Export subsidies, Consumption Inequality, and Current Account Imbalances

submitted by

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January, 2026

Abstract

This paper studies how export subsidies affect the current-account balance and contribute to a more equitable distribution of consumption in a small open economy. Using a Two-Agent New Keynesian (TANK) model, I show that, in the flexible-price equilibrium, the goods trade balance deficit may be eliminated by adopting export incentive programs. These programs simultaneously cause welfare losses; however, in the future consumption levels are expected to be higher due to a stronger net foreign asset position. Relying on a simple theoretical framework, I find an indirect effect: export subsidies lead to a more efficient redistribution of consumption between richer and poorer households. More specifically, compared with a zero-export-subsidy policy, the average consumption gap decreases by 1% under unilateral export-subsidy programs targeted at households with access to financial markets when the elasticity of substitution between traded and non-traded goods is 0.74. The finding indicates that, despite the primary function of consumption-driven current account adjustments, export subsidies result in more equitable consumption in an economy.

Export subsidies; Current account; Ricardian vs. hand-to-mouth households; Consumption inequality; Welfare analysis; Small open economy

F32, F41, E52

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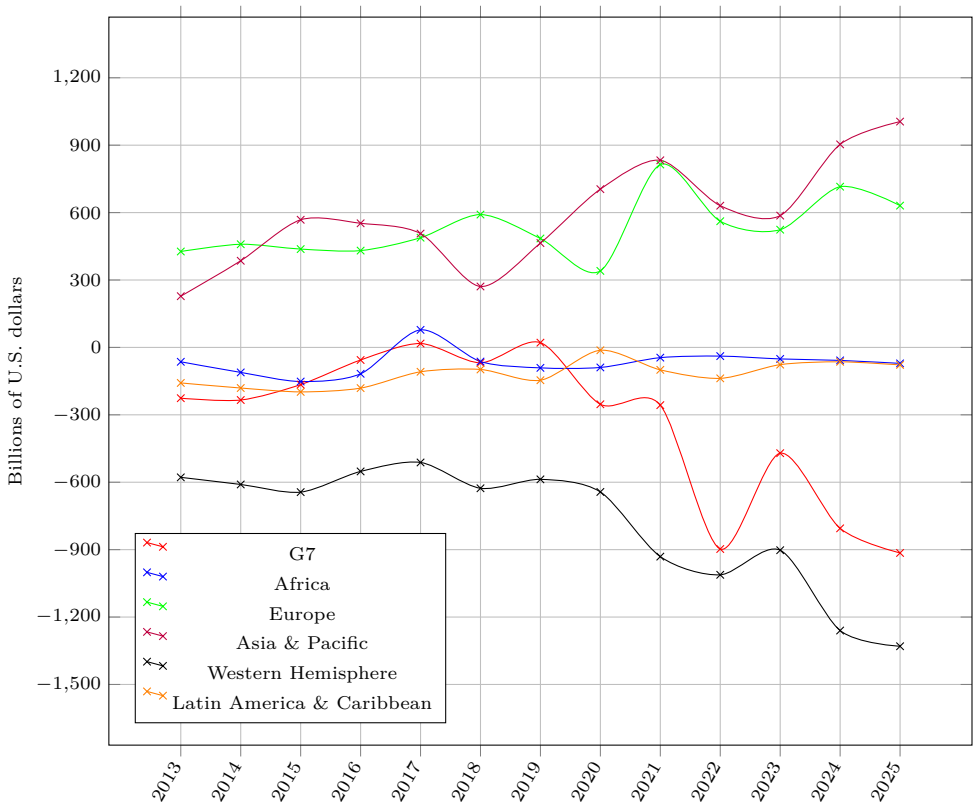
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1 Introduction

In recent years, developed and emerging market economies (EMEs) have faced persistent current-account imbalances (see Figure 1). Additionally, recently witnessed a large share of poor households, particularly in developing countries. According to the 2024 Global Findex Database, the share of hand-to-mouth households that do not have access to financial markets or lack the ability to smooth consumption is 65 % in India, 53% in Brazil, 38% in Mexico, 43% in Argentina, and 39% in Egypt. Moreover, current economic shocks and income fluctuations tend to exacerbate current-account deficits in economies with high levels of consumption inequality Edwards (2002). A growing literature examines how to rebalance the current account, focusing on export-subsidies programmes, (see Levy (1989), Beladi and Chao (2003), Melitz and Messerlin (1987), Salant (1984) and Chen and Devereux (1994)). Less is known, however, about the link between reducing consumption heterogeneity and improving the current account via a lump-sum export-subsidy to households. Accordingly, this study aims to fill a gap in the literature by providing evidence on the impact of subsidies on exports of industries that receive them, using a small open-economy framework.



Notes: Source: IMF.

Figure 1: Current account imbalances, 2013-2025

In this paper, I investigate the economic rationale for export subsidies and show that, in the flexible-price equilibrium of the Debortoli and Galí (2017) TANK model, the current account can be rebalanced. The study considers different variants of ad-valorem export-subsidies within a small open-economy model. More specifically, this study aims, first, to examine the effectiveness of government policy that provides lump-sum

export subsidy payments to all household types. Second, it compares this policy with a no-subsidy baseline and with a policy that targets export-promotion to households with access to financial markets. More precisely, it examines how export subsidies affect the current account, consumption patterns, asset holdings, and an index of consumption heterogeneity. Furthermore, the paper asks whether a country implementing such a policy would experience welfare losses and, if so, what mechanisms would explain overcoming these negative consequences.

The central research question is: Can export subsidies stabilise the current account and cause a more efficient redistribution of consumption across richer and poorer households? This study is expected to provide valuable insights into the implementation and evaluation of export-subsidy policies. A key contribution of this paper is the analysis of four government policies: (i) a no-export-subsidy baseline, (ii) an export subsidy intended for constrained (financial market-access) households, (iii) an export subsidy targeted at unconstrained households, and (iv) an export subsidy applied to both constrained and unconstrained households in a small open economy. These results are expected to improve our understanding of current-account rebalancing and of how export subsidies can reduce consumption heterogeneity.

Most notably, this results shows that when a small open economy implements export subsidies for both household types, (constrained and unconstrained), consumption of traded goods declines for both Ricardian and hand-to-mouth households. Further, higher export subsidies lead to increased consumption of nontraded goods by both hand-to-mouth and Ricardian households. In this scenario, the country experiences a 15% increase in the consumption gap between the two household groups, redistributing consumption of traded goods. Aggregate household asset holdings decline. Consequently, this policy increases the country's exports, improves the current account (CA), and promotes a more equitable distribution of consumption. However, welfare declines by the equivalent of a 0.4% permanent reduction in the composite consumption index relative to the baseline (no-export-subsidy) model.

Compare to the case in which export subsidies are targeted only at Ricardian households, the equilibrium level of Ricardian's traded consumption decreases, consumption of nontraded goods increases, and aggregate asset holdings decline. Under this targeted-subsidy scenario, the country experiences an 1% decline in the consumption gap between the two household groups, redistributing consumption of traded goods. Finally, welfare falls by the equivalent of 0.05 % permanent reduction in the composite consumption index relative to the baseline (no-export-subsidy) model.

Concerning the TANK literature, this paper evaluates a lump-sum export-subsidy program targeted at domestic households. It analyses this program in the context of consumption-driven current account adjustments. Thus, it complements the study of Debortoli and Galí (2017) and the broader body of literature that focuses on the effect of export-promotion policies in open-economy models. Furthermore, these findings could inform the design of government policies in order to make consumption more equitable.

This paper contributes to several strands of literature on the consumption-driven current account adjustment and the effects of export subsidies on the current account. First, it elaborates on macroeconomic models relating to the heterogeneous consumption responses to current account adjustments. A number of studies have examined the role of fiscal policy in current account dynamics. For instance, Lambertini and Proebsting (2019) show that a reduction in government spending and combined with an increase in the value-added tax improves the current account through internal devaluation: the relative price of nontradables falls, boosting net exports. Their empirical evidence indicates that the adjustment is driven by falling imports rather than rising exports. Aggarwal et al. (2023) show that debt financed fiscal transfres generate persistent current account in a Two-Agent New Keynesian (TANK) model as long as hand-to-mouth households consume the

entire transfer, consistent with the classic twin-deficits hypothesis. Belabed et al. (2018) argue that rising income inequality can generate current account deficits when lower-income households borrow to sustain consumption. This paper extends this literature by analyzing the short-, and long-term consequences of higher lump-sum export subsidies implied on the current account and for consumption inequality across household groups.

Second, the paper contributes to the literature on export subsidies and current account dynamics. Research has shown that export subsidies, as a form of export promotion policy, boost net exports and improve the trade balance. For instance, Melitz and Messerlin (1987) examine export credit subsidies as a tool for mitigating macroeconomic challenges, including current account deficits, declining industrial profitability, high inflation, and employment, while noting their distortionary effects. Similarly, Salant (1984) assesses export subsidies for economic and foreign policy aims, concluding they offer limited justification under perfect competition in multi-good trade settings. Complementing this, Brander and Spencer (1985) demonstrate that, under imperfect competition, export subsidies can raise the subsidizing country's welfare by enabling prices to exceed marginal export costs. Such subsidies lower world prices but boost domestic profits while reducing foreign rivals' profit. Defever et al. (2018) provide evidence that 1 % or 2 % ad-valorem export subsidies enhance firm-level export performance, particularly when sustained over multiple years. The impact of export subsidies on importing capital goods for export product production was the central focus of Beladi and Chao (2003) work. They found that the trade balance may deteriorate and cause the balance-of-payment crises if the speed of capital accumulation is within the savings rate. Desai and Hines Jr (2008) analyze the impact of export subsidies through stock price responses to a WTO ruling on US export tax exemptions. The authors found that these subsidies benefit foreign consumers and improve exporters' profitability.

In addition, Svetlana (2023) examines export promotion policies, finding that Chinese incentives have negative third-country spillovers, particularly if other countries have the similar geography of exports, while Brazilian and Indian incentives have positive effects. Brown and Troutt (2018) argue that export subsidies artificially expand trade volumes withough generating a wedge between domestic and world market prices. Domestic prices increase relative to world only through accompanying import barriers, which the authors recommend governments adopt alongside export subsidies. More recently, Rotunno and Ruta (2024) examine domestic subsidies' effects on trade volumes, including export promotion, finding that such policies—and their announcements—have proliferated over time. The study by Chen and Devereux (1994) provide early evidence that equal-rate import tariffs and export subsidies expand exports and improve the current account. In a subsequent study by Schnabl (2025) reports that Germany's implicit export subsidies rose from €38 billion in 2000 to €98 billion in 2022 to bolster exporters amid the ECB's accommodative interest-rate policy. To add to the background in this field of enquiry, de Rugy (2025) contends that China's product subsidies surpass those in Europe and the USA, thereby supporting expanded US export subsidies. This paper contributes to this literature by modeling consumption-driven current account adjustments in a small open-economy framework through lump-sum export subsidies. This approach highlights the importance of evaluating such fiscal interventions. It further provides policy recommendations for mitigating consumption inequality among heterogeneous households via export subsidies.

Third, the paper relates to the international macroeconomics literature on value-added tax (VAT) and its role in boosting export volumes. Studies such as Erceg et al. (2023) and Farhi et al. (2014) model fiscal devaluations through combinations of import tariffs with export subsidies, or VAT increases with payroll subsidies. These models confirm that VAT increases paired with payroll subsidies stimulate economic activity and expand net exports. Arachi and Assisi (2021) and Ciżkowicz et al. (2020) focused on VAT's impact on

price competitiveness and trade balances. The present analysis extends this literature by showing that uniform increases in lump-sum export subsidies and the VAT rate enhance current account improvements. In addition, it examines the effects on consumption inequality across heterogeneous agents.

The remainder of the paper is organised as follows. Section 2 describes the theoretical environment, formulates the hand-to-mouth and Ricardian household problems and presents firm's pricing decisions and the government budget constraint. Section 3 characterises equilibrium and the current-account identity. Section 4 presents the long-run equilibrium and comparative statics. Section 5 provides an extension of the benchmark model that introduces a value-added tax (VAT). Section 6 presents the simulation evidence. Section 7 discusses the key findings, and Section 8 concludes. Proofs of theoretical results are provided in the appendix.

2 Model

2.1 Environment

This research draws upon a Two-Agent New Keynesian (TANK) model Debortoli and Galí (2017), the structure of which represents a deviation from the benchmark model. The following key assumptions characterizes this study. Firstly, it is an infinite-horizon model. The world economy consists of a continuum of small open economies represented by the unit interval [0, 1]. Since each economy is of measure zero, its performance does not have any impact on the rest of the world.

Secondly, a small open economy is represented by a continuum of heterogeneous households. Accordingly, there are two types of households at each point in time: constrained or hand-to-mouth and unconstrained or Ricardian, which can be described as follows. Hand-to-mouth households, where a fraction $\lambda \in [0, 1]$ of households do not access financial markets. Consequently, the intertemporal Euler equation will not hold for these agents. Ricardian households, where a fraction $1 - \lambda \in [0, 1]$ of the population has full access to financial markets, and is expected to satisfy the consumption Euler equation. In this context, $\mathcal{H} = \lambda$ denotes the fraction of constrained households, and $\mathcal{R} = (1 - \lambda)$ denotes the fraction of unconstrained households. Moreover, households have different marginal propensities to consume. Only this scenario is considered, which allows us to analyze, in addition to rebalancing the current account debt of the small open economy, the reduction of the consumption gap between the two groups of households through the government policy of export subsidization. Further, there is a constant share of constrained consumers and no heterogeneity within either type.

Thirdly, the economy includes traded and nontraded industries. Output in the nontraded sector is produced by firms, which use the simplest production function with labor input in order to produce nontraded goods. Further, both types of households contribute to the workforce and receive income accordingly by supplying labor inelastically. By contrast, the traded sector is characterized by exogeneity of output: every representative household is endowed the same quantity of the traded product $\bar{y}_T$ for each period. The following assumptions are in line with the literature based on Obstfeld and Rogoff's work.

Fourthly, it is assumed that the preferences of the hand-to-mouth and Ricardian households are identical. In addition, nominal prices of traded and nontraded goods are completely flexible. The only internationally traded asset is a real risk-free bond, B_t, denominated in the composite consumption of traded goods, which implies that the financial markets are incomplete. As this model abstracts from money in the utility function and in the budget constraint, the Ricardian households use real bonds to trade and intertemporally smooth consumption of traded goods between periods. In addition, the initial net foreign assets are not equal to zero in the economy ($B_{t-1} \neq 0$). Ricardian equivalence holds such that the government runs a balanced budget for each period.

Furthermore, it is assumed that the world interest rate on traded bonds is given exogenously to the small open economy. Additionally, the levels of output and consumption of nontraded goods and consumption of traded goods are determined endogenously, while the equilibrium output of traded goods is specified exogenously. Furthermore, the Law of One Price (LOP) holds for each traded good, so the price of a small country's traded good is the same in all countries. $P^*_{T,t}$ is exogenous and constant in the SOE, and the nominal exchange rate is equal to one. Finally, in the context of the following theoretical model with export subsidies, there are no trade agreements between the countries. Moreover, the small open economy features trade liberalization, which ensures free exchange of traded goods between the SOE and the rest of the world.

