

The Harberger-Laursen-Metzler Effect Revisited: An Indirect-Utility-Function Approach*

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Abstract

In order to assess the effect of a terms-of-trade shock on the current account, the papers by Ostry and Reinhart (1992) and Cashin and McDermott (1998) estimate the intertemporal and intratemporal elasticities of substitution of a set of economies constructing importable and non-tradable consumption series. Unfortunately, these series are not available for most of developing countries. This paper presents a dynamic stochastic framework, similar to Ostry and Reinhart's, that maximizes a representative agent's indirect utility function. The Euler conditions derived for the optimization do not depend on variables such as tradable and non-tradable consumption, avoiding the need for constructing them and adopting strong assumptions. These conditions can be estimated using GMM. Using Chilean quarterly data that covers the 1986-2002 period, I conclude that there exist low intratemporal and intertemporal substitution effects. The first estimated elasticity lies in the range of 0.46-0.56 and the latter is around 1.

Keywords: Terms of Trade, Current Account, Harberger-Laursen-Metzler, Intertemporal Elasticity of Substitution.

JEL classification: F41, E21oE22, F32

* I thank Klaus Schmidt-Hebbel, Rómulo Chumacero, Rodrigo Valdés, Norman Loayza, Claudio Soto, and seminar participants at the Central Bank of Chile, for helpful comments and suggestions. I also thank Gabriela Contreras for providing part of the data. The usual disclaimer applies.

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1. Introduction

Economic theory states that the relationship between terms of trade and current account is ambiguous (see Table 1). More than fifty years ago, Laursen and Metzler (1950) and Harberger (1950) proposed that a positive change of the terms of trade would increase real income –given a constant marginal propensity to consume less than one. Accordingly, this would cause a rise on private savings and an improvement of the current account. The so-called Harberger-Laursen-Metzler effect (HLME) was not challenged until the beginning of the eighties, when Sachs (1981), in a dynamic framework, contended that the HLME depends on the duration of the shock. Only if the shock is temporary the HLME arises. If it is permanent, the final result is ambiguous.

Over the past decade, other studies stated that the link between these variables depends on intertemporal and intratemporal substitution effects. Thus, the works by Ostry and Reinhart (1992) and Cashin and McDermott (1998) have proposed that the intratemporal and intertemporal substitution effects can be assessed through the estimation of first order conditions derived from a dynamic stochastic model. However, estimation of these conditions depends on the availability of importable and non-tradable consumption series. Unfortunately, these series are not available in developing and most developed countries, forcing researchers to adopt certain assumptions to construct them. Evidently, these assumptions could potentially affect the final estimates.

This paper proposes an alternative to avoid the need of these assumptions. Its approach follows the one by Ostry and Reinhart (1988) but with an indirect-utility maximization to avoid the use and construction of non-tradable and importable consumption series. This approach implies first order conditions (FOC) that depend on total private consumption, the sum of non-tradable and importable consumption, and can be easily estimated by Generalized Method of Moments (GMM). These FOC are estimated for Chilean economy using quarterly data for the 1986-2002 period. The estimates show an intertemporal elasticity of substitution around 0.46-0.56 and an intratemporal elasticity of substitution slightly over 1. Accordingly,

it is possible to affirm that the HLME is empirically valid for the Chilean economy since inter and intratemporal substitution effects are quite small.

The structure of the paper is as follows. Section 2 provides an overview of the theoretical and empirical literature related to the link between terms of trade and current account. In section 3, a simple optimizing three-good framework is formulated to examine the income and substitution effects of a terms-of-trade shock on external trade. Section 4 briefly presents data issues and the results of estimating the model with GMM. Concluding remarks and next steps for future research are provided in the last section.

**Table 1. Effect of a Terms-of-Trade Shock on Current Account
According to the Theoretical Literature^{/a}**

| Type of Shock | Temporal Shock | | Permanent Shock | |
|---------------------|-----------------------------|-------------------|-----------------------------|--------------|
| | Author | Sign | Author | Sign |
| Unanticipated shock | Sachs (1981) | (+) | Laursen and Metzler (1950) | (+) |
| | Svensson and Razin (1983) | (+) | Harberger (1950) | (+) |
| | Persson and Svensson (1985) | (-, 0) | Sachs (1981) | (+/-) |
| | Edwards (1988) | (+/-) | Obstfeld (1982) | (-) |
| | Matsuyama (1988) | (-, +) | Svensson and Razin (1983) | (+/-) |
| | Ostry (1988) | (+/-) | Persson and Svensson (1985) | (-, +, -, 0) |
| | Sen and Turnovsky (1989) | (+/-) | Edwards (1988) | (+/-) |
| | Gavin (1990) | (+/-) | Ostry (1988) | (+/-) |
| | Ostry and Reinhart (1992) | (+/-) | Sen and Turnovsky (1989) | (+/-) |
| | Kent (1997) | (+/-) | Gavin (1990) | (+/-) |
| | Servén (1999) | (+/-) | Ostry and Reinhart (1992) | (+/-) |
| | De Holanda (2000) | (+, 0) | Kent (1997) | (-) |
| | | Servén (1999) | (-) | |
| | | De Holanda (2000) | (-) | |
| Anticipated shock | Persson and Svensson (1985) | (+, -, +, -, 0) | Persson and Svensson (1985) | (+, -, +, 0) |
| | Bean (1986) | (-, +, -, 0) | Bean (1986) | (-, +, 0) |
| | Matsuyama (1988) | (+/-) | Sen and Turnovsky (1989) | (+/-) |
| | De Holanda (2000) | (-, +, 0) | De Holanda (2000) | (-) |

a. The sign “+” denotes a positive effect on current account; “-” denotes a negative effect on current account; “+/-” denotes an ambiguous effect on current account; “0” denotes the absence of any effect on current account.

