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What accounts for the Chilean saving 'miracle'?

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This paper examines the recent saving performance of the Chilean economy in the light of its long-run (1940–96) trends. The first conclusion that can be derived from the data is that most of the increase in private saving since the mid-1980s is due to business saving. Household saving turns out to be a stationary variable with zero mean. Since business saving has a unit root, households do not seem to take the saving of firms into account when making their own saving decisions. Within the theoretical framework of a model of business investment with liquidity constraints, we estimate a VAR for business saving, private investment, public saving and foreign saving (the current account deficit). We are able to determine that business saving is unaffected by public saving, but that, in the long run, foreign saving and business saving are perfect substitutes. Private investment, business saving and foreign saving are jointly determined. The policy conclusions are that policies that stimulate investment are likely to lead to an increase in private saving, that policies aimed at raising household saving will be ineffective, and that increases in public saving are very powerful for increasing domestic saving in the long run.

Key words: Saving, Chile
JEL classifications: E21, E22, O11

1. Introduction

The rapid increase in saving rates since the mid-1980s has been one of the main characteristics of the Chilean growth process since the recovery from the debt crisis. In fact, it is sometimes claimed that the rise in domestic saving is one of the major, if not the main, cause for Chile's superior economic performance over this period (Inter-American Development Bank, 1996). This paper seeks to put recent performance in a historical context by examining the long-term behaviour of Chilean saving in the period 1940–96.

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Most empirical macroeconomic analyses of saving behaviour in developing countries treat national saving as a single entity. To be sure, this is partly due to the fact that disaggregated saving data for households, businesses and government are quite scarce. Generally, saving is obtained as a residual between GDP and consumption. However, most empirical studies make the implicit or explicit assumption that aggregate saving can be analysed as if it were the product of household decisions. This, in turn, implies, in the first place, that Ricardian equivalence holds: every peso saved by government is 'dissaved' by households.[1] Secondly, it also means that business and household saving are determined by the same factors, or, in other words, that households are able to lift the corporate veil.[2]

In this paper, we put these hypotheses to the test. Do households internalise the saving that is done 'for them' by business firms? Is there Ricardian equivalence in the behaviour of households or businesses? Are domestic and foreign saving perfect substitutes ? More specifically, do changes in foreign saving offset changes in private saving?

These questions have important policy implications. Ricardian equivalence means, of course, that governments cannot raise the economy's saving rate. On the other hand, if all forms of private saving respond to decisions made by households, any attempt to increase business saving through the reduction of corporate taxation will be a useless endeavour. For example, Chile underwent a drastic tax reform in 1984, which, in effect, transformed business taxes into withholding taxes on the income tax liabilities of their owners. This policy shift is generally considered to have had a positive effect on business saving. However, if households are able to lift the corporate veil, private saving as a whole should not have increased at all as a consequence of the business tax reform. Policies to stimulate saving would also be unnecessary if domestic saving and foreign saving were perfect substitutes, since shortfalls in domestic saving would be completely made up by foreign saving.

The view that saving, in the last analysis, depends on household decisions not only has negative implications for what will not work; it also has positive implications for what will. If governments wish to stimulate saving, they have to act on variables that impinge on household consumption and saving decisions. For example, the deepening of domestic capital markets, with the attendant increase in the variety of financial vehicles through which households can save, may well lower transaction costs and raise the saving rate (or at least saving in the form of financial instruments, as opposed to, say, durable goods). In the same vein, the elimination of financial repression, by raising interest rates, might also raise saving.

A contrasting view would emphasise the existence of a corporate veil that households cannot pierce. Corporations may in fact respond to very different stimuli from households. If households do not internalise changes in business saving, aggregate private saving will turn out to be affected by the variables that determine business saving. Recent literature, for example, has emphasised the tight link that exists between business saving and investment. Since firms tend to face liquidity constraints, corporate saving is undertaken mainly in order to finance investments (Fazzari *et al.*, 1988; Hubbard, 1998). If this is so, investment opportunities would in fact drive an important component of saving. In this case, policies to stimulate investment, and to improve or supplement financial markets in

[1] This hypothesis has been kicking around in the literature since Barro (1974) published his celebrated article. Most studies have shown that, in fact, strict Ricardian equivalence fails to hold, with private saving offsetting only a fraction of changes in government saving (see, for example, Corbo and Schmidt-Hebbel, 1991).