2.2 Households

2.2.1 Hand-to-mouth Households

The present discounted value of lifetime utility of a hand-to-mouth household is

$$U^H = \sum_{t=0}^{\infty} \beta^t \left[\gamma \log C^H_{T,t} + (1-\gamma) \log C^H_{N,t}\right] \tag{1}$$

where $C^H_{T,t}$ is agent H's consumption of the traded goods composite and γ is the weight of traded goods in consumption, $C^H_{N,t}$ is agent H's consumption of the nontraded goods composite and $(1-\gamma)$ is the weight of nontraded goods in consumption, and β represents the subjective discount factor that measures individuals' impatience to consume, where $0 < \beta < 1$. Hence, the time-separable utility function depends exclusively on consumption of traded and nontraded goods. Further, it is assumed that the above-mentioned period utility function $U(C^H_t)$ increases in the consumption of both traded and nontraded goods, and is concave: $U'(C^H_t) > 0$ and $U''(C^H_t) < 0$.

The real consumption Dixit–Stiglitz index representing the H^{th} individual consumption of nontraded good z is defined as

$$C^H_{N,t} = \left[\int_0^1 c^H_{N,t}(z)^{\frac{\varepsilon-1}{\varepsilon}} dz\right]^{\frac{\varepsilon}{\varepsilon-1}} \tag{2}$$

where ε is the price elasticity of substitution among nontraded goods, and $\varepsilon > 1$. Equation (2) is a generalization of the two-good constant elasticity of the substitution (CES) function.

The real consumption Dixit–Stiglitz index representing the H^{th} individual consumption of traded good z is defined as

$$C^H_{T,t} = \left[\int_0^n c^H_{T,t}(z)^{\frac{\eta-1}{\eta}} dz + \int_n^1 c^H_{T,t}(z)^{\frac{\eta-1}{\eta}} dz\right]^{\frac{\eta}{\eta-1}} \tag{3}$$

$c^H_{T,t}(z)$ represents the quantity consumed of a specific good z within the traded goods category. Further, this aggregate combines consumption of n domestic traded goods and $(1-n)$ imported goods. The domestic goods are indexed by z ranging from 0 to n, and the imported goods are indexed by z from n to 1.

The Aggregate domestic price deflator of nontraded goods is the consumption based price index corresponding to (2), and is determined as

$$P_{N,t} = \left[\int_0^1 p_{N,t}(z)^{1-\varepsilon} dz\right]^{\frac{1}{1-\varepsilon}} \tag{4}$$

where $p_{N,t}(z)$ is the price of nontraded good z.

It is assumed that a free exchange of traded goods exists between the small open economy and foreign countries, so the LOP holds for each traded good. It requires that good z sells for the same price in all countries when expressed in a common exchange equivalent. This requires, in particular,

$$\frac{p_{T,t}(z)}{S_t} = p^*_{T,t}(z) \tag{5}$$

The Aggregate domestic price deflator of tradables is

$$P_{T,t} = \left[\int_0^n p_{T,t}(z)^{1-\eta} dz + \int_n^1 [S_t p^*_{T,t}(z)]^{1-\eta} dz \right]^{\frac{1}{1-\eta}} \tag{6}$$

where S_t is the nominal exchange rate (the price of a unit of one traded product in the small open economy country at the price of another traded product in the foreign country). $P_{T,t}$ is the home consumer price index of tradables, and, $P^*_{T,t}$ is the foreign consumer price index of tradables measured in foreign currency units. Dividing both sides of equation (6) by the nominal exchange rate (NER), S, or — equivalently — multiplying both sides of (6) by S, convinces us that purchasing power parity (PPP) also holds, because preferences are identical across countries; and there are no departures from the law of one price, so that:

$$P_{T,t} = S_t P^*_{T,t} \tag{7}$$

As the small country case is examined in this study, it is assumed that $P_{T,t}$ is exogenous and constant. The LOP holds for each traded good, which means that identical products should sell for the same price everywhere, and the real exchange rate is equal to one ($S_t = 1$). Furthermore, the equation (8) represents a price index P_t as a weighted average of the price of traded goods ($P_{T,t}$) and the price of nontraded goods ($P_{N,t}$).

$$P_t = \left[\int_0^\gamma P_{T,t}(z)^{\frac{\iota-1}{\iota}} dz + \int_\gamma^1 P_{N,t}(z)^{\frac{\iota-1}{\iota}} dz \right]^{\frac{\iota}{\iota-1}} \tag{8}$$

The real consumption Dixit–Stiglitz index representing the H^{th} individual consumption of traded and nontraded good z is defined as

$$C^H_t = \left[\int_0^\gamma C^H_{T,t}(z)^{\frac{\iota-1}{\iota}} dz + \int_\gamma^1 C^H_{N,t}(z)^{\frac{\iota-1}{\iota}} dz \right]^{\frac{\iota}{\iota-1}} \tag{9}$$

To complete the specification of the hand-to-mouth individual problem, the nominal budget constraint of the hand-to-mouth household is

$$P_{N,t} C^H_{N,t} = W_{N,t} N^H_t + (1 + \zeta_t)(P_{T,t} \bar{y}^H_{T,t} - P_{T,t} C^H_{T,t}) + \lambda \pi_t - P_{T,t} \tau^H_t \tag{10}$$

where $P_{T,t}$ is the consumer price index of tradables, $P_{N,t}$ is the consumer price index of nontradables, $\bar{y}_{T,t}$ is output of traded goods (exogenous endowment), $W_{N,t}$ is the nominal wage per efficient unit of labour, N^H_t is the number of hours supplied by the hand-to-mouth household, ζ_t is the export subsidy, τ^H_t denotes lump-sum taxes, and π_t is the profit of the nontraded producer.

From the individual budget constraints of a representative hand-to-mouth household, it can be observed that they cannot participate in the trading of riskless bonds in the asset market, as was highlighted in the model specification.The consumers of this group allocate their spending between traded and nontraded goods. The current period budget constraint for the representative hand-to-mouth household can be rewritten in real terms. These consumers aim to maximise their utility function, observing the following real budget constraint.

$$\frac{P_{N,t}}{P_t}C^H_{N,t} = \frac{W_{N,t}}{P_t}N^H_t + (1+\zeta_t)\left(\frac{P_{T,t}}{P_t}\bar{y}^H_{T,t} - \frac{P_{T,t}}{P_t}C^H_{T,t}\right) + \lambda\frac{\pi_t}{P_t} - \frac{P_{T,t}}{P_t}\tau^H_t \tag{11}$$

The hand-to-mouth Household maximises (1) subject to (11), yielding the following optimality conditions:

$$\frac{C^H_{T,t}}{C^H_{N,t}} = \frac{\gamma}{(1+\zeta_t)(1-\gamma)}\frac{P_{N,t}}{P_{T,t}} \tag{12}$$

Equation (12) shows that the allocation between traded and non-traded goods depends on the relative prices of non-traded to traded goods, the share of traded and nontraded goods in consumption, and the rate of export subsidy. It maintains rigor by citing sources and using standard TANK extensions for open economies, and extensions like traded and nontraded sectors align with the Obstfeld-Rogoff (Redux model). In addition, this equation differs from the literature by accounting for the export subsidy level.

2.2.2 Ricardian Households

Ricardian households have an analogous utility function

$$U^R = \sum_{t=0}^{\infty}\beta^t\left[\gamma\log C^R_{T,t} + (1-\gamma)\log C^R_{N,t}\right] \tag{13}$$

As was mentioned before, this group of households has access to riskless bonds in the asset market, and their budget constraint is presented as follows

$$P_{N,t}C^R_{N,t} + P_{T,t}B_t = (1+\zeta_t)(P_{T,t}\bar{y}^R_{T,t} - P_{T,t}C^R_{T,t}) + P_{T,t}R_{t-1}B_{t-1} + W_{N,t}N^R_t - P_{T,t}\tau^R_t + (1-\lambda)\pi_t \tag{14}$$

where $P_{T,t}$ is the consumer price index of traded goods, $P_{N,t}$ is the consumer price index of nontraded goods, $\bar{y}^R_{T,t}$ is output of traded goods (exogenous endowment), B_t is a riskless bond denominated in the composition of traded goods, ζ_t is the export subsidy, τ^R_t denotes lump-sum taxes, $W_{N,t}$ is the nominal wage, N^R_t is the labour supplied by the household, and π_t is the profit of the nontraded producer. It is important to note that stocks are defined at the end of the period, so that B_{t-1} is the Ricardian agent's holdings of bonds entering period t. Dividing quation (14) by the price level of traded goods, the nominal budget constraint can be rewritten in real terms

$$\frac{P_{N,t}}{P_t}C^R_{N,t} + \frac{P_{T,t}}{P_t}B_t = (1+\zeta_t)\left(\frac{P_{T,t}}{P_t}\bar{y}^R_{T,t} - \frac{P_{T,t}}{P_t}C^R_{T,t}\right) + \frac{P_{T,t}}{P_t}R_{t-1}B_{t-1} + \frac{W_{N,t}}{P_t}N^R_t - \frac{P_{T,t}}{P_t}\tau^R_t + (1-\lambda)\frac{\pi_t}{P_t} \tag{15}$$

Since this study focuses on the consumption-driven current account adjustments by using the export subsidy, $(1+\zeta_t)$ is multiplied by the quantity of Ricardian traded goods that the small open economy exports to the rest of the world. Specifically, the real value of Ricardian exports is defined in this model as the difference between the output of traded goods, is fixed in this economy, and the home consumption level of traded goods by Ricardian households $(\bar{y}^R_{T,t} - C^R_{T,t})$. The government finances the export subsidy by imposing the lump-sum taxes to the Ricardian and hand-to-mouth households and runs a balanced budget each period. Further, only Ricardian households are able to trade in the international financial markets, as they typically hold bonds denominated in traded goods. The asset markets are incomplete in the sense that the only financial instrument available to households is the riskless real bond. At the same time, there is an integrated world capital market where countries can borrow or lend by trading in bonds. According to

a mechanism for foreign asset accumulation added to the model, the country's current account is defined as $CA = B_t - B_{t-1}$. It is assumed that a country with negative net exports must be borrowing an equal amount to finance its deficit with foreigners, and it is argued that this situation is undesirable.

Ricardian households allocate their spending between traded and nontraded goods. They maximise the utility of their received income from the sales of output and allocate this income to consumption and bond holding, thus observing a real budget constraint.

The constrained maximization problem of the representative Ricardian household is presented in Appendix A.2, which yields the following optimal conditions:

$$\frac{C^R_{T,t}}{C^R_{N,t}} = \frac{\gamma}{(1+\zeta_t)(1-\gamma)} \frac{P_{N,t}}{P_{T,t}} \tag{16}$$

$$\beta R_t (C^R_{T,t+1})^{-1}(1+\zeta_{t+1})^{-1} = (C^R_{T,t})^{-1}(1+\zeta_t)^{-1} \tag{17}$$

It is important to point out that the equation (16) is similar to the hand-to-mouth optimality conditions and shows that allocation between traded and non-traded goods depends on the relative prices of non-traded to traded goods, the share of traded and non-traded goods in consumption, and the level of export subsidy. Moreover, the asset holders have an additional equation (17) that characterizes their optimality conditions. It is the Euler equation: when maximizing utility, the consumer cannot gain from feasible shifts in consumption between periods. One unit saved can be converted into R_t units of second-period consumption. Furthermore, the Euler equation states that at an optimum (when consumers can reach their utility maximum), the two quantities $(C^R_{T,t+1})^{-1}(1+\zeta_{t+1})^{-1} = (C^R_{T,t})^{-1}(1+\zeta_t)^{-1}$ are equal under the condition that the subjective discount factor equals the market discount factor, which ensures the Euler condition for their optimal consumption path. Note that $\beta R_t = 1$, because bonds are denominated in traded goods, with R_t denoting the constant world gross interest in tradables. The Euler equation differs from the literature by accounting for the export subsidy level.

Log-linearize Equation (17) around the steady state (Appendix C.1 shows the solution), one obtains

$$-\hat{c}^R_{T,t+1} - \hat{\zeta}_{t+1} = -\hat{c}^R_{T,t} - \hat{\zeta}_t \tag{18}$$

where lower-case letters with hat indicate logged variables as a percentage deviation from the steady state. Next, it remains to derive the Euler equation, which captures the features of the heterogeneity index between the Ricardian and hand-to-mouth households, in order to examine the impact of export subsidy on the level of heterogeneity in the small open economy. For this reason, the average consumption of traded goods among the unconstrained, $C^R_{T,t}$ is determined, taking into account the formula of aggregate consumption of traded goods

$$C_{T,t} = (1-\lambda)C^R_{T,t} + \lambda C^H_{T,t} \tag{19}$$

The index of the average consumption gap between constrained and unconstrained households is defined as:

$$\alpha_t \equiv (C^R_{T,t} - C^H_{T,t})/C^R_{T,t} \tag{20}$$

that represents consumption heterogeneity between the two types of households.

By substituting from Equation (19) into (20), the following equation of average consumption of traded

goods is obtained

$$C_{T,t} = C^R_{T,t}(1 - \lambda\alpha_t) \tag{21}$$

Thus, the extent to which aggregate consumption differs from the average unconstrained consumption will be the result of one factor: change in the gap measure α_t, as the share of constrained households remains constant. In particular, for any given level of average unconstrained consumption, aggregate consumption will be larger, the smaller the gap is between the two household types. The linearized equation (21) is

$$\hat{c}_{T,t} = \hat{c}^R_{T,t} - \frac{\lambda}{1 - \lambda\alpha}\hat{\alpha}_t \tag{22}$$

where $\hat{\alpha}_t \equiv \alpha_t - \alpha$. Combining (18) and (22) yields the following Euler equation for aggregate consumption of traded goods:

$$\hat{c}_{T,t} = \hat{c}_{T,t+1} + \Delta\hat{h}_{t+1} + \Delta\hat{\zeta}_{t+1} \tag{23}$$

where, $\hat{h}_t$ is a heterogeneity index defined by

$$\hat{h}_t \equiv \frac{\alpha}{1 - \lambda\alpha}\hat{\alpha}_t \tag{24}$$

Note that equation (23) differs from the standard Euler equation for the representative households due to the presence of $\hat{h}_{t+1}$ term. The latter term captures the consumption heterogeneity level.

Current-account identity. To determine the current-account identity, the analysis begins by aggregating of budget constraints across hand-to-mouth and Ricardian households. According to the model, hand-to-mouth households lack access to the financial market, and therefore do not use real bonds to save or borrow. Each period, they consume their income, which consists of endowments of traded goods, real wages, and profits from the nontraded sector, according the following real budget constraints. Based on the model's set-up, only Ricardian households have financial assets (B_t). Therefore, the current account — viewed as foreign- asset accumulation - can be determined through their budget constraint, which allows calculation of the change in net foreign-assets position. After the government budget constraint is imposed, and market-clearing conditions for nontraded goods are applied, the final equation yields (the complete derivation of the current account can be found in Appendix B.1):

$$CA_t \equiv B_t - B_{t-1} = \bar{y}^H_{T,t} - C^H_{T,t} + \bar{y}^R_{T,t} - C^R_{T,t} + r_{t-1}B_{t-1} \tag{25}$$

Thus, from the foreign-assets-accumulation perspective, the current account equals the change in Ricardian households' asset holdings between periods t and $t-1$. Equivalently, it represents the net foreign-asset (NFA) position of a small open economy — domestic residents' holdings of foreign bonds minus foreign holdings of domestic bonds. From the point net-exports perspective, the current account is the difference between total income and aggregate consumption of traded goods. Total income has two components: the value of traded-goods endowment to Ricardian and hand-to-mouth households, and interest income from previously acquired foreign assets. Therefore, equation (25) shows that the change in net foreign assets equals total income minus total consumption — that is, the country's trade balance.

