International Sanctions and Limits of Lerner Symmetry*

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After a wave of globalization following the end of the Cold War, trade wars and financial sanctions have become frequent tools of international policymaking over the last ten years. This renewal has led to an increased interest in the welfare and allocative consequences, and more generally the overall effectiveness of international sanctions. Studying these questions in Itskhoki and Mukhin (2022b), we show that Lerner (1936) symmetry provides an important benchmark with import and export sanctions equivalent in terms of their effects on allocations and welfare. However, this analysis abstracts from several practical issues, including the timing of sanctions, the interactions between trade and financial restrictions, and the effects of sanctions on the financial sector. This article incorporates these features into the model and studies their implications for the equivalence of export and import sanctions, emphasizing points of departure from Lerner symmetry.[1]

Setup Assume there are two periods $t = 1, 2$ and consider a small open economy with non-tradables C_t, imported goods C_t^*, and exported commodities Y_t^*. Households choose consumption of home and foreign goods and savings in a foreign-currency (dollar) bond B_1^* with gross returns R^* to maximize utility $u(C_1, C_1^*, C_2, C_2^*)$ subject to budget constraints

$$P_1 C_1 + \mathcal{E}_1 P_1^* C_1^* + \frac{\mathcal{E}_1 B_1^*}{R^*} = \Pi_1, \qquad P_2 C_2 + \mathcal{E}_2 P_2^* C_2^* = \mathcal{E}_2 B_1^* + \Pi_2,$$

where P_t is the price of home goods, P_t^* is the price of import goods in foreign currency, Π_t are profits of firms, and $\mathcal{E}_t$ is the nominal exchange rate, defined in units of home currency for one unit of foreign currency. The optimal expenditure switching between home and foreign

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[1]For a complementary discussion of departures from Lerner symmetry under sticky prices see Barbiero, Farhi, Gopinath, and Itskhoki (2019) in the context of a border adjustment tax.

goods pins down the equilibrium real exchange rate

$$\frac{\mathcal{E}_t}{P_t} = \frac{u_{C_t^*}}{P_t^* u_{C_t}}$$

and the elasticity of substitution between goods is assumed to be greater than one.

Given the global price of commodities Q_t^*, firms maximize a discounted sum of profits $\Pi_t = P_t Y_t + \mathcal{E}_t Q_t^* Y_t^*$ subject to an exogenous endowment of non-tradables Y_t and a production possibility frontier for exported goods $F(Y_1^*, Y_2^*) = 0$, which captures an intertemporal substitution in the production of commodities. The equilibrium is efficient, and following the first welfare theorem, we focus on the planner's problem:

$$\max_{C_1^*, C_2^*, Y_1^*, Y_2^*} U(C_1^*, C_2^*) \quad \text{s.t.} \quad P_1^* C_1^* + \frac{P_2^* C_2^*}{R^*} = Q_1^* Y_1^* + \frac{Q_2^* Y_2^*}{R^*}, \quad F(Y_1^*, Y_2^*) = 0.$$

where $U(C_1^*, C_2^*) \equiv u(Y_1, C_1^*, Y_2, C_2^*)$. For simplicity, the welfare calculations below assume that $U(\cdot)$ and $F(\cdot)$ are homothetic CES functions with elasticities σ and θ, while all figures illustrate the case of zero substitution in production $\theta = 0$ with $Y_1^* = Y_2^* = 1$.