[2] Examples of the implicit use of these assumptions can be found in Morandé (1996); Edwards (1995) and Carroll and Weil (1994).

order to relieve liquidity constraints on private investment, are of greater relevance to higher growth and saving than policies to raise household saving rates. Saving, in this view, takes care of itself.

There is a literature on saving, going back to Smith and Ricardo and given a more modern form by Cambridge (England) economists such as Joan Robinson, Kaldor and Pasinetti, which postulates that the source of all (or most) saving is business profits, because wage earners (practically) do not save, and profit earners save all (or a large proportion) of their income. Thus it is the distribution of income between wages and profits that determines saving, investment and growth (see Pasinetti, 1974, pp. 86–102; Kaldor, 1957). The recent modelling of business investment as being constrained by retained earnings is consistent with this framework.

2. The stylised facts

2.1 Recent trends

Chilean economic growth took a quantum jump after the recovery from the depression of the early 1980s. The process of growth of the Chilean economy over the last decade has been attended by a strong increase both in gross investment as well as in domestic saving (see Figure 1 and Appendix Table A1).[1] As a percentage of GDP, gross domestic saving increased from levels close to zero in 1982 to about 21% in 1996.[2] In turn, gross fixed capital formation as a proportion of GDP rose from 15 to 25% over the same period.

Another interesting change associated with saving has been the decline in foreign saving and the increase in domestic saving as a source of funding investment. This is a relatively recent trend, which becomes very marked beginning in 1986, despite the strong capital inflows that begin to take place from 1987 onwards (Agosin, 1995; Ffrench-Davis *et al.*, 1995). Both the increase in investment and national saving, as well as the decrease in foreign saving, are significant during this period.

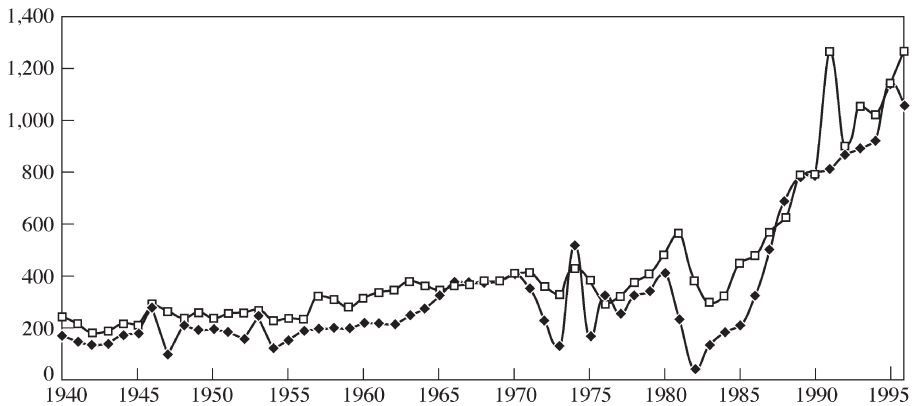

Fig. 1. *Per capita gross domestic saving and fixed investment, 1940–96 (000 1986 pesos).* ◆, *saving;* □, *fixed investment. Source: see Table A1.*

[1] The following national accounts identities ought to be kept in mind: SDOM ≡ I–SFOR; SPRIV ≡ SDOM—SPUB; SBUS ≡ SPRIV–SHOUS; I ≡ IPRIV + IPUB. As usual S and I are symbols for saving and gross investment; DOM stands for domestic, PRIV and PUB for private and public, BUS for business, HOUS for household, and FOR for foreign.

[2] All ratios are between nominal magnitudes.

Since the mid-1980s, with the long upswing in the economy that lasted until late 1997, both private and public saving have expanded. Between the crisis years of 1982–86 and 1987–96, public saving rose from –1·3% of GDP to more than 4·5%. These figures include the quasi-fiscal losses of the Central Bank[1] and the operating surpluses (profits plus depreciation funds) of state-owned enterprises (SOEs). Private saving has also increased markedly: from 7·9% to 17·2% of GDP.

The statistical work undertaken allows us to study the evolution of the two chief components of private saving: household saving and business saving. It can be seen from Appendix Table A1 that, despite the social security reform of 1981, measured household saving has been close to zero since the early 1980s, with a slight upturn since the middle of the past decade. Business firms, on the other hand, have significantly increased their levels of saving. Business saving rose from an average of 8·6% of GDP in 1982–86 to 15·2% in 1987–96. In the most recent period, business saving accounted for 70% of all gross domestic saving. So, the raw data suggest that the chief actor in the play entitled 'Why Has the Saving Rate of the Chilean Economy Increased so Much?' is indeed the saving of the business sector, and not, as is usually assumed, the increase in saving brought about by the social security reform.