Consequently, if aggregate consumption exceeds total income, the country imports from abroad and Ricardian households borrow internationally to finance the deficit, leading to negative net exports and current-account deterioration. Conversely, if aggregate consumption is less than its total income, it must lend abroad, leading to a current account surplus.

Since the subsidy $(1+\zeta_t)$ in this model applies only to the net exports - $(\bar{y}_{T,t} - C_{T,t})$, of the difference between traded output and traded consumption - it directly influences the value of net exports. This adjustment reflects the subsidy-induced net exports value. The subsidy effectively increases current-account inflows through higher net exports.

The current account is a fundamental component of a country's balance of payments. On this basis, the design of monetary, fiscal, and trade policies is developed. It reflects all receipts from the sale of goods and services by non-residents and all expenditures by residents on goods and services provided to foreigners, as well as net investment income and net current transfers. A current account surplus indicates that a country is a net lender to the rest of the world, while a deficit means that it is a net borrower. This lending and borrowing dynamic reflects the interplay between exports and imports. A country with negative net exports must borrow an equal amount to finance its deficit with foreigners, leading to a current-account deficit. A country with positive net exports acquires foreign assets of equal value, as it sells more abroad than it purchases.

The current account is particularly important for small open economies because of their dependence on international trade, sensitivity to capital flows, limited policy autonomy, and exposure to external shocks. By analyzing the current account, policymakers in small open economies can gain valuable insights that supports external equilibrium in trade. Therefore, the next section investigates current-account rebalancing in a small open economy using export subsidies within the Two-Agent New Keynesian model (TANK).

Further, according to Ghironi (2008), this model assumes a non-zero long-run net foreign-asset position, which allows determination of Ricardian households' steady-state asset holdings and analysis of the impact of export subsidies on them. Basically, the following model focuses both on the foreign asset accumulation and the net exports views of the current account, following Obstfeld and Rogoff (1996) and Terra (2015). This model focuses on the foreign-asset-accumulation and net-exports views of the current account. According to the foreign-asset- accumulation view, the current account is defined as the change in asset holdings between t and $t-1$. According to the net-exports view, the current account equals total income minus total consumption. It is assumed that the country initially runs a current-account deficit, a situation considered undesirable in the model.

Additionally, following Gandolfo (2001), the small-country assumption implies that developments in the domestic economy have negligible effects on global variables. In particular, changes in the country's imports (the rest of the world's exports) do not significantly affect world income or imports. Consequently, these external variables are treated as exogenous in the model. Nevertheless, these assumptions may be relaxed if foreign repercussions are considered. Moreover, consumption is an endogenous variable, allowing consumption-driven adjustments in the current account. For example, a decrease in Ricardian consumption in the small country increases the net foreign-asset position and therefore improves the current account. All or part of these additional exports will be directed to the rest of the world, which will experience an increase in imports.

2.3 Firms

In this model it is assumed that in the nontraded sector a continuum of producers, indexed by i $\in [0,1]$ have monopoly power and charge prices above marginal cost. Prices of nontradables are set optimally each period to mazimise real revenue net of the cost of labour.

The representative Home producer chooses in period t prices of nontradables to produce that goods to maximize profit

$$\frac{\pi_t}{P_t} = \frac{P_{N,t}}{P_t}(i)Y_{N,t}(i) - \frac{W_{N,t}}{P_t}\bar{N}_t(i) \tag{26}$$

where $P_{N,t}$ is the price that must be charged to sell, $Y_{N,t}(i)$ is the nontraded output produced by firm (i) in period t, $Y_{N,t}(i) = \left(\frac{P_{N,t}(i)}{P_{N,t}}\right)^{-\varepsilon} Y_{N,t}$. Moreover, it is assumed that $\bar{N}_t(i) = \bar{N}_t^R(i) + \bar{N}_t^H(i)$ and $\bar{N}_t$ denotes the constant labor amount (inelastically) supplied by the households, and $W_{N,t}$ is the nominal wage. Additionally, it is assumed that the production function is given by

$$Y_{N,t}(i) = A_t\bar{N}_t(i) \tag{27}$$

Here, $A_t \equiv exp\{a_t\}$ is the economy-wide exogenous technology parameter that follows AR(1) process

$$a_t = \rho_a a_{t-1} + \varepsilon_t^a \tag{28}$$

Taking the first-order derivative with respect to $P_{N,t}(i)$ gives the pricing rule for the representative nontraded good

$$P_{N,t} = \frac{W_{N,t}}{A_t}\frac{\varepsilon}{\varepsilon - 1} \tag{29}$$

where the parameter ε is the price elasticity of demand faced by each monopolist. Since marginal revenue is positive when the elasticity of demand exceeds one, it is required that $\varepsilon > 1$ to ensure a positive level of output. Thus, prices of nontraded goods are set above marginal costs.

2.4 Government

The government budget constraint, in units of tradables is given

$$0 = \tau_t^H \frac{P_{T,t}}{P_t} - \zeta_t(\bar{y}_{T,t}^H - C_{T,t}^H)\frac{P_{T,t}}{P_t} \tag{30}$$

$$0 = \tau_t^R \frac{P_{T,t}}{P_t} - \zeta_t(\bar{y}_{T,t}^R - C_{T,t}^R)\frac{P_{T,t}}{P_t} \tag{31}$$

The government is assumed to run a balanced budget each period. It is also assumed that there is no government spending, so all taxes are rebated to the public through transfers. In order to focus on the analysis of the macroeconomic effect of the export subsidy, it is assumed that the government transfers are equal to the tax amount.

2.5 Equilibrium

Equilibrium in the model is defined by a system of nine equations in nine endogenous variables (B_t, $C_{T,t}^H$, $C_{T,t}^R$, $C_{N,t}^H$, $C_{N,t}^R$, $\frac{\pi_t}{P_t}$, $\frac{P_{N,t}}{P_{T,t}}$, $w_{N,t}$, $Y_{N,t}$), such that hand-to-mouth, Ricardian households and firms maximise their objectives, and the goods, labour and financial markets clear. Goods market clearing for nontraded goods yields:

$$C_{N,t}^H + C_{N,t}^R \equiv Y_{N,t} \tag{32}$$

The current account identity embodies the market clearing condition for traded goods.

$$B_t - B_{t-1} = \bar{y}_{T,t}^H - C_{T,t}^H + \bar{y}_{T,t}^R - C_{T,t}^R + r_{t-1}B_{t-1} \tag{33}$$

The labour market clears when:

$$\bar{N}_t = N_t^d \tag{34}$$

Labour supply is fixed, $\bar{N}_t = \bar{N}_t^R + \bar{N}_t^H$, labour demand satisfies $w_{N,t} = A_t \frac{\varepsilon}{\varepsilon - 1}$

2.6 Steady states and their properties

In this section, the steady-state levels are examined. Firstly, the values of variables are denoted without the time subscript. Secondly, solving the system of equations, the following results for the model's steady state with an export subsidy for hand-to-mouth and Ricardian households by the small open economy country are obtained:

$$\frac{\bar{P}_N}{\bar{P}_T} = (1+\zeta)^{-\frac{1}{\iota}} \left(\frac{1-\gamma}{\gamma} \right)^{\frac{\iota-1}{\iota}} \tag{35}$$

$$\bar{C}_T^H = \frac{\gamma}{1+\zeta(1-\gamma)} \left[\bar{y}_T^H + A\frac{\bar{P}_N}{\bar{P}_T} \left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H \right) \right] \tag{36}$$

$$\bar{C}_N^H = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)} \left[\bar{y}_T^H + A\frac{\bar{P}_N}{\bar{P}_T} \left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H \right) \right] \tag{37}$$

$$\bar{C}_T^R = \frac{\gamma}{1+\zeta(1-\gamma)} \left[\bar{y}_T^R + rB + A\frac{\bar{P}_N}{\bar{P}_T} \left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R \right) \right] \tag{38}$$

$$\bar{C}_N^R = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)} \left[\bar{y}_T^R + rB + A\frac{\bar{P}_N}{\bar{P}_T} \left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R \right) \right] \tag{39}$$

$$\bar{B} = -r^{-1} \left[\bar{y}_T^H + \bar{y}_T^R - \frac{\gamma}{(1+\zeta)(1-\gamma)} A\bar{N}\frac{\bar{P}_N}{\bar{P}_T} \right] \tag{40}$$

In Appendix E, I also present the model's steady state with (i) zero export subsidy; (ii) an export subsidy for hand-to-mouth households, and (iii) an export subsidy for Ricardian households. In order to characterize the impact of an unanticipated temporary increase in the export subsidy level, it is assumed that the economy is initially in a steady-state. Suppose that at time t the export subsidy rises unexpectedly and remains elevated only for one period. The effects on steady-state equilibrium levels of traded-goods consumption, bonds denominated in traded goods, and the nontraded-to-traded price ratio can be obtained by differentiating equations (45)-(50) with respect to zeta. This procedure determines how export-promotion policy alters the equilibrium values of endogenous variables.

$$\frac{d(\bar{P}_N/\bar{P}_T)}{d\zeta} = -\frac{1}{\iota}(1+\zeta)^{-\frac{1-\iota}{\iota}} \left(\frac{1-\gamma}{\gamma} \right)^{\frac{\iota-1}{\iota}} \tag{41}$$

Since, $\frac{d(\bar{P}_N/\bar{P}_T)}{d\zeta} < 0$ an increase in the level of export subsidy reduces the price level of traded and nontraded goods in small open economy.

$$\frac{\bar{C}_T^H}{d\zeta} = -\frac{\gamma(1-\gamma)}{[1+\zeta(1-\gamma)]^2}\left[\bar{y}_T^H + A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{42}$$

Since $\frac{dC_T^H}{d\zeta} < 0$, an increase in export subsidies for both hand-to-mouth and Ricardian households reduces hand-to-mouth households' consumption of traded goods. Given a fixed quantity of traded goods, the decrease in domestic consumption by households types increases exports abroad. Therefore, a rise in export subsidies for both household types in Home market leads to an increase in exports. This suggests that higher exports, driven by lower domestic consumption of traded goods, improve the Home country's trade balance.

$$\frac{dC_N^H}{d\zeta_t} = \frac{\gamma(1-\gamma)}{[1+\zeta(1-\gamma)]^2}\left[\bar{y}_T^H + A\frac{P_N}{P_T^*}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{43}$$

Since $\frac{dC_N^H}{d\zeta} > 0$, Keynesian households substitute non-traded goods for traded goods.

$$\frac{C_T^R}{d\zeta} = -\frac{\gamma(1-\gamma)}{[1+\zeta(1-\gamma)]^2}\left[\bar{y}_T^R + rB + A\frac{P_N}{P_T^*}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{44}$$

Since $\frac{dC_T^R}{d\zeta} < 0$, an increase in the export subsidy reduces Ricardian households' consumption of traded goods. Given the fixed quantity of traded goods, the decline in domestic consumption by both household types increases exports abroad. Therefore, higher export subsidies in the Home market increase exports. Thus, higher exports, resulting from decrease in traded-goods consumption, implies an improvement in the Home country's trade balance.

$$\frac{dC_N^R}{d\zeta_t} = \frac{\gamma(1-\gamma)}{[1+\zeta(1-\gamma)]^2}\left[\bar{y}_T^R + rB + A\frac{P_N}{P_T^*}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{45}$$

Since $\frac{dC_N^R}{d\zeta} > 0$, Ricardian households substitute non-traded goods for traded goods.

$$\frac{dB}{d\zeta} = -\frac{1}{r}\frac{\gamma}{(1-\gamma)(1+\zeta)^2}\bar{Y}_N\frac{P_N}{P_T} \tag{46}$$

Since $\frac{dB}{d\zeta} < 0$, an increase in export subsidies for both Ricardian and Keynesian households decreases the Home country's holdings of foreign bonds. A country may improve its current account by boosting exports, but if the policy simultaneously worsens the steady-state net-foreign-asset position through borrowing induced by the subsidy, the NFA will ultimately deteriorate. This again reflacts transitional versus steady-state distinction emphasized in models such as Obstfeld–Rogoff (1996) or Corsetti–Pesenti–Roubini (1998).

These findings indicate that an increase in Home export subsidies decreases both hand-to-mouth and Ricardian consumption of traded goods ($\frac{dC_T^H}{d\zeta} < 0$ and $\frac{dC_T^R}{d\zeta} < 0$), increases their consumption of non-traded goods ($\frac{dC_N^H}{d\zeta}$ and $\frac{dC_N^R}{d\zeta}$), and reduces the level of foreign-bond holdings ($\frac{dB}{d\zeta} < 0$).

3 Simulation Evidence

In this section, the model is taken to the data and solved numerically. In this section, the calibration is first discussed before analysing the effects of export subsidy shocks.

3.1 Calibration

To calibrate the TANK model parameters, I follow Debortoli and Galí (2017), acoordingly, the share of hand-to-mouth households is set to 30 percent. The weight of tradables in consumption is set to 40 percent, following Obstfeld and Rogoff (1996). The endowment of traded goods and labour supply are normalized to 1, following Uribe and Schmitt-Grohé (2017). Additionally, the international risk-free annual interest rate is set to 6 percent and the discount factor β to 0.944, following Durdu et al. (2020). The remaining structural parameters—non-traded output and productivity — are normalized to unity in steady state. The export subsidy shock size in period 1 is calibrated to 8 percent based on Egypt's export subsidy programme.

To examine the impact of elasticity of substitution among tradables and nontradables (ι) on the current account adjustments, I use three different cases, namely 1) Cobb-Douglas Case, where $\iota = 1$ following Ambrosino et al. (2024); 2) gross complements, where $\iota = 0.74$ using Mendoza (1995) estimates results; and 3) gross substitutes, where $\iota = 1.5$ following Kehoe et al. (1995). Using the calibrated parameters, the steady state is computed based on the open-economy equilibrium in levels, as derived in Section 3. The results are presented in Table 2, which includes: (i) the steady state with zero export subsidy; (ii) the steady state with an export subsidy to Ricardian households; and (iii) the steady state with subsidies to both household types.

Parameter	Interpretation	Value	Source
β	Discount factor	0.944	Durdu et al. (2020)
γ	Weight of tradables in consumption	0.40	Obstfeld and Rogoff (2000)
θ	Elasticity of substitution among non-tradables	11	Ambrosino et al. (2024)
ι	Elasticity of substitution among tradables and non-tradables	1	Ambrosino et al. (2024)
η	Elasticity of substitution among home and foreign goods	1	Ambrosino et al. (2024)
λ	Share of hand-to-mouth households	0.30	Debortoli and Galí (2024)
ρ^a	Persist. of technology shock	0.95	Debortoli et al. (2019)
σ^a	Std. of technology shock	0.45	Debortoli et al. (2019)
ζ	Export subsidy shock size in period 1	0.08	Enterprise (2024)
$\bar{r}$	SS level of real interest rate	0.059	Durdu et al. (2020)
$\bar{Y}_N$	SS level of nontraded output	1	standard
$\bar{A}$	SS level of productivity	1	standard
$\bar{N}$	SS level of inelastic labour supply	1	Uribe and Schmitt-Grohé (2017)
$\bar{N}^H$	SS level of labour supply by hand-to-mouth	0.3	Author's Calculation
$\bar{N}^R$	SS level of labour supply by Ricardian	0.7	Author's Calculation
$\bar{y}_T$	Endowment of traded goods	1	Uribe and Schmitt-Grohé (2017)
$\bar{y}_T^H$	Hand-to-mouth endowment of traded goods	0.3	Author's Calculation
$\bar{y}_T^R$	Ricardian endowment of traded goods	0.7	Author's Calculation

Table 1: Calibrated Parameters

3.2 Simulation Results

This section presents model simulations to demonstrate the mechanism generating current short-run current surpluses equilibrium. More specifically, impulse response functions are presented under three government policies: (i) an export subsidy to hand-to-mouth households, (ii) one to Ricardian households, and (iii) one to both households typesi. Additionally, the effects of differential subsidy rates (15 % for Ricardians, 8 % for hand-to-mouth) are analysed in Appendix E.1. Equilibrium is solved numerically using Uhlig's method of linear approximation, as described in Appendix.

