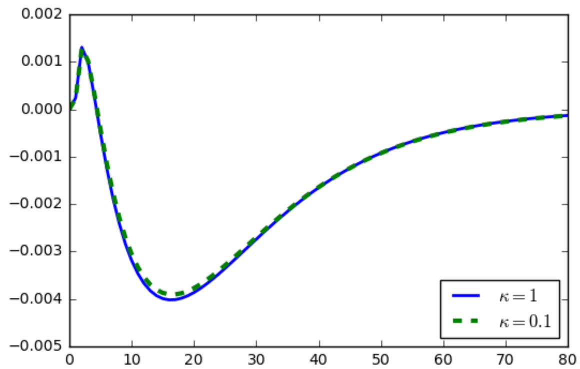


(c) Selection $(\tilde{a}_{X,t})$

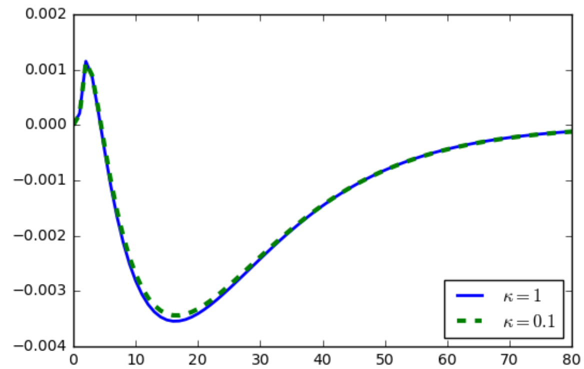


(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t})$

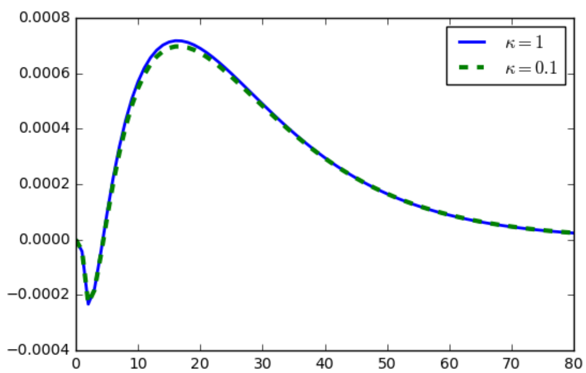
Figure C.30: Responses (percentage deviation) of extensive margin, intensive margin, and selection ($q_X^{rem} = 15$)



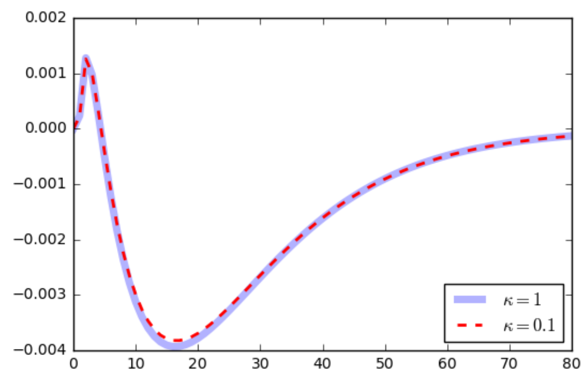
(a) Extensive margin ($1 - G(\bar{a}_{\kappa,t})$)



(b) Intensive margin ($\pi_{X,t}(\tilde{a}_X^{ss})$)



(c) Selection ($\tilde{a}_{X,t}$)



(d) Total export profit ($(1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{X,t}$)

Figure C.31: Responses to an A shock of 1% (GHH, $\lambda = 0.001$, $\kappa = 1$)