2.2 The long-term view

What does the analysis of the long-term saving and investment series tell us? Are recent trends a quirk that can be expected to be reversed in the future? Fortunately, with a little bit of archaeology, one is able to reconstruct the Chilean national accounts going back to the 1940s.[2] As can be seen from the data shown in Appendix Table A1, there does not seem to be anything remarkable in the data on Chilean saving and investment in the long period that runs from 1940 through 1986. In fact, one cannot discern any clear trends in the saving or investment rates, except that the composition of investment shifted markedly from the public to the private sector.[3]

The disaggregation of saving and investment shows an interesting pattern. All data are expressed in *per capita* terms, for the simple reason that population rose over the 1940–96 period from 4·8 million to 14·4 million people, so that aggregate macroeconomic data all show the influence of population. While household saving appears to be a stationary variable with zero mean, business saving increases steadily over time (see Figures 2 and 3). The behaviour of private investment is quite similar to that of business saving, although year-to-year variations are not always in the same direction. Finally, public saving and investment appear to be stationary with a positive mean (Figure 4).

[1] These losses originated in the support given by the Central Bank to the private banking system after the 1982 banking crisis. The Central Bank also incurred losses during 1991–97, because it accumulated low-yielding international reserves while, at the same time, it sought to sterilise the monetary effects of international capital inflows through increases in its debt denominated in pesos, which carry much higher interest rates than its foreign assets.

[2] For the period 1940–59, we used the data collected by Mamalakis (1980). For the 1960–96 period, the main sources were the Banco Central de Chile (1989, 1998). All data were spliced together from the most recent source (which includes the latest revisions to the national accounts) backward toward the earliest. All data are expressed in 1986 constant prices using the GDP deflator. The disaggregation of private saving into its household and business components is available for 1940–74 in Mamalakis (1980). For 1985–94, we use estimates of household saving calculated by MIDEPLAN (1996) and obtain business saving as a residual. Data for household saving for the intervening years and for 1995–96 were built from various sources, sticking to the methodology used in MIDEPLAN (1996). The data base is available on request.

[3] It should be noted that public investment excludes investments by government-owned companies, which are included in private investment. Public investment was defined as the investment of the general government.

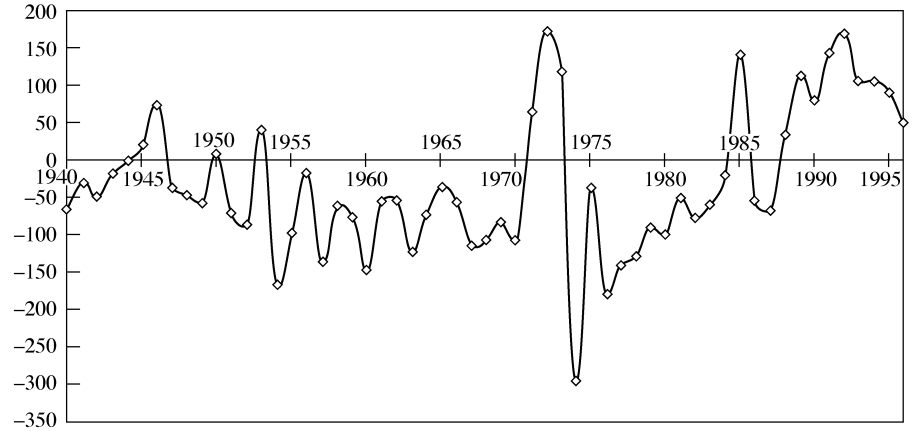

Fig. 2. *Per capita household saving, 1940–96 (000 1986 pesos). Source: see Table A1.*