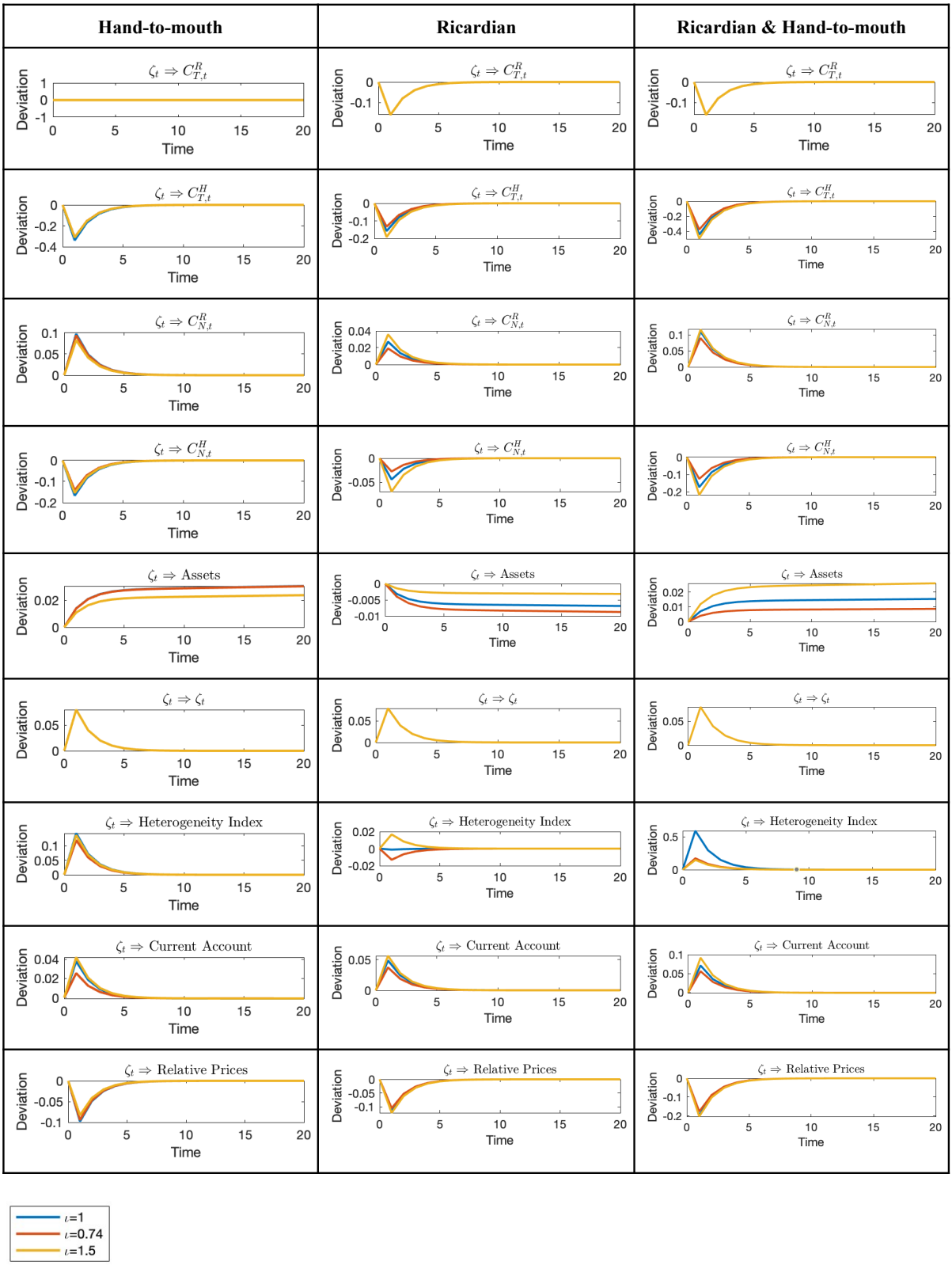


Figure 2: Impulse responses of traded and nontraded consumption to export subsidy policy shock

Notes: In this figure, each row compares the dynamics of the main aggregate consumption variables when the economy is affected by a positive deterministic shock (ζ_t=10 %).

Export subsidy policy	$\bar{C}_N^H$	$\bar{C}_N^R$	$\bar{C}_T^H$	$\bar{C}_T^R$	$\bar{B}$	$\frac{\bar{P}_N}{\bar{P}_T}$	$\bar{w}_N$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	$\iota = 1$ (Cobb-Douglas Case)						
Hand-to-mouth ($\zeta_t^H = 8\%$)	0.37	0.63	0.23	0.42	-5.93	1	0.91
Ricardian ($\zeta_t^R = 8\%$)	0.38	0.62	0.23	0.40	-6.01	0.93	0.91
Hand-to-mouth & Ricardian ($\zeta_t = 8\%$)	0.39	0.61	0.22	0.35	-7.43	0.93	0.91
Hand-to-mouth & Ricardian ($\zeta_t^H = 8\%, \zeta_t^R = 10\%$)	0.39	0.61	0.22	0.37	-6.29	0.93	0.91
Hand-to-mouth & Ricardian ($\zeta_t^H = 10\%, \zeta_t^R = 8\%$)	0.39	0.61	0.22	0.37	-6.01	0.91	0.91
	$\iota = 0.74$ (Gross Complements)						
Hand-to-mouth ($\zeta_t^H = 8\%$)	0.40	0.60	0.21	0.4	-5.24	0.87	0.91
Ricardian ($\zeta_t^R = 8\%$)	0.41	0.59	0.21	0.36	-5.06	0.78	0.91
Hand-to-mouth & Ricardian ($\zeta_t = 8\%$)	0.42	0.58	0.20	0.28	-8.79	0.78	0.91
Hand-to-mouth & Ricardian ($\zeta_t^H = 8\%, \zeta_t^R = 10\%$)	0.39	0.61	0.22	0.37	-6.01	0.90	0.91
Hand-to-mouth & Ricardian ($\zeta_t^H = 10\%, \zeta_t^R = 8\%$)	0.40	0.60	0.21	0.37	-6.01	0.88	0.91
	$\iota = 1.5$ (Gross Substitutes)						
Hand-to-mouth ($\zeta_t^H = 8\%$)	0.35	0.65	0.24	0.43	-7.06	1.14	0.91
Ricardian ($\zeta_t^R = 8\%$)	0.34	0.66	0.25	0.41	-6.65	1.08	0.91
Hand-to-mouth & Ricardian ($\zeta_t = 8\%$)	0.35	0.65	0.24	0.43	-5.65	1.08	0.91
Hand-to-mouth & Ricardian ($\zeta_t^H = 8\%, \zeta_t^R = 10\%$)	0.38	0.62	0.22	0.38	-6.29	0.95	0.91
Hand-to-mouth & Ricardian ($\zeta_t^H = 10\%, \zeta_t^R = 8\%$)	0.38	0.62	0.22	0.38	-6.01	0.94	0.91

Table 2: Calibrated Parameters (Author's Calculation)

Notes: The table reports the steady-state values of the endogenous variables. Columns 1–7 show hand-to-mouth consumption of nontraded goods, Ricardian consumption of nontraded goods, hand-to-mouth consumption of traded goods, Ricardian consumption of traded goods, assets, relative prices and real wages.

Hand-to-mouth net export promotion. Figure 2 shows that a deterministic export subsidy shock of 8% reduces relative prices ($P_{N,t}/P_{T,t}$) by 9%. According to their intertemporal conditions, hand-to-mouth households allocate consumption between tradable and nontradable goods based on relative prices. Moreover, their consumption is linked to labour income, from working in the non-traded sector. After a ζ_t shock, the real wage ($W_{N,t}/P_t$) decreases, reducing real purchasing power. Consequently, the real cost of consumption rises. As a result, hand-to-mouth households reduce tradable consumption ($C_{T,t}^H$) by 31% and non-tradable consumption ($C_{N,t}^H$) by 15% from steady-state levels to cope with the higher real cost of the consumption bundle. Despite the fall in the relative prices, Ricardian tradable consumption remains unchanged, as they can smooth consumption intertemporally through financial markets. Figure 2 thus illustrates the short-run neutrality of fiscal policy with respect to Ricardian tradable consumption ($C_{T,t}^R$), which remains at its steady-state level following the export subsidy shock. Ricardian consumption of nontraded goods increases. The significant decrease in hand-to-mouth consumption of traded goods and neutral response of Ricardian consumption of traded goods produce a remarkable increase in heterogeneity by 14%. The export subsidy shock generates a short-run current account surplus of approximately 0.04 percentage points (see Figure 2), when the elasticity of substitution between traded and nontraded goods is greater or equal to one. In case that the elasticity of substitution between traded and nontraded goods is 0.74, the current account increases by 0.02 percentage points. Over time, the current account returns towards its steady state.

Ricardian net export promotion. Additionally, Figure 3 shows that the export subsidy reduces relative prices ($P_{N,t}/P_{T,t}$) by 12% in case that traded and nontraded goods are gross substitutes. As a result, $C_{T,t}^H$ and $C_{N,t}^H$ dropped sharply. Moreover, Ricardian tradable consumption falls by approximately 16 %, in the initial periods following the fiscal policy shock. This is consistent with Ricardian households adjusting consumption downward because of the new shock ζ_t, making them value present consumption less relative to future consumption. They finance this adjustment by borrowing or drawing assets, leading to a decline in the net foreign asset position. This implies that the current account increases by 4%. Moreover, an increase in ζ_t causes an increase in $C_{N,t}^R$, households substitute between traded and nontraded goods.

Finally, the consumption gap between Ricardian and hand-to-mouth households decreases by 1%.

Additionally, given that the elasticity of substitution between traded and nontraded goods is equal to one, the current account improves by 4.8 % and the heterogeneity index is zero in the first period after the shock. Assuming that the elasticity of substitution between traded and nontraded goods is greater than one leads to the conclusion that the current account increased by 5.6 %. However, heterogeneity also increases by up to 2 %.

Hand-to-mouth & **Ricardian net export promotion**. Figure 3 shows that relative prices decrease by 20 % in the short run. Ricardian households respond by reducing tradable consumption by 16 %. They shift spending from relatively more expensive tradables to cheaper nontradables. Hand-to-mouth households decrease consumption of both traded and nontraded goods. The export subsidy shock increases the consumption inequality index by 59 %, when the elasticity of substitution between traded and nontraded goods is equal to one, and by 15 %, when considering that it is greater or less than one. Ricardian household consume less today than tomorrow, leading them to purchase bonds (accumulating assets); this raises bond holdings in the short run, it defined at the gross level. Ricardian households accumulate assets (lending) to smooth consumption in response to the ζ_t shock. Over time, as ζ_t fades, they reduce consumption and repay debts. Asset holdings rise sharply before gradually returning to zero.

Hand-to-mouth & **Ricardian net export promotion (different rates of export subsidies)**. Results in Appendix E.1 indicate that a policy applying a 10 % subsidy to Ricardian households and 8 % to hand-to-mouth households is more efficient: it increases the current account by 0.08 percentage points while raising the heterogeneity index by only 0.08 percentage points. The reverse policy (8 % to Ricardians, 10 % to hand-to-mouth) increases heterogeneity by 0.11 percentage points and improves the current account by only 0.08 percentage points. Moreover, Figure 4 and 5 show that hand-to-mouth consumption of traded goods reduces significantly up to 40%, in response to the relative price change. The consumption of nontraded goods for this group declines up to 14 %. Ricardian households will cut their tradable consumption by approximately 16%.

The analysis carried out in this section leads to three general conclusions regarding policy effectiveness in the short run. First, in the short run the most effective export subsidy policy will be when both Ricardian and hand-to-mouth households are subsidised, because it will imply that the current account will increase by 9 % in response to the zeta shock. Second, the export policy when Ricardian households obtain 10 % and hand-to-mouth households 8 % is also efficient, because it helps to improve the current account by 0.08 percentage points. Finally, taking into account the heterogeneity level, it is more reasonable to subsidise only Ricardian households, which helps to improve the current account by 0.056 %, while increasing the heterogeneity level only by 2%, when $\iota = 1.5$. In case $\iota = 0.74$, the heterogeneity index decreased by 1 %, when $\iota = 1$, the heterogeneity index is equal to zero.

4 Extension

The main finding is of an export subsidy increase for hand-to-mouth and Ricardian households, with the deficit of the current account falling as a consequence of the reduction of the consumption of traded goods. Moreover, the consumption is inequality reduced. In this section, extensions and refinements of the governmental policy of export subsidies and the value-added tax. The benchmark case that considers financing of export subsidies through lump-sum taxes is costly for the government. Therefore, the VAT is added in order, to generate revenues of the VAT and increase export revenues. Additionally, in the open economy framework the VAT is considered as fiscal devaluation, which increases the prices in the domestic market, while reducing the export prices. Such a shift in relative prices would diminish demand for traded goods within the home country and provide macroeconomic stimulus by boosting international trade. During the period 2024-2025, the EU countries experienced a significant increase in consumption tax (See Table 1).