2. Terms of Trade and Current Account: A Brief Review

2.1 The Theoretical Viewpoint

For the sake of simplicity, I will divide the literature that studies the link between terms of trade and current account (or trade balance) in its main channels (see Appendix 1 for a summary table). First, it is clear to distinguish a saving channel, that is, a terms-of-trade shock causes a positive or negative effect on aggregate saving and, therefore, on the current account. Second, there also exist a saving-investment channel. Through this, a terms-of-trade shock not only implies a positive or negative effect on saving, but also a positive or negative effect on investment, and therefore an ambiguous consequence on the current account. Finally, the third channel is the government expenditure channel. In this case, a terms-of-trade shock causes a positive or negative effect on public expenditures, generates a public deficit or surplus, and a worsening or improvement of the current account.

a) The Saving Channel

The economic discussion on the link between terms of trade and current account began in the middle of the twentieth century. In a traditional Keynesian framework, the classic works by Laursen and Metzler (1950) and Harberger (1950) proposed that a positive terms-of-trade shock should cause an increment of real income, aggregate saving –due to a marginal consumption propensity less than one– and, consequently, an improvement of the current account. This was called the Harberger-Laursen-Metzler effect.

This proposition was not questioned until the beginning of the eighties. The static framework was challenged and the inclusion of time and optimization in models played a key role. The first paper in this line was the one by Sachs (1981). He formulated a life-cycle-saving model of a representative agent that maximizes his utility function during two periods. This model predicts that even though a temporal terms-of-trade shock has a positive effect on current account, a permanent shock has an ambiguous impact. Therefore, the positive link between those variables –the HLME– could be broken depending on the expected duration of

the shock. It has to be emphasized that since the paper by Sachs (1981), the use of dynamic equilibrium models has propagated to study such economic relationship.

The contribution by Obstfeld (1982) addressed the role of expectations. In a two-good model with Uzawa (1968)-type utility function, a permanent terms-of-trade shock that is not anticipated by agents implies a worsening of the current account position. Again, the HLME would be absent, but in this case, only if the shock were anticipated.

The study by Svensson and Razin (1983) was the first to decompose a terms-of-trade shock in income and substitution effects. Through a N-good model, the authors concluded that a permanent unanticipated shock has a negative effect on current account only if the rate of time preference increases with welfare level. Besides, a temporal anticipated shock produces a diminishment of the current account balance. As a result, the HLME emerges providing the rate of time preference decreases with welfare level and the shock has a long expected duration. In a similar approach, Bean (1986) highlighted only the income effect of a shock in terms of trade.¹ The author's conclusions are as follows. A temporal anticipated shock generates a deficit-surplus-deficit effect on current account, and then it disappears. In contrast, a permanent anticipated shock causes a deficit-surplus effect that finishes with a current account in equilibrium. Other papers such as Edwards (1988) proposed a model with three goods in which the effect on current account of a permanent terms-of-trade shock is ambiguous and depends on the real exchange rate appreciation or depreciation.

On the other hand, in a two-period model Ostry (1988) analyzed the income and substitution effect in an economy with three goods. According to his paper, he concluded that the final results depend critically on the intertemporal and intratemporal elasticities of substitution and the ratio of imports to consumption of importables. In an infinitely-lived-agent model, Gavin (1990)² and Ostry and Reinhart (1992) arrived to similar conclusions: a temporal terms-of-trade shock has an ambiguous effect on current account because of the presence of a positive consumption-smoothing effect and negative intertemporal and

¹ Defined by the price of value added relative to price of consumption goods.

² The model by Gavin (1990) includes investment but does not emphasize explicitly an investment channel.

intratemporal substitution effects. Based on Obstfeld's (1982) model, De Holanda (2000) endogenized the international interest rate as a function of risk premium and terms of trade. In his model, the HLME is reversed as long as the shock is permanent.

b) The Saving-Investment Channel

Persson and Svensson (1985) constructed an overlapping generation model with investment. Aside from the income effect, they contend that there can be also a temporary negative "investment effect" in response to a shock in terms of trade. In a similar framework, Matsuyama (1988) examined the income, investment and Stopper-Samuelson effect that can lead to ambiguous results on current account depending whether the export (or import) sector is labor intensive or not. Similarly, Sen and Turnovsky (1989) provided a dynamic equilibrium model with a q-theoretic investment function by which the final effect on current account position depends on the response of capital stock to the terms-of-trade shock.

According to Kent (1997), the positive link between terms of trade and current account depends on the degree of persistence of the shock if this is unanticipated and temporary. In his simple two-good model, the investment effect is negative: a terms-of-trade improvement leads –aside from the income effect– an increment of the value of marginal capital productivity which generates an increase of capital stock and investment and, as a result, deteriorates the current account.