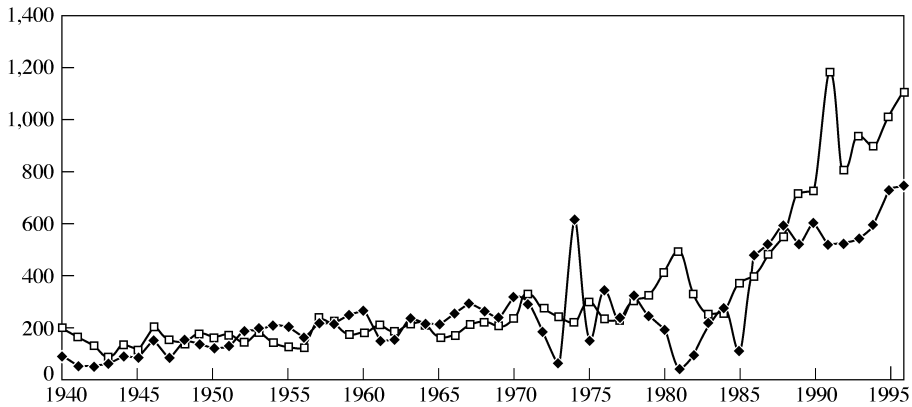

Fig. 3. *Per capita gross business saving and private investment, 1940–96 (000 1986 pesos): ◆, business saving; □, private investment. Source: see Table A1.*

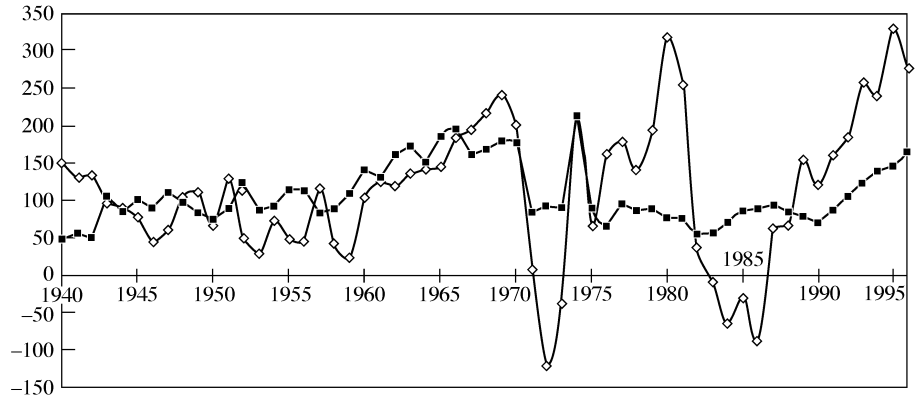

Fig. 4. *Per capita public saving and investment, 1940–96 (000 1986 pesos): ◆, public saving; □, public investment. Source: see Table A1.*

Formal unit root tests verify these hunches based on naked-eye inspection of the series. As shown in Appendix Table A2, Augmented Dickey–Fuller tests using MacKinnnon critical values allow us to determine that household saving is a stationary variable with zero mean, that public saving and public investment are stationary variables with a constant, and that all other variables have unit roots. We also added GDP to the tests, since we will be using this variable in the econometric exercises that follow. Because the data on private investment and business saving appear to begin increasing at a much faster pace around 1986, we also conducted Perron tests to determine the existence of structural breaks in these series in 1986. However, the tests failed to produce evidence that these variables are stationary with structural breaks.

What is the significance of these findings? In the first place, it would seem that household saving, and not total private saving, behaves as the permanent income hypothesis of the consumption function would lead us to expect. In other words, it would seem that there is a corporate veil. If one were to accept the permanent income hypothesis of consumption *and at the same time posit that there is no corporate veil*, private saving as a whole would have to be stationary with zero mean. If, as we find, business saving has a unit root, then household saving would also need to have a unit root: in other words, in the long run, any increase in business saving would need to be offset by *declines* in household saving. This obviously does not happen. Thus households do not seem to treat business saving as their own.

The simplest version of Friedman's permanent income hypothesis bears this out. Let s be saving, c consumption, y disposable income; let subscripts 'p' and 't' stand for permanent and transitory, respectively. The permanent income hypothesis can be interpreted by the following set of equations:

$$s \equiv y - c \tag{1}$$

$$y \equiv y_p + y_t \tag{2}$$

$$c \equiv c_p + c_t \tag{3}$$

$$c_p = y_p \tag{4}$$

Equations (1)–(3) are, of course, definitional. Equation (4), on the other hand, is the permanent income hypothesis (Friedman, 1957). Replacing (1)–(3) in (4), we have:

$$s = y_t - c_t \tag{5}$$

Since y_t and c_t are both random variables with zero mean, so is s. That is, the relevant concept of saving associated with a theory of household consumption should be stationary. What the data for Chile tell us is that the concept we are looking for is, indeed, household saving, not total private saving, and much less so domestic saving.