Country	Sector	Old rate	New Rate	Start date
Estonia	All	20%	24%	July 2025
Finland	All	24%	25.5%	September 2024
Germany	Food product	7%	19%	January 2024
Ireland	Tourism and hospitality	9%	13.5%	August 2023
Lithuania	All	21%	22%	January 2025
Luxembourg	All	16%	17%	January 2024
Poland	Food product	0%	5%	April 2024
Romania	Food product with added sugar	9%	19%	January 2024
Slovakia	All	20%	22%	July 2024
Switzerland	All	7.7%	8.1%	January 2024

Table 3: Consumption Tax Increase in the EU Countries

Suppose that everything is as described above; the subsidy $(1+\zeta_t)$ in this model applies only to net exports, which is $(\bar{y}_{T,t} - C_{T,t})$, total output of traded goods minus total consumption of traded goods. Additionally, the VAT (which is denoted by τ_t) is imposed on the traded goods that are sold domestically. This is in line with the EU VAT Directive: zero rating VAT on an export of goods. This section highlights the main findings which are as follows:

$$\frac{P_N}{P_T} = (1+\zeta)^{-\frac{1}{\varepsilon}}(1+\tau^R)^{-\frac{1}{\varepsilon}}\left(\frac{1-\gamma}{\gamma}\right)^{\frac{\varepsilon-1}{\varepsilon}} \tag{47}$$

$$C_T^H = \frac{\gamma}{(1+\tau^H)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^H + A\frac{P_N}{P_T^*}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{48}$$

$$\frac{C_T^H}{d\zeta} = -\frac{\gamma}{(1+\tau^H)(1+\zeta)^2}\left[A\frac{P_N}{P_T^*}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{49}$$

$$\frac{C_T^H}{d\tau^H} = -\frac{\gamma}{(1+\tau^H)^2(1+\zeta)}\left[(1+\zeta)\bar{y}_T^H + A\frac{P_N}{P_T^*}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{50}$$

where the sign of $\frac{dC_T^H}{d\zeta}$ and $\frac{C_T^H}{d\tau^H}$ are is negative, which means that an increase in export subsidy in the small open economy implies a negative effect on the level of home consumption of traded goods. As the home

country is endowed with a constant quantity of traded goods each period, the decrease in the consumption of the traded goods encourages the home country to export the remaining quantity of goods to the foreign countries. Therefore, a rise in export subsidies in the home market leads to an increase in home exports. This suggests that a higher level of exports, caused by the decrease in consumption of traded goods, implies a positive effect on the trade balance in the home country.

$$C_N^H = (1-\gamma)\left[(1+\zeta)\bar{y}_T^H + A\frac{P_N}{P_T^*}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{51}$$

$$\frac{dC_N^H}{d\zeta} = (1-\gamma)\bar{y}_T^H \tag{52}$$

where the sign of $\frac{dC_N^H}{d\zeta}$ is positive, which means that hand-to-mouth households will substitute the part of their consumption of traded goods for that of non-traded ones.

$$C_T^R = \frac{\gamma}{(1+\tau^R)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^R + rB + A\frac{P_N}{P_T^*}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{53}$$

$$\frac{C_T^R}{d\zeta} = -\frac{\gamma}{(1+\tau^R)(1+\zeta)^2}\left[rB + A\frac{P_N}{P_T^*}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{54}$$

$$\frac{C_T^R}{d\tau^R} = -\frac{\gamma}{(1+\tau^R)^2(1+\zeta)}\left[rB + A\frac{P_N}{P_T^*}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{55}$$

where the signs of $\frac{dC_T^R}{d\zeta}$ and $\frac{dC_T^R}{d\tau^R}$ are negative, which means that an increase in export subsidy in the home country implies a negative effect on the level of home consumption of traded goods. As the home country is endowed with a constant quantity of traded goods each period, the decrease in the consumption of the traded goods encourages the home country to export the remaining quantity of goods to the foreign countries. Therefore, a rise in export subsidies in the home market leads to an increase in home exports. This suggests that a higher level of exports, caused by the decrease in consumption of traded goods, implies an improvement of the trade balance in the home country

$$C_N^R = (1-\gamma)\left[(1+\zeta)\bar{y}_T^R + rB + A\frac{P_N}{P_T^*}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{56}$$

$$\frac{dC_N^R}{d\zeta} = (1-\gamma)\bar{y}_T^R \tag{57}$$

where the sign of $\frac{dC_N^R}{d\zeta}$ is positive effect, which means that an increase in export subsidy in the home country implies a positive on the level of home consumption of nontraded goods. Ricardian households will substitute part of their consumption of traded goods for that of non-traded ones.

$$B = -\frac{1}{r}\left[(1+\zeta)(\bar{y}_T^H + \bar{y}_T^R) - \frac{\gamma}{1-\gamma}\bar{Y}_N\frac{P_N}{P_T}\right] \tag{58}$$

$$\frac{dB}{d\zeta} = -\frac{1}{r}(\bar{y}_T^H + \bar{y}_T^R) \tag{59}$$

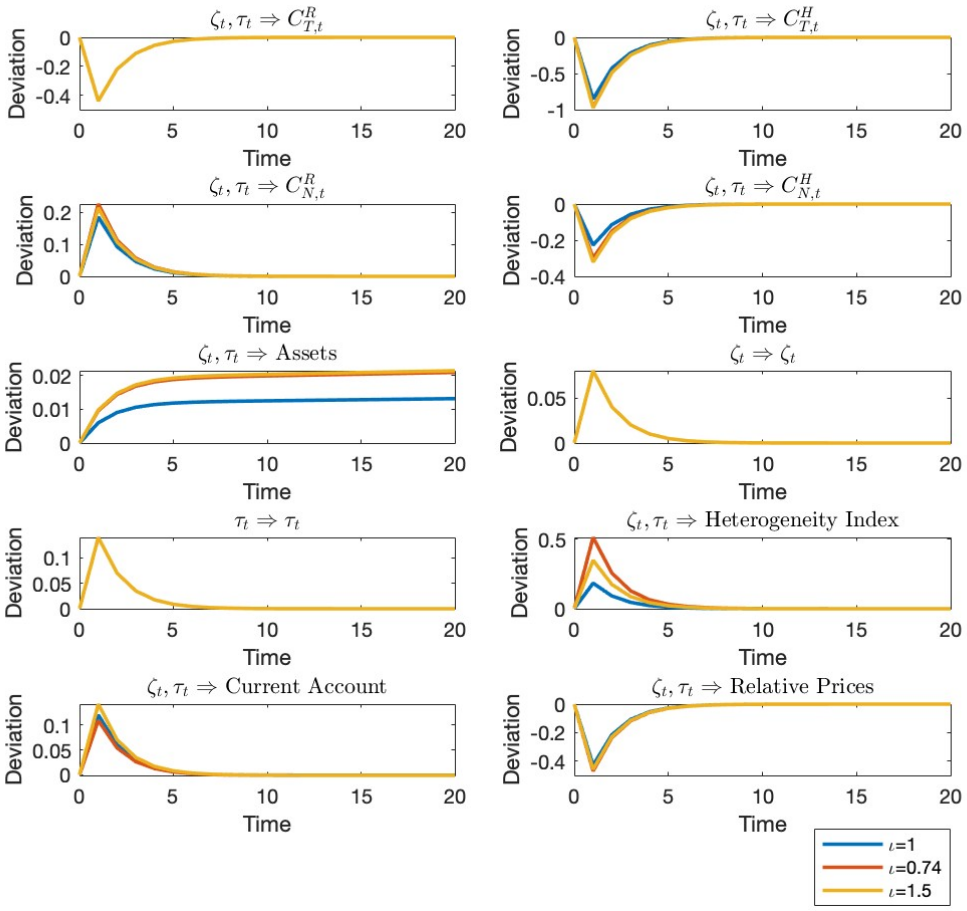


Figure 3: Impulse responses of the main variables to export subsidy policy shock and the value-added tax shock

where the sign of $\frac{dB}{d\zeta}$ is negative, which means that an increase in the level of export subsidy by Ricardian households and hand-to-mouth households implies that the level of bonds in the home country will decrease. So raising ζ reduces B (worsens the NFA). Which means that export volumes increases when ζ rises. However, steady-state bond holdings decline, because the intertemporal adjustment (via asset trade) ensures overall balance. The "extra exports" do not make the country richer; they are offset by a more negative bond position in equilibrium. More exports (because of reduced domestic tradable absorption) improve the trade balance, and thus the current account. This is exactly the type of transitional versus steady-state distinction emphasised in models such as Obstfeld–Rogoff (1996) or Corsetti–Pesenti–Roubini (1998).

These findings indicate that an increase in subsidy on home exports causes a decrease in the domestic consumption of traded goods ($\frac{dC^H_T}{d\zeta} < 0$ and $\frac{dC^R_T}{d\zeta} < 0$), an increase in the domestic consumption of non-traded goods ($\frac{dC^H_N}{d\zeta} > 0$ and $\frac{dC^R_N}{d\zeta} > 0$), and the level of bonds decreases ($\frac{dB}{d\zeta} < 0$).

An increase in export subsidies and value-added taxes have been shown to provide significant stimulus to exports of traded goods in a small open economy with flexible prices. The results depicted in Fig. 3, show that under the condition that the elasticity of substitution between tradables and nontradables is equal to one, the current account improved by about 10 % in the first period. At the same time, the heterogeneity index

increases by 18 % and relative prices increase substantially, rising by up to 48 % relative to their baseline values. Ricardian householdss cut consumption of traded goods and increased raise their consumption of nontraded goods. After a remarkable decrease in the relative prices, hand-to-mouth households in order to afford a more expensive consumption bundle, reduce consumption of both traded and nontraded goods in order to afford the more expensive consumption bundle.

In comparison to the condition when the elasticity of substitution between tradables and nontradables is greater than one, the current account improves by 14% in the first period after the shock, and the heterogeneity index increases by 35%. Finally, under conditions that the elasticity of substitution between tradables and nontradables is less than one, the current account improves by 7%, and the heterogeneity index increases by 51%.

5 Welfare

So far, I have examined at the effects of a unilateral export-subsidy policy on the current account and consumption inequality. In this section, I study how changes in export subsidies affect welfare in the small open economy. A key implication of the model is that export-subsidy policies can worsen welfare by reducing consumption levels. However, consumption is expected rise in subsequent periods of the current account strengthens. First, I consider the economy with no export subsidy. Second, I compare welfare when only Ricardian households are subsidised with welfare when both hand-to-mouth and and Ricardian households receives subsidies. I compute welfare losses in the baseline and extended models using the calibrated levels of consumption. Welfare losses are measured as consumption-equivalent factors (λ) that make households indifferent between the baseline and extended economies.

If I assume that economy remains in the steady-state, then $C^K_{T,t} = \bar{C}^K_T$, $C^K_{N,t} = \bar{C}^K_N$, $C^R_{T,t} = \bar{C}^R_T$ and $C^R_{N,t} = \bar{C}^R_N$. Steady-state levels of traded and nontraded consumptions are determined by equations (58-61) and (63-66). I compute welfare for each types of export subsidy policy: (1) zero export subsidies (U^0); (2) subsidies to hand-to-mouth households (U^H); (3) subsidies to Ricardian households (U^R); and (4) subsidies to both types at & Ricardian (ζ=10%) (U^{HR}). Therefore, the utility differences across scenarios are computed as $\Delta U = U^1 - U^0$ (values to be corrected to match the recomputed utility levels). The CEV, λ is the constant percentage change in consumption each period that makes the household indifferent between U^0 and U^1. Welfare losses are presented in Table 3. It is measured as consumption-equivalent factors (λ), which is determined as

$$\lambda = exp((1-\beta)(U_1 - U_0)) - 1 \tag{60}$$

	Consumption-equivalent factors		
Export subsidy policy	$\iota = 1$	$\iota = 0.74$	$\iota = 1.5$
Hand-to-mouth ($\zeta^H_t = 8\%$)	-0.0007	-0.001	-0.003
Ricardian ($\zeta^R_t = 8\%$)	-0.001	-0.0005	-0.003
Hand-to-mouth & Ricardian ($\zeta_t = 8\%$)	-0.004	-0.004	-0.003
Hand-to-mouth & Ricardian ($\zeta^H_t = 8\%, \zeta^R_t = 10\%$)	-0.003	-0.003	-0.002
Hand-to-mouth & Ricardian ($\zeta^H_t = 10\%, \zeta^R_t = 8\%$)	-0.003	-0.003	-0.002
Hand-to-mouth & Ricardian ($\zeta_t = 8\%$) + the VAT (14%)	-0.007	-0.007	-0.01

Table 4: Welfare analysis

Relative to the baseline with zero export subsidies, welfare falls by the equivalent of a 0.05 % permanent reduction in the composite consumption index (which aggregates traded and nontraded goods). This outcome applies to the case where only Ricardians households are subsidised under condition that $\iota = 0.74$. Welfare falls by 0.4 % when both hand-to-mouth and Ricardian households are subsidised under condition that $\iota = 1$ or $\iota = 0.74$. These results confirm that implementing an export-subsidy policy generates welfare losses. The results align qualitatively with Erceg et al. (2023), although the model structure differs. In the extended model that includes both export subsidies and a value-added tax, the consumption-equivalent loss is about 1 % when $\iota = 1.5$, indicating additional distortions in spending decisions.

6 Discussion of Research Findings

This section presents research findings regarding the short-, and long-term consequences of the export subsidy policy on international trade, the current account, and consumption heterogeneity across households. The section also analyses differences between our results and those of previous studies, and presents the study's limitations and suggestions for future research.

The results indicate that a 8 % export subsidy targeted at hand-to-mouth and Ricardian households leads to an approximately 6-9 % improvement in the current account in the short run depending on the elasticity of substitution between traded and non-traded goods. This effect may occur because the shock lowers relative prices, and both household types respond by reducing their consumption of traded goods. One explanation is that the home country has a fixed endowment of traded goods each period; when domestic consumption of traded goods falls, the surplus is exported to foreign markets. Therefore, an increase in domestic export subsidies leads to higher export volumes. The observed relationship indicates that such subsidies can enhance the home country's trade balance by raising exports, ceteris paribus (i.e., holding imports constant).

These findings are consistent with Salant (1984), Chen and Devereux (1994), Melitz and Messerlin (1987), Brander and Spencer (1985), Mai and Hwang (1987), Itoh and Kiyono (1987), who show that a fixed per unit export subsidy raises the domestic price, stimulates production, and reduces domestic consumption. One notable is that the present study explicitly accounts of households that cannot smooth consumption because of limited access to financial markets. Additionally, the model incorporates consumption heterogeneity (inequality) across household types.

A key finding is that, accounting for household heterogeneity, targeting export subsidies solely Ricardian households improves the current account by about 4 % while increasing measured consumption heterogeneity by 2%, when traded and nontraded goods are gross complements. Additionally, the export subsidy offset consumption heterogeneity, when the elasticity of substitution between traded and non-traded goods is equal to one. Further, export subsidy decreases consumption heterogeneity by 1 %, when the elasticity of substitution between traded and non-traded goods is 0.74.

One limitation is modeling the traded sector as an endowment economy, which prevents analysis of how export subsidies affect domestic production. The model also omits labor-market dynamics: labor supply is assumed inelastic, which precludes analysis of wage responses or other labor-market improvements resulting from higher export volumes. Another limitation is the model's treatment of prices and assets: it features (i) increases in domestic traded-goods prices, (ii) flexible prices, and (iii) an incomplete asset market — assumptions that limit the analysis of some real-world frictions. Future research could address these limitations by introducing production in the traded sector, endogenizing labor supply, and modelling complete asset markets or alternative price rigidities.

Despite these limitations, this study partially addressed them in the following ways: for example, treating traded-sector output as exogenous minimally affects consumption, and dynamics in calibration, and thus does not violate the model's general equilibrium condition. In addition, relaxing the the labour-market assumptions is important; however, this research focuses primarily on consumption-driven currents- account adjustments. Therefore, the paper adopts the TANK (Two-Agent New Keynesian) approach to capitalize on its strengths while minimising its drawbacks. This approach has been widely used by previous researchers to study the current-accounts dynamics. As a result, it seems that it is also appropriate for this study. Therefore, the TANK framework is appropriate for the present analysis.

7 Conclusion

In this paper, I have presented a TANK framework augmented with the export-subsidy policy to study the current-account deficit faced by a small open economy. I show that an export-subsidy shock generates approximately a 9 % improvement in the current account when both hand-to-mouth and Ricardian households receives a 8 % lump-sum subsidy. Considering consumption inequality, defined as the average consumption gap between hand-to-mouth and Ricardian households, I find that subsidising only Ricardian households is more effective, improving the current account by about 5 % while increasing heterogeneity by only 2 %. However, under this fiscal policy, welfare falls by equivalent of a 0.4 % permanent reduction in the composite consumption index relative to zero subsidies when both hand-to-mouth and Ricardian households are subsidised. Over time, rising net foreign assets sustains the stronger current account, allowing higher future consumption and potentially improving welfare. Furthemore, after supplementing the TANK model with lump-sum export subsidies and a value-added tax, I observed an additional 14 % increase in traded-goods exports and a further strengthening of the current account. These results highlight the critical role of export-subsidy policies in improving the current account of small open economies.