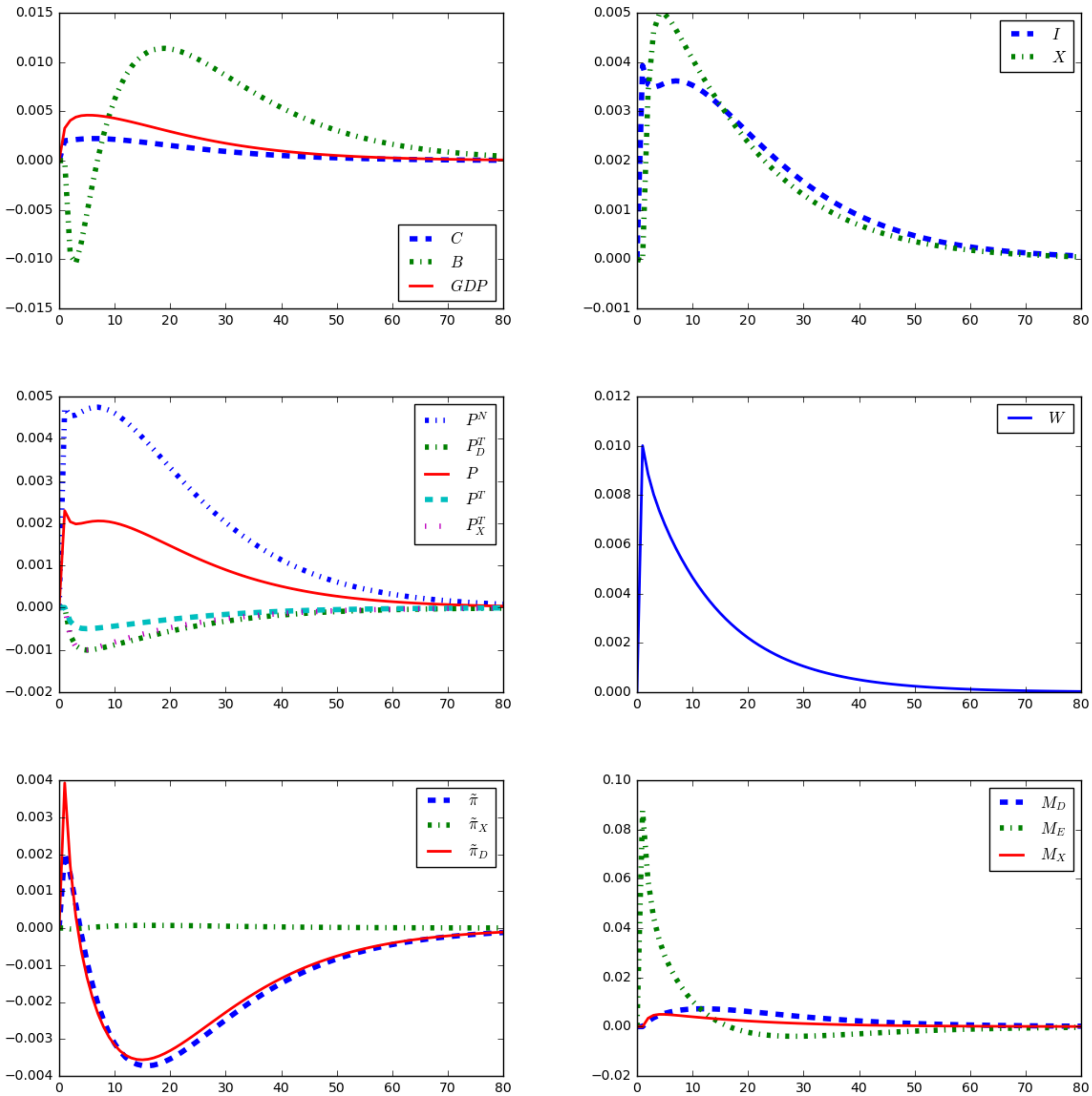


Figure C.32: Responses to an A shock of 1% (GHH, $\lambda = 0.001$, $\kappa = 0.1$)