Another implication of the finding that household saving is stationary is that the social security reform of 1981 probably did not add much to Chile's overall saving. In 1981, there was a wholesale overhaul of the social security system, and one of the rationales for the reform was that it would force households to save and would thus eventually raise private saving. The reform consisted in the replacement of the pay-as-you-go (PAYG) system then in force with an individual capitalisation scheme of compulsory saving run by regulated private pension funds (Administradoras de Fondos de Pensiones—AFPs).

In the PAYG system, social security contributions may well be considered simply as a tax. In contradistinction, the individual capitalisation system makes saving for retirement

explicit. This means that, within certain limits imposed by liquidity restrictions, in the long run, compulsory saving under the new system is fully compensated for by decreases in voluntary saving. The finding that *total* household saving (compulsory plus voluntary) is stationary suggests that forced saving is indeed counteracted in the long run.

For households not to be able to undo the rise in saving forced upon them by compulsory social security contributions, the rate of forced saving (now 12% of gross income) would probably need to be much higher than at present. The higher the rate, the less likely are low income households to offset compulsory saving, since liquidity constraints would simply not allow them to do so. Of course, the scheme is probably totally ineffective in raising the saving of high-income households. This is recognised in the current system, which has a cap on incomes subject to compulsory saving.

The pension reform may have had other positive effects on saving not captured by the data on household saving. First, in the long run, the reform has reduced the fiscal burden associated with the PAYG system, since the latter was bankrupt. Therefore, public saving is now higher than it would have been under the PAYG system. This has contributed to macroeconomic stability and to a good investment climate. Secondly, the pension reform has been fundamental in deepening financial markets, since, under the reform, household saving are explicitly channelled to financial markets. This effect could have relaxed financial constraints on investment for firms with access to financial markets. Both effects probably led to higher investment rates in comparison to what they would have been without the pension reform. By raising private investment, the reform may have contributed indirectly to higher business and total saving.

3. A model for household saving

The analysis of the time series for Chilean saving suggests that it is appropriate to estimate separate empirical models for household and business saving. We begin with a model for household saving. Since household saving is a stationary variable, one can model only its short-run behaviour. We posit that household saving depends on increases in income (*dgdp*), on public saving (*spub*), on changes in business saving (*dsbus*), and on changes in foreign saving (*dsfor*). All variables included in the analysis are stationary.

$$shous = (\alpha_1 \times dgdp) + (\alpha_2 \times spub) + (\alpha_3 \times dsbus) + (\alpha_4 \times dsfor) \tag{6}$$

The model is a straightforward application of the permanent income hypothesis to personal income. If all increases in household income are saved, we would expect to find that $\alpha_1 = 1$. In addition, the model seeks to determine whether there is substitution between household saving, on the one hand, and other forms of saving in the economy (business saving, public saving and foreign saving).

The empirical model results are to be found in Appendix Table A3. All variables except for *dsfor* turn out to be significant at standard levels, and the signs are as expected and the fit of the model is quite good. By equating lagged values with current values of all variables, we obtain a 'longer-run' version of the equation:

$$shous = (0{\cdot}97 \times dgdp) - (0{\cdot}67 \times spub) - (1{\cdot}57 \times dsbus) \tag{7}$$

Increases in GDP are positively associated with household saving, and the coefficient associating both variables ($\hat{\alpha}_1$) is almost equal to unity. In effect, a Wald test shows that this coefficient is not significantly different from 1 (see Appendix Table A3). It would thus seem that, as suggested by the permanent income hypothesis, households save all of the

increases in income. A Wald test also indicates that $\hat{\alpha}_2$ and $\hat{\alpha}_3$ are not significantly different from –1. Therefore, households appear to counteract one for one changes in public saving and changes in the rate of change in business saving. As evidenced by the strong effects of the lagged values of *shous* on the contemporary values of the variable (and also by an examination of the behaviour of the series in Figure 2), there is also quite a bit of persistence in the behaviour of household saving. This persistence could be partly the effect of liquidity constraints that do not allow households to adjust fully and rapidly their actual to their desired levels of consumption. Thus the short run can last a long time.

In conclusion, it would seem that household saving, not total private saving, is essentially a short-run phenomenon and behaves in the manner postulated by the permanent income hypothesis. At the level of the household, Ricardian equivalence holds in the short run: an increase in public saving leads to a one-to-one decline in household saving. In their saving decisions, households also appear to take into account the *rate of change* in business saving. In the long run, household saving is zero and is unaffected by changes in public or business saving.