Lerner symmetry We consider two types of exogenous shocks — import sanctions that increase the ideal price index for imported goods P_t^* and export sanctions that reduce export revenues Q_t^* — and ask which ones are more damaging to the economy.[2] Given that the aggregate terms of trade $S_t^* \equiv Q_t^*/P_t^*$ form a sufficient statistic for the impact of sanctions in a static model (Sturm 2022), our analysis focuses on two paths of shocks $\{P_1^*, P_2^*\}$ and $\{Q_1^*, Q_2^*\}$ with the same resulting path of the terms of trade $\{S_1^*, S_2^*\}$. The country's welfare function can then be defined as

$$V = \max_{C_1^*, C_2^*, Y_1^*, Y_2^*} U(C_1^*, C_2^*) \quad \text{s.t.} \quad C_1^* + \frac{C_2^*}{\tilde{R}^*} = S_1^* Y_1^* + \frac{S_2^* Y_2^*}{\tilde{R}^*}, \quad F(Y_1^*, Y_2^*) = 0,$$

where $\tilde{R}^* = \frac{R^*}{P_2^*/P_1^*}$ is the real interest rate in terms of imported consumption goods.

An important benchmark considered in Itskhoki and Mukhin (2022b) is when sanctions are *permanent and uniform* across periods. Both export and import sanctions reduce the real income of the economy — either by limiting the inflow of dollars or increasing the dollar prices of foreign goods — shifting the country's budget constraint inwards, lowering imports, and reducing welfare. Because the terms of trade $\{S_t^*\}$ deteriorate by the same amount and $\tilde{R}^* = R^*$, the real effects of import and export sanctions are the same, consistent with Lerner (1936) symmetry of import tariffs and export taxes. At the same time, this equivalence of outcomes must be supported by an exchange rate depreciation ($\mathcal{E}_t/P_t \uparrow$) under export sanctions which limit

[2] From the point of view of the domestic economy , it does not matter whether these sanctions are implemented using trade tariffs, price floor/ceiling, or quantity restrictions.

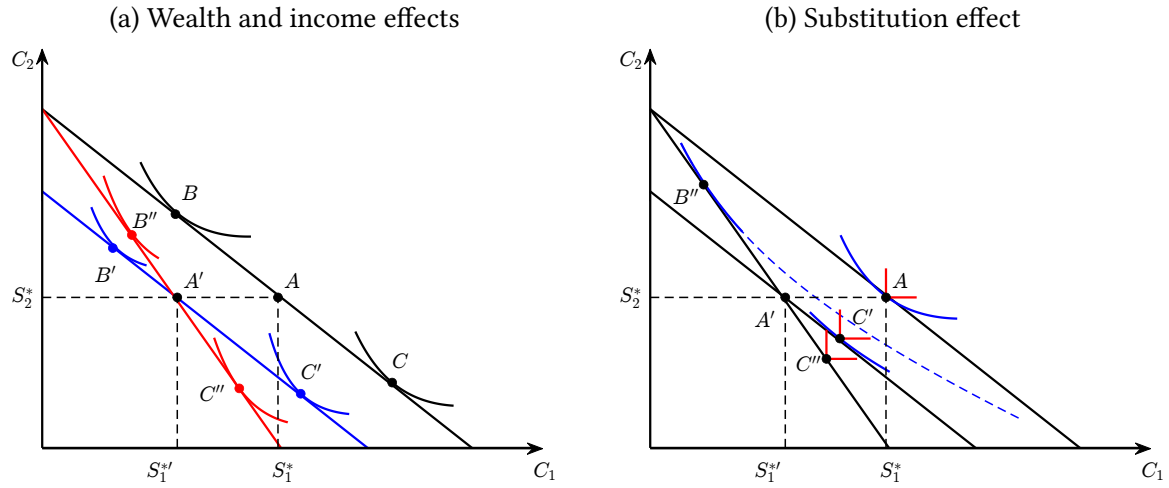

Figure 1: Frontloaded sanctions

Note: Panel (a) illustrates the effect of frontloaded temporary export (in blue) and import (in red) sanctions for a saver (points B) and a borrower (points C) country respectively. Panel (b) illustrates the second order consumption substitution effect for $\sigma = 0$ (points C) and for $\sigma > 1$ (point B''). Parallel inward shift of the budget constraint line corresponds to export sanctions (reduction in S_1^*), and frontloaded import sanctions add an additional clockwise rotation around $(S_1^{*\prime}, S_2^*)$ corresponding to an increase in $\tilde{R}^*$. Figures normalize $Y_1^* = Y_2^* = 1$.

the supply of foreign currency and by an exchange rate appreciation ($\mathcal{E}_t/P_t \downarrow$) under import sanctions which limit the demand for foreign currency.