Servén (1999) formulated a two-good model with capital goods. This predicts a deficit-surplus sequence on current account if import content of capital is high, or if the shock is long lasting, or if the marginal installation cost is low when the economy faces a temporal unanticipated shock in terms of trade. In this framework, the income effect can be positive or zero, the substitution effect depends on intertemporal elasticity of substitution, and the investment effect is negative.³

³ The economic intuition of the investment effect is similar to Kent's (1997).

c) The Government Expenditure Channel

A less stressed mechanism in the literature on the HLME is the government expenditure channel. The study that focused on it is Tornell and Lane (1994). They propose the so-called “voracity effect”. By this, if a shock generates a windfall of $x\%$ of national income, then aggregate absorption increases by more than that percentage (even if the shock is perceived to be transitory). In the presence of a temporary terms-of-trade shock, the current account response is positive as long as there is a unitary fiscal structure,⁴ but when there is divided control over the fiscal process,⁵ the voracity effect is also present counteracting the aforementioned positive effect and deteriorating the current account balance. The intuition is as follows. The improvement in terms of trade expands income and tax revenue, then government expenditure increases more than the income increment and, consequently, the current account deteriorates.

2.2 The Empirical Viewpoint

Surprisingly, unlike the theoretical literature, the empirical works on the HLME are –to a certain extent– relatively scarce and less ambiguous in results (see Appendix 1B). For instance, Mendoza (1995) calculated simple serial correlations between terms of trade and trade balance and concluded that they are positively correlated in most Latin American countries.

a) Estimation of Reduced-Form Models

Using panel data regressions for 128 countries including Chile, Kent (1997) found that countries that face less persistent terms-of-trade shocks show a positive and permanent effect on current account. In contrast, those countries that face more persistent terms-of-trade shocks show a positive impact but a negative effect since the fourth period.

⁴ The authors mention as examples the cases of Indonesia under Suharto and Chile under Pinochet.

⁵ For instance, Mexico in 1978-79 and Chile in the 1960s.

Calderón, Chong, and Loayza (1999) assessed through GMM dynamic panel estimates for 44 developing countries including Chile that a positive transitory terms-of-trade shock caused an improvement in the current account, but that permanent shocks do not have significant effects. Finally, based on VAR-type impulse response functions for 15 OECD and 40 developing countries, Otto (2001) concluded that a positive transitory terms-of-trade shock causes an improvement on the trade balance both small OECD and developing countries.

b) Estimation of Dynamic Stochastic Models

The paper by Ostry and Reinhart (1992) was the first to test not only the income effect but also the substitution effect. The authors estimated the intertemporal and intratemporal elasticities for a set of developing countries using GMM. They found that the intertemporal substitution elasticities were in the 0.37-0.43 range for Latin America,⁶ around 0.8 for Asia, and about 0.44 for Africa (see Appendix 1B). Besides, their estimates show that the intratemporal substitution elasticities were in the 0.76-1.1 range for Latin America, 0.66-1.15 for Asia, and 1.27-1.44 for Africa.

Cashin and McDermott (1998) used the two-step cointegration-GMM technique by Cooley and Ogaki (1996) to estimate Ostry and Reinhart's (1992) model. They used annual data for five OECD countries during the 1970-1995 period. Their findings can be summarized as follow: significant intertemporal substitution effects (elasticities between 0.72 and 2.65), and considerable intratemporal substitution effects (0.7-5.6).

It must be mentioned that the model by Ostry and Reinhart (1992) implies the availability of non-tradable and importable consumption series, which do not always exist for developing and for most developed countries.

On the other hand, the Cashin and McDermott's (1998) approach, which followed the model by Ostry and Reinhart (1992), implies the presence of unit roots in the ratio of non-

⁶ Chile is not included in the panel of countries.

tradable to importable consumption and in the ratio of terms of trade to real exchange rate. That is, the optimization problem gives, among others, the following first order non-stochastic condition:

$$w \left(\frac{n}{m} \right)^{\frac{1}{\epsilon}} = \frac{p}{q}$$

where n denotes the non-tradable good, m is the importable good, p the reciprocal of the terms of trade, and q is the reciprocal of the real exchange rate. Following Cooley and Ogaki (1996), the authors estimate ϵ and ρ using an Error Correction Model. Before that, they found that both the ratio of consumption (n/m) and the ratio of prices (p/q) are integrated of order one. However, this finding implies that each series, non-tradable consumption, importable consumption, terms of trade, and real exchange rate, are not only non-stationary but also integrated of order two, which is difficult to find in actual data. In fact, this assumption is empirically rejected in the case of the real exchange rate in Chile.⁷

In summary, economic theory states that the relationship between terms of trade and current account is ambiguous. Besides, on one hand, the effect of terms-of-traded shocks on current account in Chile has been studied only as a part of panel-data studies using reduced-form linear regressions. This kind of methodology allows only the estimation of the final effect; that is, it does not permit to analyze the presence of substitution effects, neither intertemporal nor intratemporal effects. On the other hand, even though the empirical approach by Ostry and Reinhart (1992) overcomes this problem, it implies the need to have non-tradable and tradable consumption series which most of the time are not available for developing countries like Chile.

⁷ For instance, Calderón and Duncan (2003) found that the real exchange rate is covariance stationary in Chile using long-span data. Taylor (2002) also finds that real exchange rates are stationary in Argentina, Brazil and Mexico.