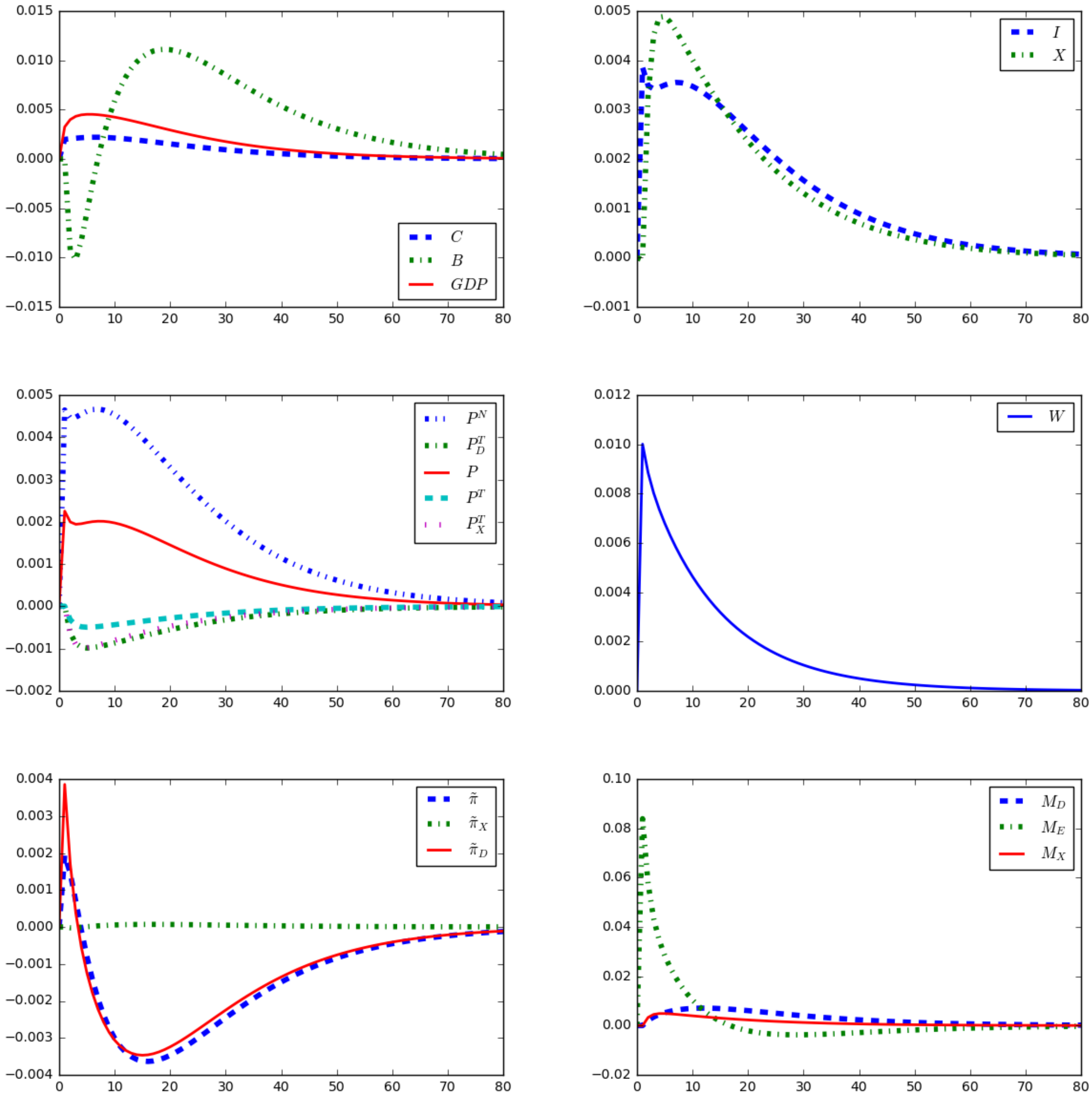
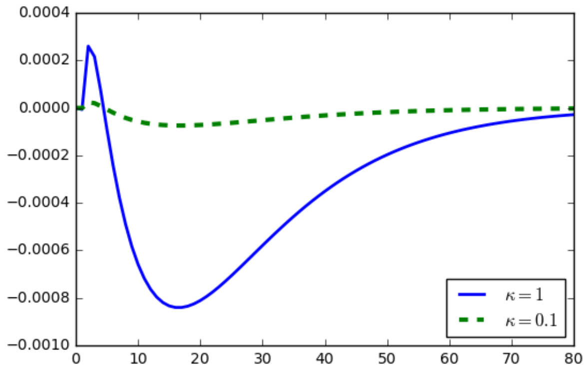
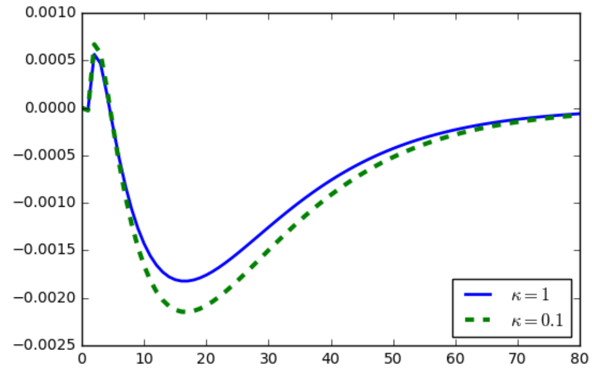


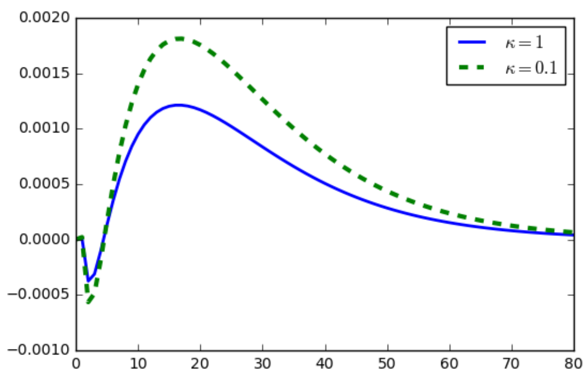
Figure C.33: Responses (level deviation) of extensive margin, intensive margin, and selection (GHH, $\lambda = 0.001$)