Frontloaded sanctions The equivalence between import and export sanctions disappears when restrictions are imposed *non-uniformly* over time. Consider frontloaded temporary sanctions that reduce S_1^* without affecting S_2^*. Using the envelope condition, the first-order welfare effect is given by

$$\mathrm{d}\log V = \underbrace{\Phi\,\mathrm{d}\log S_1^*}_{\text{wealth effect}} + \underbrace{(\Phi-\Omega)\,\mathrm{d}\log \tilde{R}^*}_{\text{income effect}}, \tag{1}$$

where $\Phi \equiv \frac{Q_1^*Y_1^*}{Q_1^*Y_1^*+Q_2^*Y_2^*/R^*}$ and $\Omega \equiv \frac{P_1^*C_1^*}{P_1^*C_1^*+P_2^*C_2^*/R^*}$ are respectively the shares of first-period revenues and expenditures in the permanent income of the economy. The first term represents the wealth effect and is the same for the two types of sanctions, while the second term corresponds to the income effect and is non-zero only for import restrictions.[3]

With frontloaded import sanctions, $\mathrm{d}\log \tilde{R}^* > 0$, as import prices increase temporarily in the first period and fall back in the second period, resulting in an increase in the effective interest rate that is absent under export sanctions. It follows that borrower countries with a first-period current account deficit $\Phi < \Omega$ suffer more from frontloaded import sanctions,

[3] A first-order income effect arises in response to a change in the consumption-based real interest rate $\tilde{R}^*$ when the country is either a borrower ($\Phi < \Omega$) or a lender ($\Phi > \Omega$), and this effect is distinct from a second order substitution effect that we explore below (see Obstfeld and Rogoff 1996, Ch. 1.3.2). For this reason, elasticities of substitution σ and θ do not appear in the first-order expansion (1).

while lender countries that run a first-period current account surplus $\Phi > \Omega$ are more sensitive to export sanctions. This departure from Lerner symmetry is the result of a differential change in the intertemporal price introduced by temporary import sanctions.

Figure 1a illustrates this result. Both export and import sanctions worsen terms of trade S_1^* resulting in an inward shift of the endowment point A to point A'. Both saver and borrower countries experience a negative wealth effect moving from B to B' and from C to C' respectively. However, under import sanctions, there is an additional income effect from an increase in $\tilde{R}^*$ which rotates the budget set and improves welfare for borrowers (shift from B' to B'') and reduces welfare for lenders (shift from C' to C'').

Non-linear effects The welfare analysis above focuses on the first-order effects, which provide an accurate approximation when economic sanctions are small. In practice, imposed restrictions are often sufficiently large to generate substantial intertemporal substitution in production and consumption. To characterize these additional substitution effects from front-loaded temporary sanctions, we take a second-order approximation to the country's welfare around the autarky equilibrium with $\Phi = \Omega$ (*cf.* Baqaee and Farhi 2019):

$$\mathrm{d}\log V = \Omega\,\mathrm{d}\log S_1^* + \frac{1}{2}\Omega(1-\Omega)\Big[(\sigma-1)(\mathrm{d}\log P_1^*)^2 + (\theta+1)(\mathrm{d}\log Q_1^*)^2\Big]. \tag{2}$$

Consistent with the analysis above, import and export sanctions are equivalent up to the first order for a country with a zero net foreign asset position — an approximate version of Lerner symmetry with temporary sanctions.