3. A Simple Model of Saving and Current Account

Consider an agent that lives infinitely in a small open economy with three goods (non-tradable, exportable, and importable goods) as in Ostry and Reinhart (1992).⁸ The agent maximizes an expected CES utility function given by (1) that depends directly on the real consumption of a non-tradable good n , and another imported good m . The representative agent's maximization is subject to the law of movement of the net foreign assets b_t , equation (2).

$$E_t \left\{ \sum_{t=0}^{\infty} \beta^t u(m_t, n_t) \right\} = E_t \left\{ \sum_{t=0}^{\infty} \beta^t \left(\frac{\mathbf{s}}{\mathbf{s}-1} \right) \left(w m_t^{\frac{1-\mathbf{s}}{\mathbf{e}}} + n_t^{\frac{1-\mathbf{s}}{\mathbf{e}}} \right)^{\frac{1-\mathbf{s}}{\mathbf{e}}} \right\}, \quad \mathbf{b}, \mathbf{s}, \mathbf{w}, \mathbf{e} > 0; \mathbf{b} < 1, \quad (1)$$

$$\Delta b_{t+1} = r_t b_t + p_t y_t + (m_0 - m_t) + \frac{p_t}{s_t} (n_0 - n_t) \quad (2)$$

In this framework, $E\{.\}$ is the expectation operator; β denotes the subjective discount factor; σ is the intertemporal elasticity of substitution; ε denotes the intratemporal elasticity of substitution; r_t represents the exogenous international real interest rate in period t ; b_t is the stock of net foreign assets; p_t stands for the exogenous relative price of exportable good in terms of importable goods (the terms of trade); y_t represents the exogenous production of the exportable good, totally sold out the country; s_t is the real exchange rate (relative price of the exportable good in terms of the non-tradable good); n_0 is the exogenous endowment of non-tradable goods; and m_0 is the exogenous endowment of importable goods. Besides, it is supposed that the utility function is strictly increasing and concave in the consumption of the goods.

When does the HLME surge? As explained by Cashin and McDermott (1998), the intertemporal and intratemporal elasticity of substitution affects the extent of the HLME. On

⁸ Probably the only difference with Ostry and Reinhart's model is the expression of real variables in terms of the importable good instead of the exportable good.

one hand, the intertemporal elasticity of substitution σ measures the extent to which agents defer current consumption in response to a higher expected real return. On the other hand, the intratemporal elasticity of substitution ε measures the extent to which agents alter their consumption of importables in response to a change in its price relative to that of non-tradables.

In this economy, the representative agent maximizes (1) subject to equation (2) and the respective transversality condition.

However, as aforementioned, there are no available and confident data of importable and non-tradable consumption, even for most developed economies. In order to overcome this inconvenience, I formulate dual maximization problem through the agent's indirect utility function. The use of dual maximization to solve the model in a simple way comes from Obstfeld (1982), the difference between that work and the present is that Obstfeld did not use it to simplify the empirical methodology since his paper was basically theoretical. Then, the problem consist of maximizing the intratemporal utility function:

$$u = u(m_t, n_t) = \left(\omega m_t^{1-\frac{1}{\varepsilon}} + n_t^{1-\frac{1}{\varepsilon}} \right)^{\frac{1}{\varepsilon}} \quad (3)$$

subject to the equation of aggregate consumption:

$$d_t = m_t + \left(\frac{p_t}{s_t} \right) n_t \quad (4)$$

where now d_t is the real expenditure of the importable and the non-tradable goods (in terms of the prices of the first). If the representative consumer optimizes (3) subject to (4), he will obtain the demand functions for each good. If these functions are substituted in the (direct) utility function (3), the indirect utility function is gotten (see Appendix 2 for the derivation of the dual intratemporal problem):

$$V = V(d_t, p_t, s_t) = d_t^{1-\frac{1}{s}} \left(\frac{s}{s-1} \left[\left(\frac{1}{1+p_t^{1-e} s_t^{e-1}} \right)^{1-\frac{1}{e}} + \left(\frac{1}{1+p_t^e s_t^{-e}} \right)^{1-\frac{1}{e}} \right]^{\frac{1}{1-\frac{1}{s}}} \right) \quad (5)$$

Now, this function depends only on d_t , p_t and s_t .⁹ Fortunately, expression (5) does not depend on importable and non-tradable consumption series as in (1), so we can use available aggregate consumption series to estimate it. Then, the consumer problem is translated into an intertemporal maximization of his expected indirect utility:

$$E_t \left\{ \sum_{t=0}^{\infty} \mathbf{b}^t V(d_t, p_t, s_t) \right\} \quad (6)$$

subject to the net foreign assets constraint formulated as follows:

$$\Delta b_{t+1} = r_t b_t + p_t y_t + \frac{p_t}{s_t} n_0 + m_0 - d_t, \quad (7)$$

and the corresponding transversality condition. The first order conditions respect to real expenditure and net foreign assets are:

$$V_{d,t} = \mathbf{l}_t \quad (8)$$

$$\mathbf{l}_t = \mathbf{b} E_t \{ \mathbf{l}_{t+1} (1+r_{t+1}) \} \quad (9)$$

where:

$$V_{d,t} = \frac{\partial V(d, p, s)}{\partial d_t}$$

Using expressions (8) and (9) we can obtain:

⁹ For simplicity, and given that it is not a parameter of interest, I assume $\beta=1$.

$$V_{d,t} = \mathbf{b} E_t((1+r_{t+1})V_{d,t+1}) \quad (10)$$

This expression can be finally arranged to estimate the parameters, basically those of interest (ε and σ), in the following form:

$$E_t \left(\frac{\mathbf{b}(1+r_{t+1})V_{d,t+1}}{V_{d,t}} - 1 \right) = 0 \quad (11)$$

See Appendix 2 for the specific form that equation (11) takes using the CES utility function.