4. A model for business saving

The fact that household saving is a stationary variable suggests that, if one wishes to understand the long-run behaviour of private saving, it is necessary to study the determinants of business saving. For this purpose, we estimate a VAR using Johansen's technique. We posit that the data generation process has the following form:

$$Z = [sbus, ipriv, spub, sfor, t] \tag{8}$$

We consider that firms' saving and investment decisions are determined jointly. We also test for the influence on the system of public saving and foreign saving.[1]

This model was estimated with annual data for the period 1940–96. The optimum lag was determined to be three years. The estimated system is (almost) free of econometric problems (see Appendix Table A4). The only problem that could be detected was the existence of mild first-order autocorrelation in the equation for *ipriv*, but we did not correct for it because at the level of the system as a whole the problem disappears. As Appendix Table A5 shows, it was possible to determine that there is only one cointegration vector in the system. Both tests—maximal eigenvalue and trace statistics—yield the same result. The standardised version of the vector, which defines the long run relationships between business saving and the other variables included in the VAR, is the following:

$$sbus = (0{\cdot}453 \times ipriv) + (0{\cdot}074 \times spub) - (0{\cdot}832 \times sfor) + (3{\cdot}704 \times t) \tag{9}$$

Several tests of hypothesis were conducted on this vector. These can be found in Appendix Table A6. In the first place, we are interested in knowing whether the coefficient associated with *ipriv* is significantly different from zero *and* from one. We can reject both hypotheses that $\beta_{ipriv} = 0$ and that $\beta_{ipriv} = 1$ at the 1% level of significance (see first two lines in Appendix Table A6). This provides support for the hypothesis that business saving and private investment are jointly determined in the long run.

[1] A time trend and three impulse dummies were added to system, d46 to reflect the effects of the end of World War II on investment, d81 for an unusually high level of private investment in 1981, and d91 for the positive effects on investment of the return to democracy.

Secondly, the hypothesis that $\beta_{spub} = 0$ cannot be rejected (line 3). Therefore, there is no evidence, from the side of business saving, in favour of Ricardian equivalence: long-run changes in public saving have no impact on business saving.

Thirdly, we can reject the hypotheses that $\beta_{sfor} = 0$ at the 1% level of significance (line 4); however, we cannot reject the hypothesis that the coefficient is significantly different from –1. This means that, in the long run, foreign saving is a perfect substitute for business saving. While firms may in fact find themselves constrained in their access to foreign saving in the short run, this does not appear to be the case in the long run. The joint hypothesis of $\beta_{spub} = 0$, $\beta_{sfor} = -1$ cannot be rejected. Finally, the trend appears to be significantly different from zero at the 1% level.

Given these tests of hypothesis, in the vector error correction model (VECM), the coefficient associated with foreign saving was restricted to take the value of –1, and the coefficient of public saving was restricted to zero. In order to test for weak exogeneity, the VECM was first run for all variables in the VAR differentiated once.

The system obtained is shown in Appendix Table A7.[9] Since the error correction term is significantly different from zero for all three equations shown, we can conclude that business saving, private investment and foreign saving are endogenous variables that are jointly determined. It is interesting that disequilibria in business saving are associated with *positive* changes in private investment: when business saving is above its long-run equilibrium level, private investment accelerates. The opposite is, of course, true (as it should be) for business saving. As regards foreign saving, it is also the case that an excess of business saving relative to its equilibrium level decelerates foreign saving in the next period. This indicates that business and foreign saving are substitutes in the short run as well as in the long run.

We then proceeded to estimate a parsimonious VECM for the three endogenous variables by full information maximum likelihood methods. The results are shown in Appendix Table A8. Public saving (*spub*) is the only exogenous variable in the system. In the short run, an increase in government saving is associated with a *rise, not a decline*, in private investment and business saving. This may be because, in the short run, public saving acts as a signalling devise for the private sector: increases in public saving may be considered to be the result of 'virtuous' public policies, eliciting increases in private investment and in business saving. Thus, public saving *crowds in* private saving in the short run.[2] The error-correction variable indicates that about half of the short-term disequilibria in business saving and in private investment are corrected in one year. The system has excellent diagnostic properties and, therefore, appears to describe accurately the saving-investment process in Chile.