A Appendix

A.1 The current account identity

To determine the current account identity, the analysis starts by taking a aggregate of budget constraints across hand-to-mouth and Ricardian households.

$$\frac{P_{N,t}}{P_{T,t}}C^H_{N,t} = \frac{W_{N,t}}{P_{T,t}}N^H_t + (1+\zeta_t)(\bar{y}^H_{T,t} - C^H_{T,t}) + \lambda\frac{\pi_t}{P_{T,t}} - \tau^H_t \tag{61}$$

$$\frac{P_{N,t}}{P_{T,t}}C^R_{N,t} + B_t = (1+\zeta_t)(\bar{y}^R_{T,t} - C^R_{T,t}) + R_{t-1}B_{t-1} + \frac{W_{N,t}}{P_{T,t}}N^R_t - \tau^R_t + (1-\lambda)\frac{\pi_t}{P_{T,t}} \tag{62}$$

The aggregate budget constraints across Keynesian and Ricardian households yields

$$\frac{P_{N,t}}{P_{T,t}}C^H_{N,t} + \frac{P_{N,t}}{P_{T,t}}C^R_{N,t} + B_t = \frac{W_{N,t}}{P_{T,t}}N^H_t + (1+\zeta_t)(\bar{y}^H_{T,t} - C^H_{T,t}) + \lambda\frac{\pi_t}{P_{T,t}} - \tau^H_t + (1+\zeta_t)(\bar{y}^R_{T,t} - C^R_{T,t}) + R_{t-1}B_{t-1} + \frac{W_{N,t}}{P_{T,t}}N^R_t - \tau^R_t + (1-\lambda)\frac{\pi_t}{P_{T,t}} \tag{63}$$

After, the government budget constraint is imposed, the previous equation gives

$$\frac{P_{N,t}}{P_{T,t}}C^H_{N,t} + \frac{P_{N,t}}{P_{T,t}}C^R_{N,t} + B_t = \frac{W_{N,t}}{P_{T,t}}N^H_t + \bar{y}^H_{T,t} - C^H_{T,t} + \lambda\frac{\pi_t}{P_{T,t}} + \bar{y}^R_{T,t} - C^R_{T,t} + R_{t-1}B_{t-1} + \frac{W_{N,t}}{P_{T,t}}N^R_t + (1-\lambda)\frac{\pi_t}{P_{T,t}} \tag{64}$$

In this small open macroeconomic model, nontraded goods are produced by monopolistic firms and consumed entirely within the home country by both types of households. Thus, by incorporating the profit function for nontraded goods and market clearing conditions of nontradables into households budget constraint, the previous equation can be rewritten as

$$B_t = \bar{y}^H_{T,t} - C^H_{T,t} + \bar{y}^R_{T,t} - C^R_{T,t} + R_{t-1}B_{t-1} \tag{65}$$

where,

$$R_{t-1} = 1 + r_{t-1} \tag{66}$$

Thus, eg. (65) can be rewritten as

$$CA_t \equiv B_t - B_{t-1} = \bar{y}^H_{T,t} - C^H_{T,t} + \bar{y}^R_{T,t} - C^R_{T,t} + r_{t-1}B_{t-1} \tag{67}$$

B Appendix

B.1 The model's steady state with export subsidies by both hand-to-mouth and Ricardian households

Equilibrium in the model is defined by a system of nine equations in nine endogenous variables (B_t, $C^H_{T,t}$, $C^R_{T,t}$, $C^H_{N,t}$, $C^R_{N,t}$, $\frac{\pi_t}{P_t}$, $\frac{P_{N,t}}{P_{T,t}}$, $\frac{W_{N,t}}{P_{N,t}}$, $Y_{N,t}$). Eqs. (108)-(110) represent the FOCs, and (214), (115) the budget

constraints of the hand-to-mouth and Ricardian households.

$$\frac{C^H_{T,t}}{C^H_{N,t}} = \frac{\gamma}{(1+\zeta_t)(1-\gamma)}\frac{P_{N,t}}{P_{T,t}} \tag{68}$$

$$\frac{C^R_{T,t}}{C^R_{N,t}} = \frac{\gamma}{(1+\zeta_t)(1-\gamma)}\frac{P_{N,t}}{P_{T,t}} \tag{69}$$

$$\beta R_t \mathbb{E}_t[(C^R_{T,t+1})^{-1}(1+\zeta_{t+1})^{-1}] = (C^R_{T,t})^{-1}(1+\zeta_t)^{-1} \tag{70}$$

$$\beta R_t = 1 \tag{71}$$

$$\frac{P_{N,t}}{P_t}C^H_{N,t} = \frac{W_{N,t}}{P_t}N^H_t + (1+\zeta_t)\left(\frac{P_{T,t}}{P_t}\bar{y}^H_{T,t} - \frac{P_{T,t}}{P_t}C^H_{T,t}\right) - \frac{P_{T,t}}{P_t}\tau^H_t + \lambda\frac{\pi_t}{P_t} \tag{72}$$

$$\frac{P_{N,t}}{P_t}C^R_{N,t} + \frac{P_{T,t}}{P_t}B_t = (1+\zeta_t)\left(\frac{P_{T,t}}{P_t}\bar{y}^R_{T,t} - \frac{P_{T,t}}{P_t}C^R_{T,t}\right) + \frac{P_{T,t}}{P_t}R_{t-1}B_{t-1} + \frac{W_{N,t}}{P_t}N^R_t - \frac{P_{T,t}}{P_t}\tau^R_t + (1-\lambda)\frac{\pi_t}{P_t} \tag{73}$$

Similarly, the firm's profit maximization equation and the FOC is expressed as

$$\frac{\pi_t}{P_t} = \frac{P_{N,t}}{P_t}(i)Y_{N,t}(i) - \frac{W_{N,t}}{P_t}\bar{N}_t(i) \tag{74}$$

$$P_{N,t} = \frac{W_{N,t}}{A_t}\frac{\varepsilon}{\varepsilon-1} \tag{75}$$

The government budget constraint

$$0 = \tau^H_t - \zeta_t(\bar{y}^H_{T,t} - C^H_{T,t}) \tag{76}$$

$$0 = \tau^R_t - \zeta_t(\bar{y}^R_{T,t} - C^R_{T,t}) \tag{77}$$

The LOP

$$P_{T,t} = S_t P^*_{T,t} \tag{78}$$

$$S_t = 1 \tag{79}$$

Goods market clearing for nontraded goods:

$$C^H_{N,t} + C^R_{N,t} \equiv Y_{N,t} \tag{80}$$

Labour market equilibrium

$$\bar{N}_t = A_t\frac{\varepsilon-1}{\varepsilon} \tag{81}$$

Solution:

From the firm's optimality solution I obtain

$$\bar{P}_N = \frac{W_N}{A}\frac{\varepsilon}{\varepsilon - 1} \tag{82}$$

Thus, the real wages can be expressed as

$$\frac{\bar{W}_N}{\bar{P}_N} = A\frac{\varepsilon - 1}{\varepsilon} \tag{83}$$

Using the LOP, I express the aggregate price level in the steady state.

$$P = \gamma P_T^* + (1-\gamma)\left(\frac{W_N}{A}\frac{\varepsilon}{\varepsilon - 1}\right) \tag{84}$$

To solve for C_N^H, I express C_T^H from the FOCs from the hand-to-mouth household's optimality conditions and combine it with the hand-to-mouth BCs:

$$\frac{C_T^H}{C_N^H} = \frac{\gamma}{(1+\zeta_t)(1-\gamma)}\frac{P_N}{P_T} \tag{85}$$

$$\frac{P_N}{P}C_N^H = \frac{W_N}{P}N^H + (1+\zeta)\left(\frac{P_T}{P}\bar{y}_T^H - \frac{P_T}{P}C_T^H\right) - \frac{P_T}{P}\tau^H + (1-\lambda)\frac{\pi}{P} \tag{86}$$

$$0 = \tau_t^H - \zeta_t(\bar{y}_{T,t}^H - C_{T,t}^H) \tag{87}$$

From these 3 equations, I obtain

$$C_N^H = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\frac{W_N}{P_N}N^H + \frac{P_T}{P_N}\bar{y}_T^H + (1-\lambda)\frac{\pi}{P_N}\right] \tag{88}$$

By substituting profit function (17) into equation (31), I obtain

$$C_N^H = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\frac{P_T}{P_N}\bar{y}_T^H + \lambda\left(\bar{Y}_N - \frac{\bar{W}_N}{P_N}\bar{N}^R\right) + (1-\lambda)\frac{W_N}{P_N}N^H\right] \tag{89}$$

To solve for C_N^R, I express C_T^R from the FOCs from the Ricardians household's optimality conditions and combine it with the Ricardians BCs and I also substitute the government budget constraint:

$$\frac{C_T^R}{C_N^R} = \frac{\gamma}{(1+\zeta)(1-\gamma)}\frac{P_N}{P_T} \tag{90}$$

$$\frac{P_N}{P}C_N^R + \frac{P_T}{P}B = (1+\zeta)\left(\frac{P_T}{P}\bar{y}_T^R - \frac{P_T}{P}C_T^R\right) + \frac{P_T}{P}RB + \frac{W_N}{P}N^R - \frac{P_T}{P}\tau + (1-\lambda)\frac{\pi}{P} \tag{91}$$

$$0 = \tau_t^R - \zeta_t(\bar{y}_{T,t}^R - C_{T,t}^R) \tag{92}$$

From these 3 equations, I obtain

$$C_N^R = \frac{(1+\zeta)(1-\gamma)}{(1-\gamma)(1+\zeta)+\gamma}\left[\frac{P_T}{P_N}\bar{y}_T^R + \frac{P_T}{P_N}rB + \frac{W_N}{P_N}N^R + (1-\lambda)\frac{\pi}{P_N}\right] \tag{93}$$

By substituting profit function (17) into equation (26), I obtain

$$C_N^R = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\frac{P_T}{P_N}\bar{y}_T^R + \frac{P_T}{P_N}rB + (1-\lambda)\left(\bar{Y}_N - \frac{\bar{W}_N}{P_N}\bar{N}^H\right) + \lambda\frac{W_N}{P_N}N^R\right] \tag{94}$$

To solve for C_T^H, I express C_N^H from the FOCs from the hand-to-mouth household's optimality conditions and combine it with the hand-to-mouth BCs:

$$\frac{C_T^H}{C_N^H} = \frac{\gamma}{(1+\zeta)(1-\gamma)}\frac{P_N}{P_T} \tag{95}$$

$$\frac{P_N}{P}C_N^H = \frac{W_N}{P}N^H + \frac{P_T}{P}\bar{y}_T^H - \frac{P_T}{P}C_T^H + \lambda\frac{\pi}{P} \tag{96}$$

$$0 = \tau_t^H - \zeta_t(\bar{y}_{T,t}^H - C_{T,t}^H) \tag{97}$$

From these 3 equations, I obtain

$$C_T^H = \frac{\gamma}{(1+\zeta)(1-\gamma)+\gamma}\left[\frac{W_N}{P_T}N^H + \bar{y}_T^H + \lambda\frac{\pi}{P_T}\right] \tag{98}$$

By substituting profit function (17) into equation (26), I obtain

$$C_T^H = \frac{\gamma}{1+\zeta(1-\gamma)}\left[\bar{y}_T^H + \lambda\left(\bar{Y}_N\frac{P_N}{P_T} - \frac{\bar{W}_N}{P_T}\bar{N}^R\right) + (1-\lambda)\frac{W_N}{P_T}N^H\right] \tag{99}$$

To solve for C_T^R, I express C_N^R from the FOCs from the Ricardians household's optimality conditions and substitute it to the Ricardians BCs, and I also substitute the government budget constraint:

$$\frac{C_T^R}{C_N^R} = \frac{\gamma}{(1+\zeta)(1-\gamma)}\frac{P_N}{P_T} \tag{100}$$

$$\frac{P_N}{P}C_N^R + \frac{P_T}{P}B = (1+\zeta)\left(\frac{P_T}{P}\bar{y}_T^R - \frac{P_T}{P}C_T^R\right) + \frac{P_T}{P}RB + \frac{W_N}{P}N^R - \frac{P_T}{P}\tau + (1-\lambda)\frac{\pi}{P} \tag{101}$$

$$0 = \tau_t^R - \zeta_t(\bar{y}_{T,t}^R - C_{T,t}^R) \tag{102}$$

From these 3 equations, I obtain

$$C_T^R = \frac{\gamma}{(1+\zeta)(1-\gamma)+\gamma}\left[\bar{y}_T^R + rB^R + \frac{W_N}{P_T}N^R + (1-\lambda)\frac{\pi}{P_T}\right] \tag{103}$$

By substituting profit function (17) into equation (26), I obtain

$$C_T^R = \frac{\gamma}{1+\zeta(1-\gamma)}\left[\bar{y}_T^R + rB + (1-\lambda)\left(\bar{Y}_N\frac{P_N}{P_T} - \frac{\bar{W}_N}{P_T}\bar{N}^H\right) + \lambda\frac{W_N}{P_T}N^R\right] \tag{104}$$

I multiplied the RHS of C_N^R and C_N^H by $\frac{P_N}{P_T}$ and impose that $Y_N = A\bar{N}$

$$C_T^H = \frac{\gamma}{1+\zeta(1-\gamma)}\left[\bar{y}_T^H + \lambda\left(A\bar{N}\frac{P_N}{P_T^*} - \frac{\bar{W}_N}{P_T^*}\bar{N}^R\right) + (1-\lambda)\frac{W_N}{P_T^*}N^H\right] \tag{105}$$

$$C_N^H = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\bar{y}_T^H + \lambda\left(A\bar{N}\frac{P_N}{P_T^*} - \frac{\bar{W}_N}{P_T^*}\bar{N}^R\right) + (1-\lambda)\frac{W_N}{P_T^*}\bar{N}^H\right] \tag{106}$$

$$C_T^R = \frac{\gamma}{1+\zeta(1-\gamma)}\left[\bar{y}_T^R + rB + (1-\lambda)\left(A\bar{N}\frac{P_N}{P_T^*} - \frac{\bar{W}_N}{P_T^*}\bar{N}^H\right) + \lambda\frac{W_N}{P_T^*}N^R\right] \tag{107}$$

$$C_N^R = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\bar{y}_T^R + rB + (1-\lambda)\left(A\bar{N}\frac{P_N}{P_T^*} - \frac{\bar{W}_N}{P_T^*}\bar{N}^H\right) + \lambda\frac{W_N}{P_T^*}N^R\right] \tag{108}$$

Further simplifying, taking into account that $\bar{N} = \bar{N}^H + \bar{N}^R$

$$C_T^H = \frac{\gamma}{1+\zeta(1-\gamma)}\left[\bar{y}_T^H + \lambda A\bar{N}\frac{P_N}{P_T^*} + \frac{\bar{W}_N}{P_T^*}(\bar{N}^H - \lambda\bar{N})\right] \tag{109}$$

$$C_N^H = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\bar{y}_T^H + \lambda A\bar{N}\frac{P_N}{P_T^*} + \frac{\bar{W}_N}{P_T^*}(\bar{N}^H - \lambda\bar{N})\right] \tag{110}$$

$$C_T^R = \frac{\gamma}{1+\zeta(1-\gamma)}\left[\bar{y}_T^R + rB + (1-\lambda)A\bar{N}\frac{P_N}{P_T^*} + \frac{\bar{W}_N}{P_T^*}(\bar{N}^R - (1-\lambda)\bar{N})\right] \tag{111}$$

$$C_N^R = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\bar{y}_T^R + rB + (1-\lambda)A\bar{N}\frac{P_N}{P_T^*} + \frac{\bar{W}_N}{P_T^*}(\bar{N}^R - (1-\lambda)\bar{N})\right] \tag{112}$$