At the same time, the two types of restrictions have different substitution effects captured by the second-order terms. As shown in Figure 1b, a temporary increase in import prices has two effects. On the one hand, by reducing real income in the first period, import sanctions induce the economy to run a current account deficit. As mentioned above, a borrowing country loses more from higher P_1^*, and we now show that this effect is convex. This corresponds to moving from point C' to C'' in the figure. On the other hand, intertemporal substitution allows the country to mitigate the negative effect of temporary sanctions by shifting consumption to the second period. In fact, the country can switch from borrowing to saving, i.e. move from point C'' to B'', if the elasticity is high enough. The net effect depends on the intertemporal elasticity of substitution and is positive when $\sigma > 1$, that is when the positive second-order substitution effect ($=\sigma$) dominates the negative second-order income effect ($=1$).

Similarly, a fall in export prices in the first period can be partially offset by shifting the production of commodities to the second period. This means that export revenues fall less than export prices which is consistent with a positive coefficient in front of $(\mathrm{d}\log Q_1^*)^2$. The higher the elasticity of substitution in production θ, the easier it is to alleviate the effect of

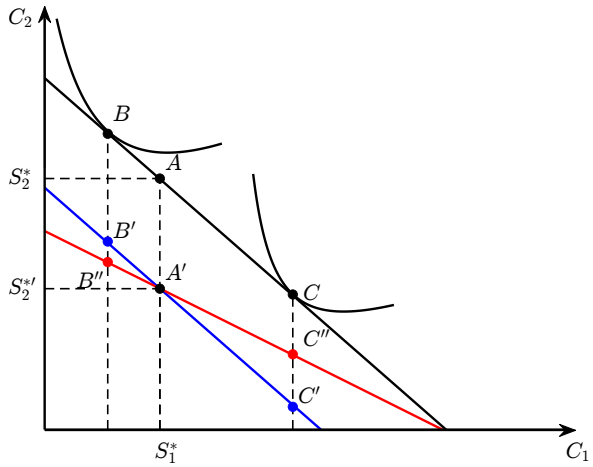

Figure 2: Backloaded sanctions

Note: The figure illustrates the effects of future unexpected export (in blue) and import (in red) sanctions for a saver (points B) and a borrower (points C) country respectively. Note the downward shift of the budget constraint under future export sanctions and its additional counterclockwise rotation under future import sanctions.

export sanctions.[4] To summarize, the ability of the country to substitute consumption and production intertemporally drives a wedge between the welfare effects of *temporary* import and export sanctions, amplifying the departure from Lerner symmetry.

Backloaded sanctions A symmetric argument applies to backloaded sanctions. To the first order, countries with a trade surplus are more sensitive to future increases in import prices than to future restrictions on their exports because of the negative effect of P_2^* on their savings. Furthermore, higher elasticities of substitution allow economies to mitigate the effect of sanctions by shifting consumption and production towards the first period with more favorable terms of trade. This analysis assumes that future sanctions are pre-announced in advance.

What happens when shocks to future terms of trade $S_2^* = Q_2^*/P_2^*$ are unanticipated? Both export and import sanctions lower real income in the second period, $S_2^* Y_2^*$, shifting down the endowment point A to A' in Figure 2. Given the unexpected nature of shocks, there is no substitution across periods. Yet, Lerner symmetry still does not hold in this case, with second-period consumption C_2^* being more sensitive to future import sanctions for lenders (point B'' vs B') and to future export restrictions for borrowers (point C' vs C''). This discrepancy arises from the income effect. The purchasing power of accumulated assets B_1^* depends on import prices P_2^*, but not on export revenues $Q_2^* Y_2^*$. The real value of both assets and liabilities goes down in response to import sanctions generating a positive income effect for borrowers and a negative income effect for lenders. Notice that the same logic extends to the first period

[4]Note that the second-order welfare effect of temporary export sanctions is positive even when $\theta = 0$ due to the ability of the country to intertemporally smooth consumption, that is to shift from the autarky point A' to point C' in Figure 1b. Also note from (2) that both consumption and production substitution effects are stronger when expenditures and revenues are distributed more uniformly across periods, i.e. $\Omega \approx 1/2$.

if the economy starts with a non-zero net foreign asset position resulting in deviations from Lerner symmetry even under permanent sanctions. The equivalence can be restored if export sanctions are coupled with a net foreign asset tax, which effectively extends the export tax to all previous trade surpluses (see Itskhoki and Mukhin 2022b).