4. Data, Estimation, and Results

Alike Ostry y Reinhart (1992) and Cashin and McDermott (1998), I estimate the parameters β , ϵ , and σ from equation (11) using Hansen's (1982) GMM technique. For that purpose, I use Chilean quarterly data that covers the 1986.1-2002.4 period. The data used in the estimation are the following: real interest rate (r), constructed as the difference between nominal banking interest rate and CPI inflation; private (non-durable) consumption (d); terms of trade index (p); and multilateral real exchange rates (s).¹⁰ The details of definitions and sources can be seen in Appendix 3.

An analysis of the series was performed to assess the degree of seasonality. As a result, I only removed the seasonal component from consumption series through an ARIMA-X12 technique. As in previous literature, I use a constant and lags of the variables included in equation (11) as instrumental variables. Estimations were performed using bandwidth by Andrews (1991) and the kernel quadratic spectral.

Table 2 reports the parameter estimates, their standard errors, the J-statistic, and the p-value related to that. In the GMM technique, the J-statistic is based on the minimized value of the objective function and is distributed as χ^2 with k degrees of freedom, which corresponds to the number of overidentifying restrictions. The latter is given by the difference between the number of instruments and that number of the parameters to be estimated. The p-value is associated to the null hypothesis of validity of overidentifying restrictions. I find that all the parameter estimators are statistically significant and have the *a-priori* expected signs, and the overidentifying restrictions cannot be rejected by the data.

It is likely that the relevant real interest rate for consumption is the lending interest rate, however, I also estimate, to test robustness of the model, the parameters using banking deposit interest rates. Besides, I also used different instrument set lags (see Table 2).

¹⁰ Results are quite similar using bilateral real exchange rates.

Even though the discount factor β is not a parameter of immediate interest, the result is well-defined and relatively consistent with previous estimates at domestic and international levels. The point estimate is around 0.99, which implies a real subjective discount rate about 4% annually. This estimate falls in the range of the values commonly used in RBC literature for Chile, which show an interval between 2% and 8.9%.¹¹

Table 2. GMM Parameter Estimates of the Euler Equation

| <i>Sample: Chile, quarterly data, 1986.I-2002.IV</i> | | | | | | | |
|---|------------|----------------|----------|----------------|----------|----------------|--------------------|
| <i>Method: Generalized Method of Moments (GMM) ^a</i> | | | | | | | |
| Instruments Set Lags | Parameters | | | | | | J-Statistic |
| | β | | s | | e | | |
| | Estimate | Standard Error | Estimate | Standard Error | Estimate | Standard Error | |
| Using Lending Interest Rates | | | | | | | |
| 1 to 2 | 0.982*** | 0.0017 | 0.456*** | 0.1546 | 1.009*** | 0.0057 | 0.0800 (0.1577) |
| 2 to 3 | 0.990*** | 0.0049 | 0.514*** | 0.1421 | 1.008*** | 0.0045 | 0.0737 (0.3625) |
| 3 to 4 | 0.989*** | 0.0052 | 0.558** | 0.2627 | 1.007*** | 0.0078 | 0.0841 (0.1513) |
| Using Deposit Interest Rates | | | | | | | |
| 1 to 2 | 0.993*** | 0.0030 | 0.226** | 0.1030 | 1.015*** | 0.0091 | 0.0661 (0.1559) |
| 2 to 3 | 0.991*** | 0.0021 | 0.301** | 0.1315 | 1.013*** | 0.0080 | 0.0817 (0.2314) |
| 3 to 4 | 0.992*** | 0.0019 | 0.331** | 0.1472 | 1.012*** | 0.0078 | 0.1199 (0.0562) |

a. Estimations were performed using bandwidth by Andrews (1991) and the *kernel quadratic spectral*. Instrumental variables are a constant and lags of de real interest rate, of the terms of trade, of the real exchange rate, and of the consumption growth. The symbols *, ** and *** denote statistical significance at the 1%, 5%, and 10% level, respectively. P-values are in parentheses.

The intertemporal elasticity of substitution is statistically significant at 1% level and its range estimate is between 0.46 and 0.56, denoting a low intertemporal substitution effect.

¹¹ See, for instance, Acuña and Oyarzún (2001), Bergoening and Soto (2002), and Chumacero and Fuentes (2002).

This range is over the upper limit of the range of estimates for Latin American countries (0.373-0.430) by Ostry and Reinhart (1992), and below the lower limit found for OECD economies by Cashin and McDermott (0.72-2.65).¹² It is worth mentioning that the empirical evidence for this coefficient is far ranging. Estimates fall from (close to) zero in the seminal work by Hall (1988) to near 1.4 by Amano et al. (1998).¹³ This estimate implies a coefficient of relative risk aversion σ , the reciprocal of s , in the 1.79-2.17 interval.