5. Conclusions and policy implications

This analysis of the saving behaviour of the Chilean economy over a long period has yielded several results that are of considerable theoretical and policy interest. The first most important conclusion is that the sharp improvement in the saving performance of

[1] Public saving is not shown in the table because it is clearly weakly exogenous, as could have been expected from the fact that it is a stationary variable.

[2] The positive short-run association between public saving and business saving could be due to the effects on both variables of GDP shocks. Thus positive GDP shocks could give an impulse to both public saving (through its revenue effects) and to business saving (through impacts on profits). I owe this suggestion to Leonardo Hernández (Central Bank of Chile).

the Chilean economy is associated with an increase in business saving, which in turn seems to be related mostly to the rise in private investment. Business saving and investment decisions are intricately interwoven, as suggested by both 'old' classical models, the Cambridge (England) school, and the new literature on financial constraints to investment.

The social security reform appears to have contributed little to the rise in saving.[1] While household saving has risen modestly since the mid-1980s, a longer-term perspective shows that household saving is stationary around a zero mean. In the long run, households may simply dissave voluntarily what they are forced to save by the social security system. Even if the entire increase in household saving in the 1987–96 period relative to 1982–86 could be attributed to the social security reform (which, of course, it cannot), its contribution to the increase in total saving would have been 2·7 percentage points of GDP, while total domestic saving rose by 15 percentage points of GDP. The increase in business saving contributed 6·6 percentage points of GDP, while government contributed 5·8 percentage points. The implication is that, if the objective of policy is to raise the domestic saving rate, the way to go is not through mechanisms to increase forced saving, unless the government attempted to raise the rate of forced saving to levels that would probably be politically unacceptable.

Clearly, the way to raise domestic saving is to increase the attractiveness of domestic investment through policies that reduce uncertainty and investment risk. The maintenance of macroeconomic stability and the avoidance of stop-go policies would appear to be a must. In small open economies such as Chile's, avoidance of high volatility in the real exchange rate, together with an exchange rate level that is favourable to exportables, are also important inducements to investment. Since investment in exportables is not constrained by the size of the domestic market (as investment in both non-tradables and importables surely is), policies that reduce the volatility of rates of return in the export sector (through greater stability in the real exchange rate) and maintain them high can have very powerful effects on investment. In fact, the upswing in investment in Chile since the mid-1980s can be explained by the very sharp real exchange rate depreciation that began in 1982 owing to the debt crisis and lasted into the early 1990s (see Agosin, 1998). Thus the exchange rate was not only favourable to investment in exportables, but it remained so for over a decade.

The econometric results reported in this paper indicate that, in the long run, changes in business saving do not affect the behaviour of households. They also show that increases in public saving have no long-run adverse effects on business saving. In fact, in the short run, public saving crowds in business saving. On the other hand, there is a trade-off between public saving and household saving, but it operates only in the short run. These results suggest that, in the long run, increases in public saving will lead to a one-to-one rise in domestic saving.

In the long run, foreign and business saving are perfect substitutes. However, changes in foreign saving appear to have no effect on household saving. How can these results be interpreted? When the availability of foreign capital rises, international borrowing constraints are relaxed. The actual use of foreign capital is, of course, the current account deficit, and this variable is indeed endogenous and determined jointly with business saving and private investment. Thus, when the current account deficit rises, it is because

[1] However, it may have contributed to higher rates of investment by relaxing the borrowing constraint of firms with access to capital markets. The main impact of the reform was to deepen very significantly what was, up to then, a puny capital market.

business firms have improved access to foreign capital to finance investment and, consequently, they save less.

Why should policy-makers worry about private domestic saving, since shortfalls in a part of it (business saving) are eventually made up by increases in foreign saving? The reason is external vulnerability. As has become evident from the recent financial crises in Mexico and East Asia, foreign portfolio investors and foreign banks become skittish about putting money into a country that is running high and persistent current account deficits. In fact, in such situations, they have been shown to be quite prone to curtail funds rather abruptly. Experience also tells us that such situations have very adverse impacts on economic activity in general and especially on private investment. Sudden and large declines in foreign capital inflows that force the current account to adjust rapidly have very adverse effects on output and investment. Policy-makers should not buy the argument that in the long run everything will be fine and that business saving will eventually make up for the shortfall in foreign saving. Better be safe than sorry and maintain a current account deficit that foreign investors are likely to finance in the long run.