Financial sanctions In practice, trade sanctions are often combined with financial restrictions, in particular, the exclusion of countries from international borrowing markets. Imposing a borrowing constraint $C_1^* \leq S_1^* Y_1^*$ affects the equilibrium allocation when the country runs a current account deficit in the first period. Nonetheless, borrowing constraints do *not* compromise Lerner symmetry between *permanent* import and export sanctions. Furthermore, if the country completely loses access to global financial markets and can neither borrow nor save internationally, the trade is balanced period-by-period and, as a result, the equivalence between import and export sanctions holds even when they are temporary (shift from point A to point A' in Figures 1 and 2).

To the contrary, partial access to international capital markets can amplify the difference between the effects of import and export sanctions when they are temporary. The borrowing constraint ensures that the current account of the economy is weakly positive and, as a result, frontloaded export sanctions and backloaded import sanctions are unambiguously more damaging as borrowing for intertemporal substitution is ruled out in this case. We illustrate the case of frontloaded sanctions under borrowing restrictions in Figure 3. In this case, without financial constraints, the country would borrow under export sanctions and save under import sanctions. However, when borrowing is ruled out, the country must consume the new endowment point A' under export sanctions, amplifying their welfare effects. This is the sense in which financial and export sanctions are complementary.

Importantly, the model also suggests that the sanctioned economy can evade financial sanctions and borrowing constraints by selling claims to future output. Such contracts can take the form of commodity futures or stakes in commodity exporting firms. As long as there are investors — perhaps from non-sanctioning countries — willing to trade such assets, the country's budget constraint is fully restored. In particular, the government can cover additional expenses relative to its export revenues by selling claims worth $P_1^* C_1^* - Q_1^* Y_1^*$ out of the country's future output $Q_2^* Y_2^* / R^*$. This is equivalent to changing the endowment from point A to point C in Figure 3 and allows the country to evade the borrowing constraint and implement optimal consumption smoothing.[5] Import and export sanctions still work in this case as before (Figure 1a). However, when commodities are perfectly storable ($\theta \to \infty$), then such forward financial contracts may help evade export and financial sanctions entirely, while import sanctions remain effective.

[5] Alternatively, the country can sell claims to its entire output moving the endowment to point F in Figure 3 and save the proceeds to finance future consumption. However, this strategy is subject to the risk of additional

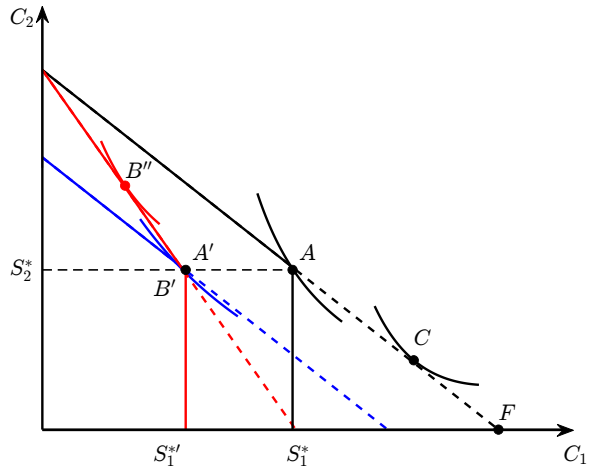

Figure 3: Borrowing limit and the forward sale of endowment

Note: Borrowing limit is binding under export sanctions in point $A' = B'$ and slack under import sanctions in point B''. Forward sale of endowment relaxes the borrowing limit and makes points C and F feasible.