With regard to the intratemporal elasticity of substitution, its GMM estimator is slightly above 1. This suggests that there exist a statistically significant -but not so high- intratemporal substitution effect between importables and non-tradables. This value lies in both the estimated range by Ostry and Reinhart, between 0.76 and 1.1, and the one by Cashin and McDermott, between 0.7 and 5.6.¹⁴

Finally, it should be mentioned that the same estimations were performed using the deposit (real) interest rate. Results are very similar in terms of the estimates of β and ϵ , but are relatively lower in terms of σ . In this latter case, this elasticity is statistically significant only at 5% and lies in the 0.27-0.33 interval.

¹² Chumacero (2001) found non-statistically significant values between 0.256 and 0.314 using monthly Chilean data from 1986.1 to 2000.12.

¹³ Other estimated or calibrated values are 0.38 by Mendoza (1995), 0.4 by Ogaki and Reinhart (1999), 0.05-1 by Epstein and Zin (1991), and near 1 by Beaudry and Van Wincoop (1995).

¹⁴ Calibrating a dynamic stochastic model, Mendoza (1995) found an intratemporal elasticity of substitution around 1.28 for a set of developing countries and -perhaps surprisingly- a lower value, 0.74, for industrialized countries.

5. Concluding Remarks

Economic theory states that the relationship between terms of trade and current account is ambiguous. The effect of terms-of-traded shocks on current account in Chile has been studied only as a part of panel-data studies using reduced-form linear regressions. This kind of methodology allows only the estimation of the final effect; that is, it does not permit to analyze the presence of substitution effects, neither intertemporal nor intratemporal effects. Despite other methodologies and international estimates, as the one by Ostry and Reinhart (1992), overcomes this problem, these imply the need to have non-tradable and tradable consumption series which most of the time are not available, specially in developing countries like Chile.

This paper provides estimates of intertemporal and intratemporal elasticities of substitution that give a hint of the magnitude of the Harberger-Laursen-Metzler effect (HLME) avoiding the need of disaggregated consumption data. Using Chilean quarterly data for the 1986-2002 period, I found that all the parameter estimators of a simple model of saving and current account are statistically significant, have the *a priori* expected signs, are relatively consistent with previous findings, and the overidentifying restrictions cannot be rejected by the data. Using lending real interest rates, the intertemporal elasticity of substitution falls in the 0.46-0.56 range, while the intratemporal elasticity of substitution is slightly over 1. This suggests that there exist a low intratemporal substitution effect between importables and non-tradables, and even lower intertemporal substitution effect. Nevertheless, the HLME is still a valid effect in the Chilean economy. That is, a positive terms-of-trade shock causes a positive impact on the current account in Chile. This finding is also consistent with panel data studies and reduced-form equations estimated for Chile and other economies.

The future line of research includes, first, the inclusion of capital goods or capital accumulation in the model in order to analyze the investment channel. Second the expansion of the data to consider other emerging market countries and compare results at international level. Finally, the estimation of non-tradable and importable consumption series for each

country, which easily can be achieved applying Roy's identity to the indirect utility function with the estimated parameters.

Appendix 1A

Theoretical Studies on the Relationship between Terms of Trade and Current Account

| Authors (Year) | Analytical Framework (Main Features and Assumptions) | Theoretical Predictions (Effects on Current Account of a Positive Term-of-Trade Shock) | Analyzed Channels and Effects |
|--------------------------------|---|--|---|
| Laursen and Metzler (1950) | Based on traditional static Keynesian framework. | A permanent unanticipated shock: + | Saving channel: Income effect (positive)*** |
| Harberger (1950) | Based on traditional static Keynesian framework. | A permanent unanticipated shock: + | Saving channel: income effect (positive)*** |
| Sachs (1981) | DEM (2 periods). one-good, small open economy, with investment. Based on a life-cycle-saving model. | A temporal shock: +. A permanent shock: ambiguous. | Saving channel: Income effect: (positive or zero depending on expected duration of shock)***. |
| Obstfeld (1982) | DEM (infinitely-lived agent), 2-good, small open economy. Uzawa (1968)-type utility function: rate of time preference is an increasing function of utility. Indirect utility function is maximized. | A permanent unanticipated shock: – | Saving channel: Income effect *** |
| Svensson and Razin (1983) | DEM (infinitely-lived agent), n-good, small open economy. Based on Razin (1980) and Svensson and Razin (1981). | A temporal unanticipated shock: + A permanent unanticipated shock: + (if rate of time preference decreases with welfare level), – (if rate of time preference increases with welfare level). A temporal anticipated shock: – | Saving channel: Income effect: direct and wealth effect (positive/negative depends on if shock is unanticipated or anticipated). Substitution effect: ** |
| Persson and Svensson (1985) | OGM (2 generations), 2-good, small open economy with investment.. Based on Diamond (1965) and Svensson and Razin (1983) | A temporal unanticipated shock: +, –, +, 0. A permanent anticipated shock: –, +, –, +, 0 (the effects are greater if the shock is temporal) A permanent unanticipated shock: +, 0. | Saving channel: Income effect * Investment channel (negative) |
| Bean (1986) | DEM (infinitely-lived agent), n-good, small open economy. Based on Salop (1979). Terms of trade = price of value added good in terms of price of consumption good. | A temporal anticipated shock: –, +, –, 0 A permanent anticipated shock: –, +, 0 | Saving channel: Income effect ** |