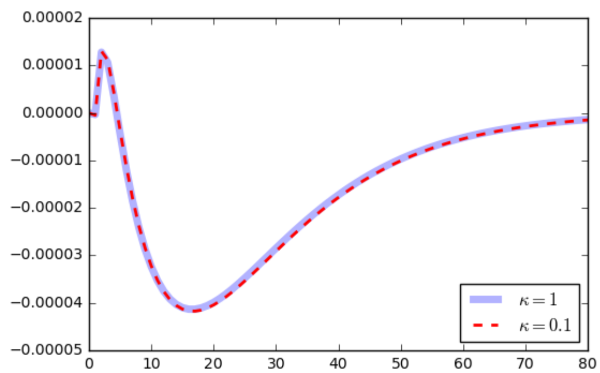
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

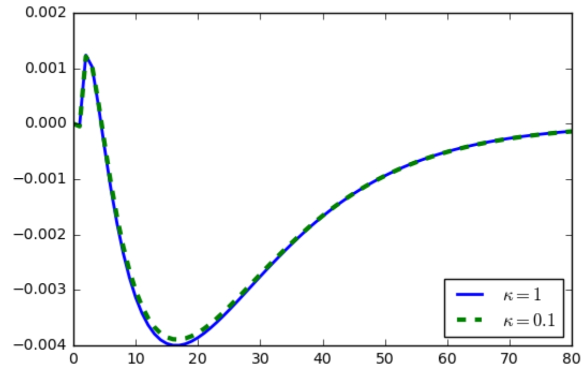


(c) Selection $(\tilde{a}_{X,t})$

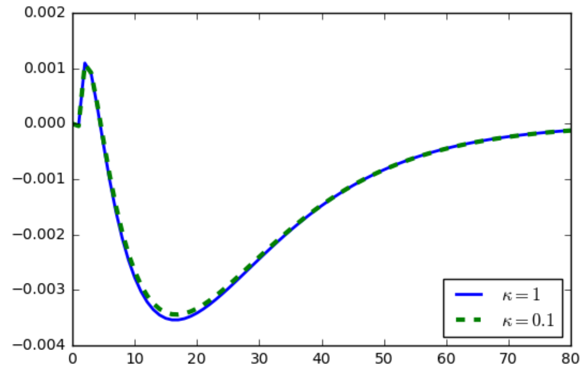


(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{\kappa,t})$

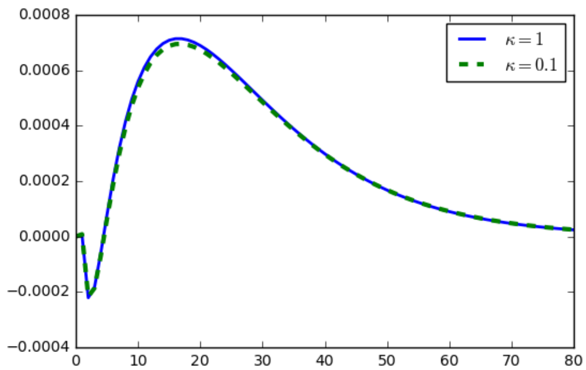
Figure C.34: Responses (percentage deviation) of extensive margin, intensive margin, and selection (GHH, $\lambda = 0.001$)



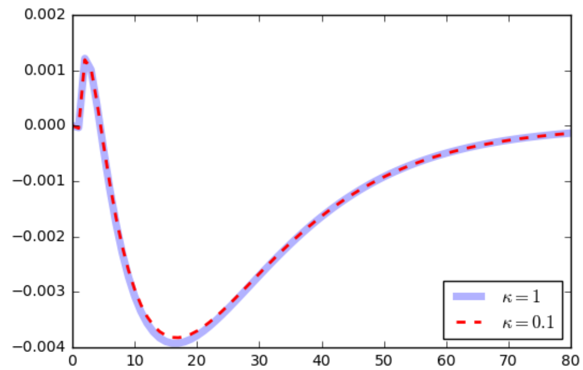
(a) Extensive margin $(1 - G(\bar{a}_{\kappa,t}))$