Financial frictions Finally, deviations from Lerner symmetry may arise due to financial frictions. To see this, consider again the case of permanent import and export sanctions, which in the baseline model result in the same allocations. However, while terms of trade shocks Q_t^*/P_t^* are the same, the real exchange rate $\mathcal{E}_t/P_t$ must move in opposite directions in response to import and export restrictions (Itskhoki and Mukhin 2022b). This differential exchange rate movement may then result in a differential tightening of the international borrowing limit (see e.g. Bianchi 2011) or of the debt overhang constraint in the domestic economy (see e.g. Eggertsson and Krugman 2012). Taking the second route, assume that domestic output depends negatively on the gross real debt in the economy $Y_t = Y\left(\frac{D_{t-1}+\mathcal{E}_t D_{t-1}^*}{P_t}\right)$, where D_t and D_t^* are gross amounts of debt denominated in local and foreign currency respectively. It follows that export sanctions are more damaging to the economy as they depreciate the real exchange rate ($\mathcal{E}_t/P_t \uparrow$) thereby increasing debt burden and lowering output. This effect is stronger for economies with a more dollarized credit market, when D_{t-1}^* is large relative to D_{t-1}.

With foreign-currency borrowing, Lerner symmetry requires that all debt contracts (domestic and international) denominated in foreign currency be adjusted downwards when export sanctions are imposed (*cf.* Farhi, Gopinath, and Itskhoki 2014). Furthermore, ex-post government interventions that redistribute wealth from savers to borrowers can mitigate the negative effect of export sanctions on local output when it is constrained by debt overhang. This includes partially inflating away or defaulting all gross debt positions, a temporary freeze of debt repayment (e.g. a bank holiday), and direct government bailouts.[6] In contrast, import sanctions reduce foreign currency demand, appreciate the domestic exchange rate and, hence,

financial sanctions and future asset freezes.

[6] As a second-best policy, the government can also use FX interventions and capital controls to offset the depreciation of the exchange rates (see Itskhoki and Mukhin 2022a).

tend to relax financial constraints in the economy. This is the sense in which export and financial sanctions may trigger a financial crisis episode, while import sanctions tend to mitigate it.

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Appendix

Consider the planner's problem

$$\max_{C_1^*,C_2^*,Y_1^*,Y_2^*} U(C_1^*,C_2^*) \quad \text{s.t.} \quad P_1^*C_1^* + \frac{P_2^*C_2^*}{R^*} = Q_1^*Y_1^* + \frac{Q_2^*Y_2^*}{R^*}, \quad F(Y_1^*,Y_2^*) = 0,$$

with isoelastic preferences and CES production frontier:

$$U(C_1^*,C_2^*) = \frac{1}{1-\frac{1}{\sigma}}\left[C_1^{*1-\frac{1}{\sigma}} + \beta C_2^{*1-\frac{1}{\sigma}}\right]^{\frac{1}{1-\frac{1}{\sigma}}}, \qquad F(Y_1^*,Y_2^*) = a_1^{-\frac{1}{\theta}}{Y_1^*}^{\frac{\theta+1}{\theta}} + a_2^{-\frac{1}{\theta}}{Y_2^*}^{\frac{\theta+1}{\theta}} - 1,$$

where $a_1 + a_2 = 1$ and $\sigma, \theta > 0$. The first-order conditions characterize the optimal intertemporal choice of consumption and production:

$$\frac{C_2^*}{C_1^*} = \left(\beta R^* \frac{P_1^*}{P_2^*}\right)^{\sigma}, \qquad \frac{Y_2^*}{Y_1^*} = \frac{a_2}{a_1}\left(\frac{Q_2^*}{R^* Q_1^*}\right)^{\theta}.$$