Appendix 1A
Theoretical Studies on the Relationship between Terms of Trade and Current Account (continued)

| Authors (Year) | Analytical Framework (Main Features and Assumptions) | Theoretical Predictions (Effects on Current Account of a Positive Term-of-Trade Shock) | Analyzed Channels and Effects |
|---------------------------|--|---|---|
| Edwards (1988) | DEM (2 periods), 3-good, small open economy. Based on Edwards (1987), Svensson and Razin (1983), Edwards and van Wijnbergen (1986). | A temporal shock: ambiguous (depends on change of real exchange rate) A permanent shock: ambiguous (opposite sign of temporal shock). | Saving channel: Income effect Substitution effect (ambiguous, depends on real exchange rate appreciation or depreciation)**. |
| Matsuyama (1988) | OGM (2 generations), 2-good, small open economy with investment. Based on Kareken and Wallace (1977) and Fried(1980). | A permanent anticipated shock: + (if export sector is more labor intensive), – (if import sector is more labor intensive) A permanent unanticipated shock: –, +. | Saving channel: Income effect Stopper-Samuelson effect (ambiguous) Investment channel (negative)* |
| Ostry (1988) | DEM (2 periods), 3-good, small open economy. Based on Svensson and Razin (1985) and Frenkel and Razin (1987). | Results depend critically on intertemporal and intratemporal elasticities of substitution, and ratio of imports to consumption of importables. | Saving channel: Income effect Substitution effect**. |
| Sen and Turnovsky (1989) | DEM (infinitely-lived agent), 2-good, small open economy. The two goods are Edgeworth complementary. Based on Abel and Blanchard (1983) and Hayashi (1982) q-theoretic investment function. The inclusion of endogenized labor and capital has a crucial role. | A permanent unanticipated shock: ambiguous, – (if substitution effect dominates), + (if income effect dominates) A temporal unanticipated shock: similar but smaller effect than a permanent shock. A permanent anticipated shock: similar but smaller effect than a unanticipated shock. | Saving channel: Income effect: (ambiguous). Substitution effect. Investment channel (implicit, negative). Effects depend on the response of capital stock to terms-of-trade shock. |
| Gavin (1990) | DEM (infinitely-lived agent), 3-good, small open economy with investment. | Effects depend on degree of substitution between imported and non-traded goods. If they are poor substitutes the HLM is confirmed. | Saving channel: Income effect Substitution effect:**. |
| Ostry and Reinhart (1992) | DEM (infinitely-lived agent), 3-good, small open economy. Based on Ostry (1988). | A temporal shock: ambiguous (positive consumption-smoothing effect and a negative inter and intratemporal substitution effect). Depends on elasticities of intertemporal and intratemporal substitution. | Saving channel: Income effect Substitution effect**. |

Appendix 1A
Theoretical Studies on the Relationship between Terms of Trade and Current Account (continued)

| Authors (Year) | Analytical Framework (Main Features and Assumptions) | Theoretical Predictions (Effects on Current Account of a Positive Term-of-Trade Shock) | Analyzed Channels and Effects |
|----------------------------|--|--|--|
| Tornell and Lane (1994) | DEM (n infinitely-lived groups), 2 sectors (public and private), small open economy. Terms of trade = price of export good in terms of price of consumption good. | A temporal unanticipated shock: + (if there is unitary fiscal structure) A temporal/permanent unanticipated shock: - (if there is divided control on fiscal process, "voracity effect") | Saving channel: Income effect (positive) Government expenditure channel (negative)**** |
| Kent (1997) | DEM (infinitely-lived agent), 2-good, small open economy with investment. | A permanent unanticipated shock: - A purely temporal unanticipated shock: + A unanticipated temporal but persistent shock: ambiguous (depends on the degree of persistence) | Saving channel: Income effect Investment channel (negative)* |
| Servén (1999) | DEM (infinitely-lived agent), 2-consumption-good, small open economy with imported and domestic capital goods. Based on Sen and Turnovsky (1989), Servén (1995). | A temporal unanticipated shock: -, +, 0 (if import content of capital is high/ shock is long lasting/ low marginal installation cost); +, -, 0 (otherwise) A permanent unanticipated shock: - | Saving channel: Income effect (positive/zero). Substitution effect (positive/negative, depends on intertemporal elasticity of substitution) Investment channel (negative) |
| De Holanda (2000) | DEM (infinitely-lived agent), 2-good, small open economy. Interest rate depends on risk premium that is a negative function of terms of trade. Indirect utility function is maximized. Based on Obstfeld (1982). | A temporal unanticipated shock: +, 0 A permanent unanticipated shock: - A temporal anticipated shock: -, +, 0 A permanent anticipated shock: - | Saving channel: Income effect *** |

NOTES:

DEM denotes Dynamic Equilibrium Model
OGM denotes Overlapping Generation Model
* Substitution effect and government expenditure channel are not analyzed
** Investment channel and government expenditure channel are not analyzed
*** Investment and government expenditure channel and substitution effect are not analyzed.
**** Investment channel and substitution effect are not analyzed.