(b) Intensive margin $(\pi_{X,t}(\tilde{a}_X^{ss}))$

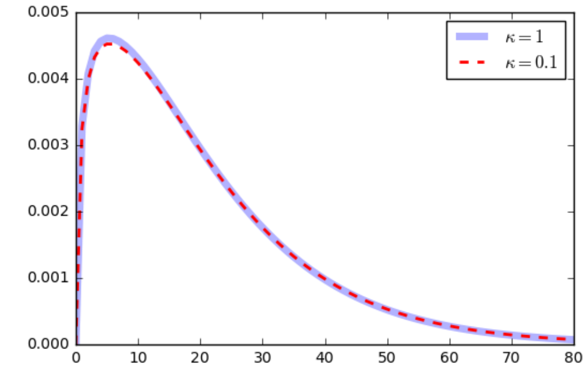


(c) Selection $(\tilde{a}_{X,t})$

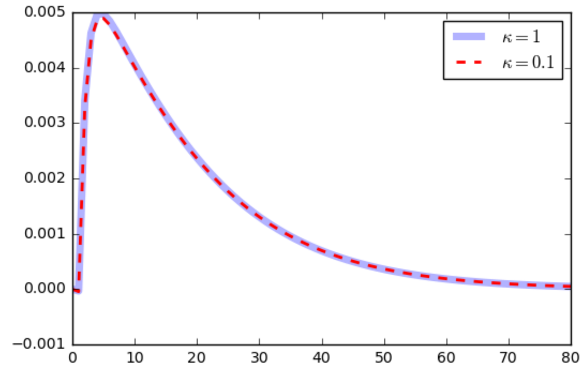


(d) Total export profit $((1 - G(\bar{a}_{\kappa,t}))\tilde{\pi}_{\kappa,t})$

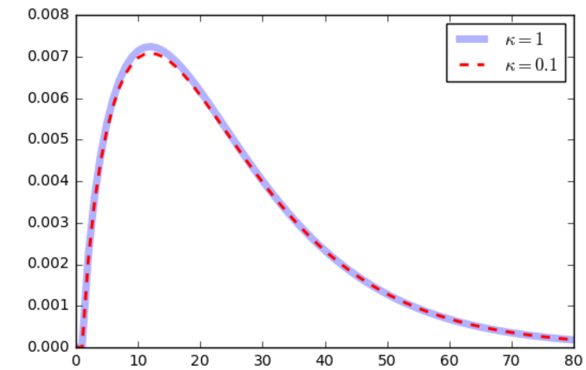
Figure C.35: Impulse responses (GHH, $\lambda = 0.001$)



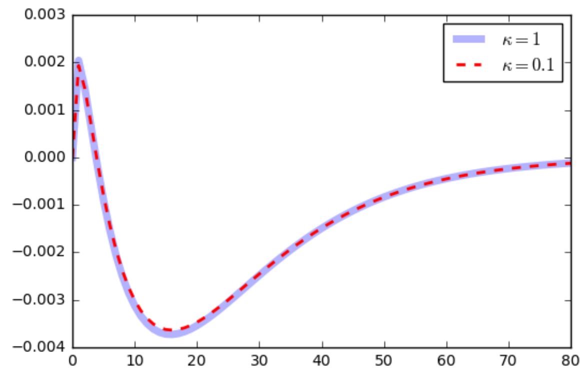
(a) GDP



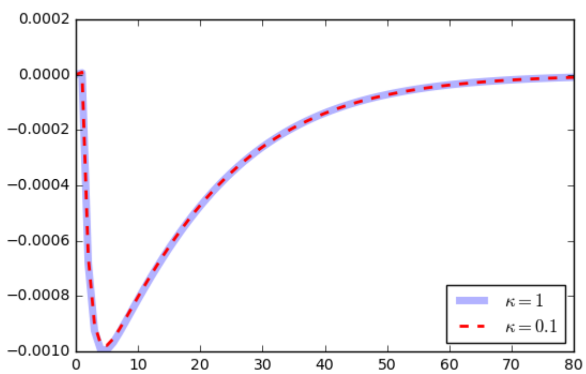
(b) X



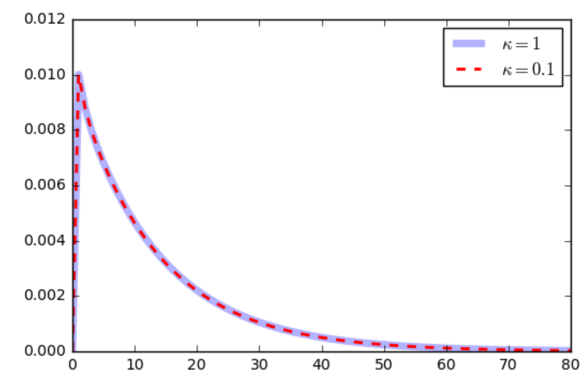
(c) M_D



(d) $\tilde{\pi}$



(e) P_X



(f) W