After that, multiplying and dividing by P_N yields $\frac{P_N\bar{W}_N}{P_T^*P_N}$. Finally substituting $\frac{W_N}{P_N} = A\frac{\varepsilon-1}{\varepsilon}$, I obtain

$$C_T^H = \frac{\gamma}{1+\zeta(1-\gamma)}\left[\bar{y}_T^H + A\frac{P_N}{P_T^*}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{113}$$

$$C_N^H = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\bar{y}_T^H + A\frac{P_N}{P_T^*}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{114}$$

$$C_T^R = \frac{\gamma}{1+\zeta(1-\gamma)}\left[\bar{y}_T^R + rB + A\frac{P_N}{P_T^*}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{115}$$

$$C_N^R = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\bar{y}_T^R + rB + A\frac{P_N}{P_T^*}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{116}$$

By using equation of the CA identity

$$0 = \bar{y}_T^H + \bar{y}_T^R - C_T^H - C_T^R + rB \tag{117}$$

$$B = -r^{-1}\left[\bar{y}_T^H + \bar{y}_T^R - \frac{\gamma}{(1+\zeta)(1-\gamma)} A\bar{N}\frac{P_N}{P_T^*}\right] \tag{118}$$

Ricardians aggregate tradables and non-tradables via CES:

$$C^R = [\gamma {C_T^R}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma){C_N^R}^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}} \tag{119}$$

Ricardian cost minimization Given a target utility level C^R, the Ricardian minimizes expenditure:

$$\begin{aligned} \min_{C_T^R, C_N^R} \quad & C_T^R + \frac{P_N}{P_T} C_N^R \\ \text{s.t.} \quad & C^R = [\gamma {C_T^R}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma){C_N^R}^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}} \end{aligned} \tag{120}$$

$$\mathcal{L} \equiv C_T^R + \frac{P_N}{P_T} C_N^R + \lambda\left(C^R - [\gamma {C_T^R}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma){C_N^R}^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}}\right) \tag{121}$$

that gives the first-order conditions with respect to C_N^R and C_T^R:

$$\frac{P_N}{P_T} - \lambda\frac{\varepsilon}{\varepsilon-1}[\gamma {C_T^R}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma){C_N^R}^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}-1}(1-\gamma)\frac{\varepsilon-1}{\varepsilon}{C_N^R}^{\frac{\varepsilon-1}{\varepsilon}-1} = 0 \tag{122}$$

$$1 - \lambda\frac{\varepsilon}{\varepsilon-1}[\gamma {C_T^R}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma){C_N^R}^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}-1}\gamma\frac{\varepsilon-1}{\varepsilon}{C_T^R}^{\frac{\varepsilon-1}{\varepsilon}-1} = 0 \tag{123}$$

After simplification yields

$$\frac{P_N}{P_T} = \left(\frac{1-\gamma}{\gamma}\right)^{\frac{\varepsilon-1}{\varepsilon}} \tag{124}$$

Finally, substituting the SS levels of consumption gives

$$\frac{P_N}{P_T} = (1+\zeta)^{-\frac{1}{\varepsilon}}\left(\frac{1-\gamma}{\gamma}\right)^{\frac{\varepsilon-1}{\varepsilon}} \tag{125}$$

B.2 The model's steady state with export subsidies and the VAT by both hand-to-mouth and Ricardian households

Equilibrium in the model is defined by a system of nine equations in nine endogenous variables (B_t, $C_{T,t}^H$, $C_{T,t}^R$, $C_{N,t}^H$, $C_{N,t}^R$, $\frac{\pi_t}{P_t}$, $\frac{P_{N,t}}{P_{T,t}}$, $\frac{W_{N,t}}{P_{N,t}}$, $Y_{N,t}$). Eqs. (108)-(110) represent the FOCs, and (214), (115) the budget constraints of the hand-to-mouth and Ricardian households.

$$\frac{C_{T,t}^H}{C_{N,t}^H} = \frac{\gamma}{(1-\gamma)}\frac{1}{(1+\tau_t^H)(1+\zeta_t)}\frac{P_{N,t}}{P_{T,t}} \tag{126}$$

$$\frac{C_{N,t}^R}{C_{T,t}^R} = \frac{(1-\gamma)}{\gamma}\frac{P_{T,t}}{P_{N,t}}[(1+\zeta_t)(1+\tau_t^R)] \tag{127}$$

$$\beta R_t \mathbb{E}_t \left\{ (C^R_{T,t+1})^{-1} [(1+\zeta_{t+1})^{-1}(1+\tau^c_{t+1})^{-1}] \right\} = (C^R_{T,t})^{-1}[(1+\zeta_t)^{-1}(1+\tau^c_t)^{-1}] \tag{128}$$

$$\beta R_t = 1 \tag{129}$$

$$\frac{P_{N,t}}{P_t} C^H_{N,t} = \frac{W_{N,t}}{P_t} N^H_t + (1+\zeta_t)\left[\frac{P_{T,t}}{P_t} \bar{y}^H_{T,t} - (1+\tau^H_t)\frac{P_{T,t}}{P_t} C^H_{T,t} \right] + \lambda \frac{\pi_t}{P_t} \tag{130}$$

$$\frac{P_{N,t}}{P_t} C^R_{N,t} + \frac{P_{T,t}}{P_t} B_t = (1+\zeta_t)\left(\frac{P_{T,t}}{P_t} \bar{y}^R_{T,t} - (1+\tau^R_t)\frac{P_{T,t}}{P_t} C^R_{T,t} \right) + \frac{P_{T,t}}{P_t} R_{t-1} B_{t-1} + \frac{W_{N,t}}{P_t} N^R_t + (1-\lambda)\frac{\pi_t}{P_t} \tag{131}$$

Similarly, the firm's profit maximization equation and the FOC is expressed as

$$\frac{\pi_t}{P_t} = \frac{P_{N,t}}{P_t}(i) Y_{N,t}(i) - \frac{W_{N,t}}{P_t} \bar{N}_t(i) \tag{132}$$

$$P_{N,t} = \frac{W_{N,t}}{A_t} \frac{\varepsilon}{\varepsilon - 1} \tag{133}$$

The government budget constraint

$$0 = \tau^H_t P_{T,t} C^H_{T,t} - \zeta_t P_{T,t} (\bar{y}^H_{T,t} - C^H_{T,t}) \tag{134}$$

$$0 = \tau^R_t P_{T,t} C^R_{T,t} - \zeta_t P_{T,t} (\bar{y}^R_{T,t} - C^R_{T,t}) \tag{135}$$

The LOP

$$P_{T,t} = S_t P^*_{T,t} \tag{136}$$

$$S_t = 1 \tag{137}$$

Goods market clearing for nontraded goods:

$$C^H_{N,t} + C^R_{N,t} \equiv Y_{N,t} \tag{138}$$

Labour market equilibrium

$$\bar{N}_t = A_t \frac{\varepsilon - 1}{\varepsilon} \tag{139}$$

Solution:
From the firm's optimality solution I obtain

$$\bar{P}_N = \frac{W_N}{A} \frac{\varepsilon}{\varepsilon - 1} \tag{140}$$

Thus, the real wages can be expressed as

$$\frac{\bar{W}_N}{\bar{P}_N} = A \frac{\varepsilon - 1}{\varepsilon} \tag{141}$$

Using the LOP, I express the aggregate price level in the steady state.

$$P = \gamma P_T^* + (1-\gamma)\left(\frac{W_N}{A}\frac{\varepsilon}{\varepsilon-1}\right) \tag{142}$$

To solve for C_N^H, I express C_T^H from the FOCs from the hand-to-mouth household's optimality conditions and combine it with the hand-to-mouth BCs:

$$\frac{C_T^H}{C_N^H} = \frac{\gamma}{(1-\gamma)}\frac{1}{(1+\tau^c)(1+\zeta)}\frac{P_N}{P_T} \tag{143}$$

$$\frac{P_N}{P}C_N^H = \frac{W_N}{P}N^H + (1+\zeta)\left[\frac{P_T}{P}\bar{y}_T^H - (1+\tau^c)\frac{P_T}{P}C_T^H\right] + \lambda\frac{\pi}{P} \tag{144}$$

From these 3 equations, I obtain

$$C_N^H = (1-\gamma)\left[\frac{W_N}{P_N}N^H + (1+\zeta)\frac{P_T}{P_N}\bar{y}_T^H + \lambda\frac{\pi}{P_N}\right] \tag{145}$$

By substituting profit function (17) into equation (31), I obtain

$$C_N^H = (1-\gamma)\left[(1+\zeta)\frac{P_T}{P_N}\bar{y}_T^H + \lambda\left(\bar{Y}_N - \frac{\bar{W}_N}{P_N}\bar{N}^R\right) + (1-\lambda)\frac{W_N}{P_N}N^H\right] \tag{146}$$

To solve for C_N^R, I express C_T^R from the FOCs from the Ricardians household's optimality conditions and combine it with the Ricardians BCs and I also substitute the government budget constraint:

$$\frac{C_T^R}{C_N^R} = \frac{\gamma}{(1-\gamma)}\frac{1}{(1+\tau^c)(1+\zeta)}\frac{P_N}{P_T} \tag{147}$$

$$\frac{P_N}{P}C_N^R = (1+\zeta)\left(\frac{P_T}{P}\bar{y}_T^R - (1+\tau^c)\frac{P_T}{P}C_T^R\right) + \frac{P_T}{P}rB + \frac{W_N}{P}N^R + (1-\lambda)\frac{\pi}{P} \tag{148}$$

From these 3 equations, I obtain

$$C_N^R = (1-\gamma)\left[(1+\zeta)\frac{P_T}{P_N}\bar{y}_T^R + \frac{P_T}{P_N}rB + \frac{W_N}{P_N}N^R + (1-\lambda)\frac{\pi}{P_N}\right] \tag{149}$$

By substituting profit function (17) into equation (26), I obtain

$$C_N^R = (1-\gamma)\left[(1+\zeta)\frac{P_T}{P_N}\bar{y}_T^R + \frac{P_T}{P_N}rB + (1-\lambda)\left(\bar{Y}_N - \frac{\bar{W}_N}{P_N}\bar{N}^H\right) + \lambda\frac{W_N}{P_N}N^R\right] \tag{150}$$

To solve for C_T^H, I express C_N^H from the FOCs from the hand-to-mouth household's optimality conditions and combine it with the hand-to-mouth BCs:

$$\frac{C_T^H}{C_N^H} = \frac{\gamma}{(1-\gamma)}\frac{1}{(1+\tau^c)(1+\zeta)}\frac{P_N}{P_T} \tag{151}$$

$$\frac{P_N}{P}C_N^H = \frac{W_N}{P}N^H + (1+\zeta)\left[\frac{P_T}{P}\bar{y}_T^H - (1+\tau^c)\frac{P_T}{P}C_T^H\right] + \lambda\frac{\pi}{P} \tag{152}$$

From these 2 equations, I obtain

$$C_T^H = \frac{\gamma}{(1+\tau^c)(1+\zeta)}\left[\frac{W_N}{P_T}N^H + (1+\zeta)\bar{y}_T^H + \lambda\frac{\pi}{P_T}\right] \tag{153}$$

By substituting profit function (17) into equation (21), the final expressing for the SS level of C_H^K yields

$$C_T^H = \frac{\gamma}{(1+\tau^H)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^H + \lambda\left(\bar{Y}_N\frac{P_N}{P_T} - \frac{\bar{W}_N}{P_T}\bar{N}^R\right) + (1-\lambda)\frac{W_N}{P_T}N^H\right] \tag{154}$$

To solve for C_T^R, I express C_N^R from the FOCs from the Ricardians household's optimality conditions and substitute it to the Ricardians BCs, and I also substitute the government budget constrain

$$\frac{C_T^R}{C_N^R} = \frac{\gamma}{(1-\gamma)}\frac{1}{(1+\tau^c)(1+\zeta)}\frac{P_N}{P_T} \tag{155}$$

$$\frac{P_N}{P}C_N^R = (1+\zeta)\left(\frac{P_T}{P}\bar{y}_T^R - (1+\tau^c)\frac{P_T}{P}C_T^R\right) + \frac{P_T}{P}rB + \frac{W_N}{P}N^R + (1-\lambda)\frac{\pi}{P} \tag{156}$$

From these 3 equations, I obtain

$$C_T^R = \frac{\gamma}{(1+\tau^c)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^R + rB + \frac{W_N}{P_T}N^R + (1-\lambda)\frac{\pi}{P_T}\right] \tag{157}$$

By substituting profit function (17) into equation (26), I obtain

$$C_T^R = \frac{\gamma}{(1+\tau^R)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^R + rB + (1-\lambda)\left(\bar{Y}_N\frac{P_N}{P_T} - \frac{\bar{W}_N}{P_T}\bar{N}^H\right) + \lambda\frac{W_N}{P_T}N^R\right] \tag{158}$$

I multiplied the RHS of C_N^R and C_N^H by $\frac{P_N}{P_T}$ and impose that $Y_N = A\bar{N}$

$$C_T^H = \frac{\gamma}{(1+\tau^H)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^H + \lambda\left(A\bar{N}\frac{P_N}{P_T^*} - \frac{\bar{W}_N}{P_T^*}\bar{N}^R\right) + (1-\lambda)\frac{W_N}{P_T^*}N^H\right] \tag{159}$$

$$C_N^H = (1-\gamma)\left[(1+\zeta)\bar{y}_T^H + \lambda\left(A\bar{N}\frac{P_N}{P_T^*} - \frac{\bar{W}_N}{P_T^*}\bar{N}^R\right) + (1-\lambda)\frac{W_N}{P_T^*}\bar{N}^H\right] \tag{160}$$

$$C_T^R = \frac{\gamma}{(1+\tau^R)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^R + rB + (1-\lambda)\left(A\bar{N}\frac{P_N}{P_T^*} - \frac{\bar{W}_N}{P_T^*}\bar{N}^H\right) + \lambda\frac{W_N}{P_T^*}N^R\right] \tag{161}$$

$$C_N^R = (1-\gamma)\left[(1+\zeta)\bar{y}_T^R + rB + (1-\lambda)\left(A\bar{N}\frac{P_N}{P_T^*} - \frac{\bar{W}_N}{P_T^*}\bar{N}^H\right) + \lambda\frac{W_N}{P_T^*}N^R\right] \tag{162}$$

Further simplifying, taking into account that $\bar{N} = \bar{N}^H + \bar{N}^R$

$$C_T^H = \frac{\gamma}{(1+\tau^H)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^H + \lambda A\bar{N}\frac{P_N}{P_T^*} + \frac{\bar{W}_N}{P_T^*}(\bar{N}^H - \lambda\bar{N})\right] \tag{163}$$

$$C_N^K = (1-\gamma)\left[(1+\zeta)\bar{y}_T^K + \lambda A\bar{N}\frac{P_N}{P_T^*} + \frac{\bar{W}_N}{P_T^*}(\bar{N}^H - \lambda\bar{N})\right] \tag{164}$$

$$C_T^R = \frac{\gamma}{(1+\tau^R)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^R + rB + (1-\lambda)A\bar{N}\frac{P_N}{P_T^*} + \frac{\bar{W}_N}{P_T^*}(\bar{N}^R - (1-\lambda)\bar{N})\right] \tag{165}$$

$$C_N^R = (1-\gamma)\left[(1+\zeta)\bar{y}_T^R + rB + (1-\lambda)A\bar{N}\frac{P_N}{P_T^*} + \frac{\bar{W}_N}{P_T^*}(\bar{N}^R - (1-\lambda)\bar{N})\right] \tag{166}$$