Appendix 1B
Empirical Studies on the Relationship between Terms of Trade and Current Account

| Authors (Year) | Empirical Method | Countries | Data | Empirical findings/Estimation Results |
|------------------------------------|---|--|-----------------------|---|
| Ostry and Reinhart (1992) | Method: GMM Variables: consumption of non-traded goods and importables, terms of trade, real exchange rate, real interest rate | 13 developing countries including Brazil, Colombia, Costa Rica, and Mexico (Chile is not included). | Annual data. 1968-87 | Pooled data: Intertemporal elasticity of substitution: 0.38-0.50 Intratemporal elasticity of substitution: 1.22-1.27 Panel Data-Latin America: Intertemporal elasticity of substitution: 0.373-0.43 Intratemporal elasticity of substitution: 0.76-1.107 |
| Kent (1997) | Method: panel data regression Variables: terms of trade, current account, output, fiscal balance. | 128 countries (Chile is included). | Annual data. 1960-94. | Least-persistent-TOT countries: permanent + significant effect Full set of countries: + significant effect (every period) Most-persistent-TOT countries: + significant effect (some periods) |
| Cashin and McDermott (1998) | Method: Cointegration and GMM Variables: consumption of non-traded goods and importables, terms of trade, real exchange rate, and real interest rate | Australia, Canada, New Zealand, United Kingdom and United States. | Annual data. 1970-97 | Intertemporal elasticity of substitution: 0.72-2.65 Intratemporal elasticity of substitution: 0.69-5.63 |
| Calderón, Chang, and Loayza (1999) | Method: GMM dynamic panel data Variables: terms of trade, current account, output growth, balance of payment controls, black market premium, among others. | 44 developing countries (Chile is included) | Annual data. 1966-95 | A positive transitory terms-of-trade shock causes an improvement in the current account. Permanent shocks do not have significant effects. |
| Otto (2001) | Method: Structural VARs. Variables: terms of trade, current account, output | 15 OECD small countries and 40 developing countries (Brazil, Mexico, Peru, Colombia, etc.; Chile is not included). | Annual data. 1960-97 | A positive transitory terms-of-trade shock causes an improvement in the balance of trade from both small OECD and developing countries. |

NOTES: GMM denotes General Method of Moment

Appendix 2

$$\text{Max} \quad \left(\mathbf{w} m^{1-\frac{1}{e}} + n^{1-\frac{1}{e}} \right)^{\frac{1}{1-\frac{1}{e}}} \quad (\text{A1})$$

s.t.:

$$d = m + \left(\frac{p}{s} \right) n \quad (\text{A2})$$

The Lagrange function is:

$$\Phi_t = u(m, n) + \mathbf{I} \left(d - m - \frac{p}{s} n \right) \quad (\text{A3})$$

The first order conditions:

$$\left(\mathbf{w} m^{1-\frac{1}{e}} + n^{1-\frac{1}{e}} \right)^{\frac{1-\frac{1}{e}}{1-\frac{1}{e}-1}} m^{-\frac{1}{e}} = \mathbf{I} \quad (\text{A4})$$

$$\left(\mathbf{w} m^{1-\frac{1}{e}} + n^{1-\frac{1}{e}} \right)^{\frac{1-\frac{1}{e}}{1-\frac{1}{e}-1}} n^{-\frac{1}{e}} = \mathbf{I} \frac{p}{s} \quad (\text{A5})$$

Dividing (A4) by (A5) we obtain:

$$\mathbf{w} \left(\frac{n}{m} \right)^{\frac{1}{e}} = \frac{s}{p} \quad (\text{A6})$$

which is exactly the equation that derive Ostry and Reinhart (p. 503, 1992) and Cashin y McDermott (p.23, 1998).

Substituting (A6) in the budget constraint (A2) we can derive the demands for importable and non-tradable goods. When I substitute these functions in direct utility (A1), we obtain the indirect utility (A7), which is the specific form that equation (11) takes (see section 3):

$$E_t \left\{ \mathbf{b} (1+r_t) \left(\frac{d_{t-1}}{d_t} \right)^{\frac{1}{s}} \left[\frac{\left(\frac{1}{1+p_t^{1-e} s_t^{e-1}} \right)^{\frac{1}{1-e}} + \left(\frac{1}{1+p_t^e s_t^{-e}} \right)^{\frac{1}{1-e}}}{\left(\frac{1}{1+p_{t-1}^{1-e} s_{t-1}^{e-1}} \right)^{\frac{1}{1-e}} + \left(\frac{1}{1+p_{t-1}^e s_{t-1}^{-e}} \right)^{\frac{1}{1-e}}} \right]^{\frac{1-\frac{1}{s}}{1-e}} - 1 \right\} = 0 \quad (\text{A7})$$

Appendix 3

Data, Sources and Definitions

| Variable | Series | Source/Definition |
|------------------------------|--|--|
| Interest Rate (i_t) | Nominal Deposit and Lending Interest Rate, 30-89 days | Central Bank of Chile |
| Domestic Inflation (p_t) | Consumer Price Index Growth | Central Bank of Chile |
| Real Interest Rate (r_t) | Difference between nominal interest rate and inflation rate | $r_t = \log \left(\frac{1 + i_t}{1 + p_t} \right)$ |
| Consumption (d_t) | Real Consumption of Non-Durable Goods, expressed in 1996-million pesos | Contreras <i>et al</i> (2002). |
| Terms of Trade (p_t) | Index of Terms of Trade | 1986-1999: Bennett y Valdés (2001) 2000-2002: Central Bank of Chile Chile, <i>Informe Económico y Financiero</i> |
| Real Exchange Rate (s_t) | Multilateral RER (s^M) | Central Bank of Chile |
| | RER5 (s^5): five main trade partners | Central Bank of Chile |

a. All the series present quarterly frequency.

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