Substitute the latter condition into the production constraint to solve for Y_1^* and Y_2^*. Combining with the optimal consumption smoothing and the country's budget constraint, this leads to the welfare function

$$V = \frac{\sigma}{\sigma-1}\left[P_1^{*1-\sigma} + \beta^{\sigma}\left(\frac{P_2^*}{R^*}\right)^{1-\sigma}\right]^{\frac{1}{\sigma-1}}\left[a_1 Q_1^{*\theta+1} + a_2\left(\frac{Q_2^*}{R^*}\right)^{\theta+1}\right]^{\frac{1}{\theta+1}}.$$

Given the focus on the frontloaded shocks, rewrite the welfare briefly as

$$\log V = \frac{1}{\sigma-1}\log\left[\gamma + P_1^{*1-\sigma}\right] + \frac{1}{\theta+1}\log\left[\alpha + Q_1^{*\theta+1}\right] + \log\frac{\sigma a_1}{\sigma-1},$$

where $\gamma \equiv \beta^{\sigma}\left(\frac{P_2^*}{R^*}\right)^{1-\sigma}$, $\alpha \equiv \frac{a_2}{a_1}\left(\frac{Q_2^*}{R^*}\right)^{\theta+1}$. The first-order derivatives of $\log V$ are given by

$$\frac{\partial \log V}{\partial \log P_1^*} = -\frac{P_1^{*1-\sigma}}{\gamma + P_1^{*1-\sigma}}, \qquad \frac{\partial \log V}{\partial \log Q_1^*} = \frac{Q_1^{*\theta+1}}{\alpha + Q_1^{*\theta+1}}$$

and the second-order derivatives are

$$\frac{\partial^2 \log V}{(\partial \log P_1^*)^2} = \frac{(\sigma-1)\gamma P_1^{*1-\sigma}}{\left(\gamma + P_1^{*1-\sigma}\right)^2}, \qquad \frac{\partial^2 \log V}{(\partial \log Q_1^*)^2} = \frac{(\theta+1)\alpha Q_1^{*\theta+1}}{\left(\alpha + Q_1^{*\theta+1}\right)^2}, \qquad \frac{\partial^2 \log V}{\partial \log P_1^* \partial \log Q_1^*} = 0.$$

Given the CES structure, the share of first-period revenues in total discounted income Φ and the share of first-period spendings in total discounted expenditures Ω are equal

$$\Phi = \frac{Q_1^{*\theta+1}}{\alpha + Q_1^{*\theta+1}}, \qquad \Omega = \frac{P_1^{*1-\sigma}}{\gamma + P_1^{*1-\sigma}},$$

which allows us to express the derivatives of V in terms of Φ and Ω. The second-order expansion of the welfare can then be written as

$$\mathrm{d}\log V = -\Omega\,\mathrm{d}\log P_1^* + \Phi\,\mathrm{d}\log Q_1^* + \frac{1}{2}\Omega(1-\Omega)(\sigma-1)(\mathrm{d}\log P_1^*)^2 + \frac{1}{2}\Phi(1-\Phi)(\theta+1)(\mathrm{d}\log Q_1^*)^2.$$

Given the definitions $S_1^* \equiv Q_1^*/P_1^*$ and $\tilde{R}^* \equiv R^* P_1^*/P_2^*$, the first-order terms can be decomposed into the income and substitution effect

$$\mathrm{d}\log V = \Phi \,\mathrm{d}\log S_1^* + (\Phi - \Omega)\,\mathrm{d}\log \tilde{R}^*.$$

If at the point of approximation, the country does not borrow or save in the first period, then $\Omega = \Phi$ and the expansion simplifies to

$$\mathrm{d}\log V = \Omega \,\mathrm{d}\log S_1^* + \frac{1}{2}\Omega(1-\Omega)\Big[(\sigma-1)(\mathrm{d}\log P_1^*)^2 + (\theta+1)(\mathrm{d}\log Q_1^*)^2\Big].$$