After that, multiplying and dividing by P_N yields $\frac{P_N\bar{W}_N}{P_T^*P_N}$. Finally substituting $\frac{W_N}{P_N} = A\frac{\varepsilon-1}{\varepsilon}$, I obtain

$$C_T^H = \frac{\gamma}{(1+\tau^H)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^H + A\frac{P_N}{P_T^*}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{167}$$

$$C_N^H = (1-\gamma)\left[(1+\zeta)\bar{y}_T^H + A\frac{P_N}{P_T^*}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{168}$$

$$C_T^R = \frac{\gamma}{(1+\tau^R)(1+\zeta)}\left[(1+\zeta)\bar{y}_T^R + rB^R + A\frac{P_N}{P_T^*}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{169}$$

$$C_N^R = (1-\gamma)\left[(1+\zeta)\bar{y}_T^R + rB^R + A\frac{P_N}{P_T^*}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{170}$$

By using equation of the CA identity

$$0 = \bar{y}_T^H + \bar{y}_T^R - C_T^H - C_T^R + rB \tag{171}$$

$$B = -\frac{1}{r}\left[(1+\zeta)(\bar{y}_T^H + \bar{y}_T^R) - \frac{\gamma}{1-\gamma}\bar{Y}_N\frac{P_N}{P_T}\right] \tag{172}$$

Ricardians aggregate tradables and non-tradables via CES:

$$C^R = [\gamma {C_T^R}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma){C_N^R}^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}} \tag{173}$$

Ricardian cost minimization Given a target utility level C^R, the Ricardian minimizes expenditure:

$$\begin{aligned} \min_{C_T^R, C_N^R} \quad & C_T^R + \frac{P_N}{P_T}C_N^R \\ \text{s.t.} \quad & C^R = [\gamma {C_T^R}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma){C_N^R}^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}} \end{aligned} \tag{174}$$

$$\mathcal{L} \equiv C_T^R + \frac{P_N}{P_T}C_N^R + \lambda\left(C^R - [\gamma {C_T^R}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma){C_N^R}^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}}\right) \tag{175}$$

that gives the first-order conditions with respect to C_N^R and C_T^R:

$$\frac{P_N}{P_T} - \lambda \frac{\varepsilon}{\varepsilon - 1} [\gamma C_T^R{}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma) C_N^R{}^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}-1} (1-\gamma) \frac{\varepsilon - 1}{\varepsilon} C_N^R{}^{\frac{\varepsilon-1}{\varepsilon}-1} = 0 \tag{176}$$

$$1 - \lambda \frac{\varepsilon}{\varepsilon - 1} [\gamma C_T^R{}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma) C_N^R{}^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}-1} \gamma \frac{\varepsilon - 1}{\varepsilon} C_T^R{}^{\frac{\varepsilon-1}{\varepsilon}-1} = 0 \tag{177}$$

After simplification yields

$$\frac{P_N}{P_T} = \left(\frac{1-\gamma}{\gamma} \right)^{\frac{\varepsilon-1}{\varepsilon}} \tag{178}$$

Finally, substituting the SS levels of consumption gives

$$\frac{P_N}{P_T} = (1+\zeta)^{-\frac{1}{\varepsilon}} (1+\tau^R)^{-\frac{1}{\varepsilon}} \left(\frac{1-\gamma}{\gamma} \right)^{\frac{\varepsilon-1}{\varepsilon}} \tag{179}$$

C Appendix

C.1 The model's steady state

The model's steady state with zero export subsidy

$$\bar{Y}_N = A\bar{N} \tag{180}$$

$$\frac{\bar{W}_N}{\bar{P}_N} = A \frac{\varepsilon - 1}{\varepsilon} \tag{181}$$

$$\frac{\bar{P}_N}{\bar{P}_T} = \left(\frac{1-\gamma}{\gamma} \right)^{\frac{\iota-1}{\iota}} \tag{182}$$

$$\bar{C}_T^H = \gamma \left[\bar{y}_T^H + A \frac{\bar{P}_N}{\bar{P}_T} \left(\frac{\lambda}{\varepsilon} \bar{N} + \frac{\varepsilon - 1}{\varepsilon} \bar{N}^H \right) \right] \tag{183}$$

$$\bar{C}_N^H = (1-\gamma) \left[\bar{y}_T^H + A \frac{\bar{P}_N}{\bar{P}_T} \left(\frac{\lambda}{\varepsilon} \bar{N} + \frac{\varepsilon - 1}{\varepsilon} \bar{N}^H \right) \right] \tag{184}$$

$$\bar{C}_T^R = \gamma \left[\bar{y}_T^R + rB + A \frac{\bar{P}_N}{\bar{P}_T} \left(\frac{1-\lambda}{\varepsilon} \bar{N} + \frac{\varepsilon - 1}{\varepsilon} \bar{N}^R \right) \right] \tag{185}$$

$$\bar{C}_N^R = (1-\gamma) \left[\bar{y}_T^R + rB + A \frac{\bar{P}_N}{\bar{P}_T} \left(\frac{1-\lambda}{\varepsilon} \bar{N} + \frac{\varepsilon - 1}{\varepsilon} \bar{N}^R \right) \right] \tag{186}$$

$$\bar{B} = -r^{-1} \left[\bar{y}_T^H + \bar{y}_T^R - \frac{\gamma}{1-\gamma} A \bar{N} \frac{\bar{P}_N}{\bar{P}_T} \right] \tag{187}$$

The model's steady state with an export subsidy for hand-to-mouth households

$$\frac{\bar{P}_N}{\bar{P}_T} = \left(\frac{1-\gamma}{\gamma}\right)^{\frac{\iota-1}{\iota}} \tag{188}$$

$$\bar{C}_T^H = \frac{\gamma}{1+\zeta(1-\gamma)}\left[\bar{y}_T^H + A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{189}$$

$$\bar{C}_N^H = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\bar{y}_T^H + A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{190}$$

$$\bar{C}_T^R = \gamma\left[\bar{y}_T^R + rB + A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{191}$$

$$\bar{C}_N^R = (1-\gamma)\left[\bar{y}_T^R + rB + A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{192}$$

$$\bar{B} = r^{-1}\left[-\frac{(1+\zeta)}{1+\zeta(1-\gamma)}\bar{y}_T^H + \bar{y}_T^R + \frac{\gamma}{[1+\zeta(1-\gamma)](1-\gamma)}A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right) + \frac{\gamma}{1-\gamma}A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{193}$$

The model's steady state with an export subsidy for Ricardian households by the small open economy country

$$\frac{\bar{P}_N}{\bar{P}_T} = (1+\zeta)^{-\frac{1}{\iota}}\left(\frac{1-\gamma}{\gamma}\right)^{\frac{\iota-1}{\iota}} \tag{194}$$

$$\bar{C}_T^H = \gamma\left[\bar{y}_T^H + A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{195}$$

$$\bar{C}_N^H = (1-\gamma)\left[\bar{y}_T^H + A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^H\right)\right] \tag{196}$$

$$\bar{C}_T^R = \frac{\gamma}{1+\zeta(1-\gamma)}\left[\bar{y}_T^R + rB + A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{197}$$

$$\bar{C}_N^R = \frac{(1+\zeta)(1-\gamma)}{1+\zeta(1-\gamma)}\left[\bar{y}_T^R + rB + A\frac{\bar{P}_N}{\bar{P}_T}\left(\frac{1-\lambda}{\varepsilon}\bar{N} + \frac{\varepsilon-1}{\varepsilon}\bar{N}^R\right)\right] \tag{198}$$

$$\bar{B} = -r^{-1}\left[\frac{1+\zeta(1-\gamma)}{(1+\zeta)}\bar{y}_T^H + \bar{y}_T^R + \frac{\gamma(1+\lambda\zeta(1-\gamma))}{(1-\gamma)(1+\zeta)}A\bar{N}\frac{\bar{P}_N}{\bar{P}_T} - \frac{\gamma\zeta}{1+\zeta}\frac{\bar{P}_N}{\bar{P}_T}A\frac{\varepsilon-1}{\varepsilon}\left(\lambda N^R - (1-\lambda)N^H\right)\right] \tag{199}$$

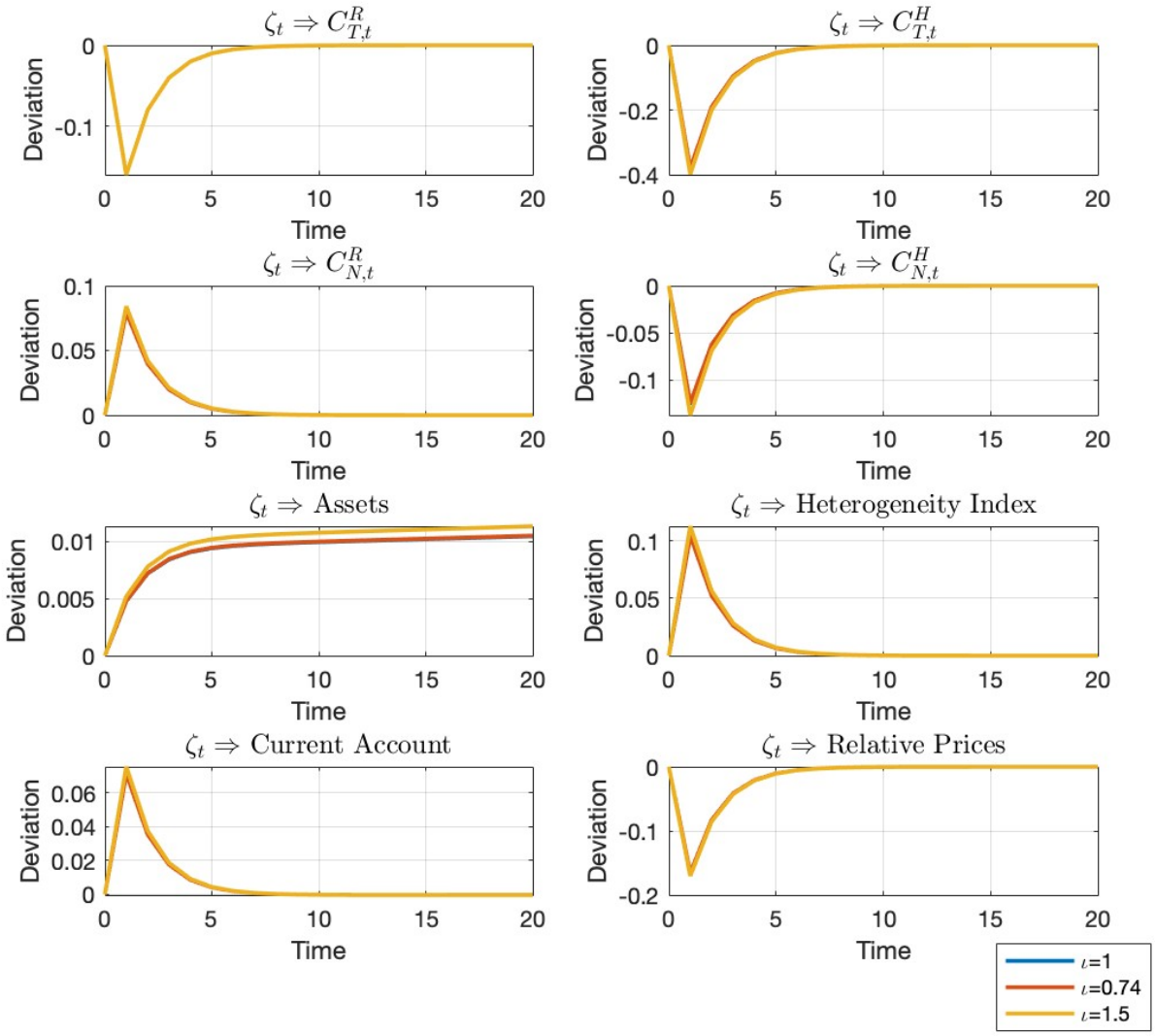


Figure 4: Impulse responses to export subsidy policy shock (Ricardian (8%) & Hand-to-mouth (10%)

D Appendix

D.1 Keynesian & Ricardian net export promotion (different rates of export subsidies)

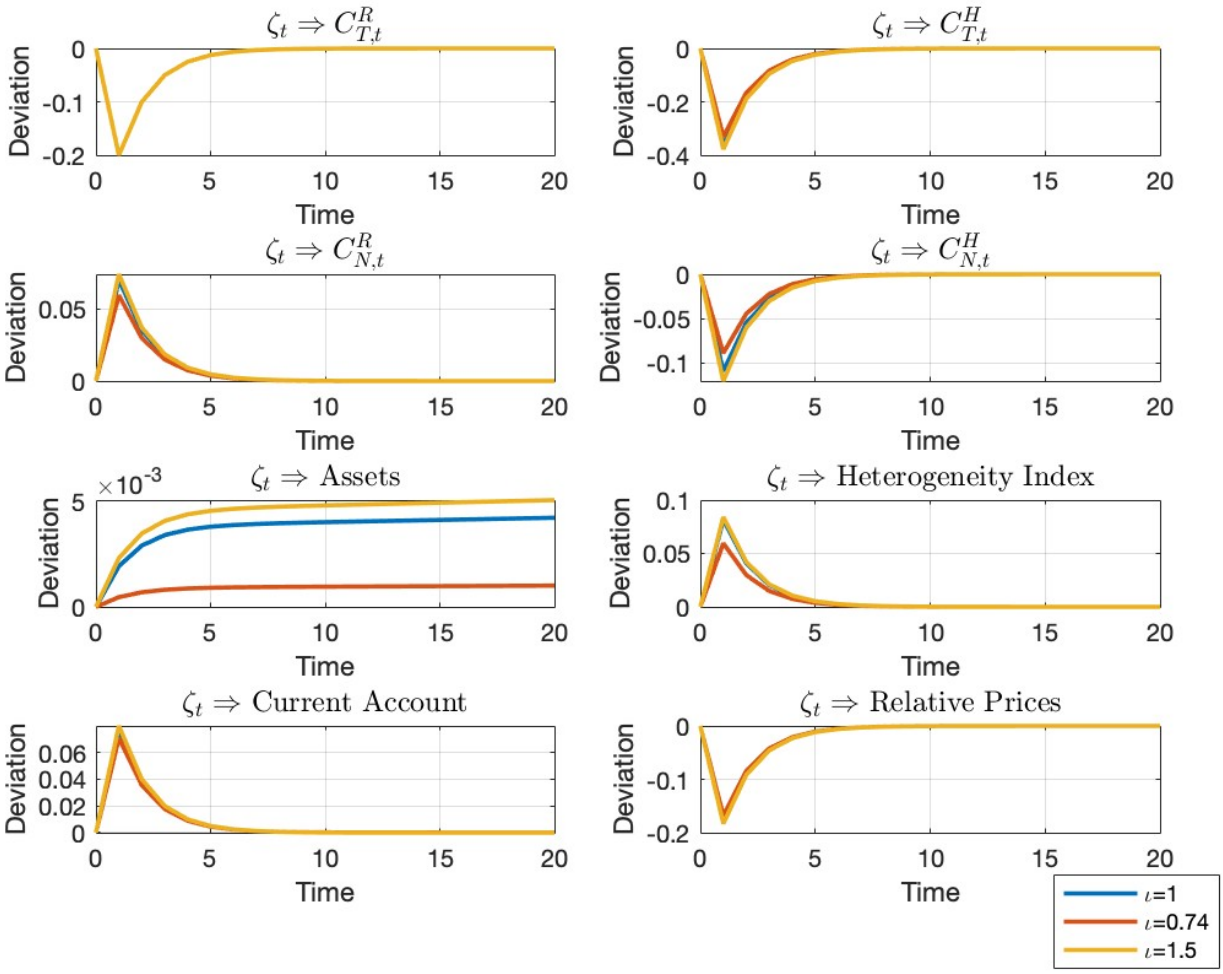


Figure 5: Impulse responses to export subsidy policy shock (Ricardian (10%) & Hand-to-mouth (8%)

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