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Appendix

Table A1. *Saving and investment in Chile, 1940–96 (percentage of GDP)*

	1940–59	1960–69	1970–73	1974–81	1982–86	1987–96
(1) GDP growth rate	1·3	2·4	–0·9	2·1	–1·6	6·2
(2) Gr. dom. saving	9·6	12·3	10·3	12·6	6·7	21·7
(3) Household saving	–2·3	–3·6	2·2	–5·2	–0·7	2·0
(4) Business saving	7·4	9·4	7·7	10·6	8·6	15·2
(5) Public saving	4·5	6·5	0·4	7·2	–1·3	4·5
(6) Private saving[a]	5·1	5·8	9·9	5·4	7·9	17·2
(7) Foreign saving	0·2	2·7	2·4	5·0	8·4	2·8
(8) Gr. fixed investment	13·4	14·8	13·9	15·8	14·6	24·1
(9) Gr. investment	9·9	15·0	12·7	17·5	15·1	24·5
(10) Public invest.	4·8	6·8	4·1	3·8	2·6	2·7
(11) Private invest.[b]	8·6	8·0	9·8	11·9	12·0	21·3

[a](3) + (4).
[b](8) – (10).
Source: Author's calculations, based on data from Mamalakis (1980), MIDEPLAN (1996), and Central Bank of Chile (1989, 1998).

Table A2. *ADF unit root tests*

Variable	ADF statistic	Order of integration	Constant and trend	Number of lags[a]
spriv	–1·75	I(1)	Constant and trend	0
shous	–4·24**	I(0)		0
sbus	2·00	I(1)	Constant and trend	1
spub	–3·02*	I(0)	Constant	0
sfor	–2·88	I(1)	Constant	0
ipriv	–0·54	I(1)	Constant and trend	1
ipub	–3·32*	I(0)	Constant	0
gdp	3·28	I(1)	Constant	0

*Significantly different from zero at 5%. **Significantly different from zero at 1%.
[a]Refers to lags of dependent variable introduced on right-hand side.

Table A3. *Determinants of household saving (shous)*

Variable	Coefficient[a]	*t*-Statistic
dgdp	0·286	5·62
spub	–0·612	–6·35
spub (–1)	0·414	4·49
dsbus	–0·462	–8·82
shous (–1)	0·705	9·68

Wald tests on coefficients

Null hypothesis	*F*-statistic	Probability
$[c(1)]/[1 - c(5)] = 1$	0·012	0·912
$[c(2) + c(3)]/[1 - c(5)] = -1$	2·946	0·092
$[c(2) + c(3)]/[1 - c(5)] = 0$	11·909	0·001[b]
$[c(4)]/[1 - c(5)] = -1$	1·444	0·235

[a]All coefficients are significant at the 1% level. Adjusted R^2 = 0·776; Jarque Bera normality test = 4·27 [0·118]; Breusch–Godfrey *F*-statistic = 1·09 [0·343]; ARCH (1) *F*-statistic = 0·08 [0·775]; White *F*-statistic (no cross terms) = 0·235 [0·991]; White *F*-statistic (cross terms) = 0·711 [0·788].
[b]Hypothesis can be rejected at the 1% level of significance.

Table A4. *Test summary for the VAR*

Variable	AR 1–2 F(2, 33)	Normality χ^2 (2)	ARCH 1 *F*(2,33)	X_i^2 *F* (26,8)
sbus	0·508 [0·606]	2·706 [0·259]	3·257 [0·080]	1·554 [0·266]
ipriv	4·771 [0·015][a]	2·318 [0·314]	1·287 [0·265]	0·302 [0·990]
spub	0·125 [0·883]	2·687 [0·261]	2·285 [0·140]	0·592 [0·852]
sfor	0·224 [0·800]	1·935 [0·380]	0·023 [0·880]	0·912 [0·603]
vector	1·566 [0·051]	8·938 [0·348]		0·138 [1·000]

[a]Hypothesis is rejected at 5% level of significance.

Table A5. *Tests for the number of cointegration vectors*

$H_0 = p$ (rank of matrix)	Maximal eigenvalue statistic[a]	Trace statistic[a]
$p = 0$	35·80⋆	72·73⋆⋆
$p \leq 1$	18·91	48·01
$p \leq 2$	14·38	18·02
$p \leq 3$	3·64	3·64

⋆Significantly different from zero: ⋆ at the 5% level; ⋆⋆at the 1% level.
[a]Corrected for degrees of freedom.

Table A6. *Likelihood ratio χ^2 significance tests on the parameters of the cointegration vector*

Hypothesis	β_{ipriv}	β_{spub}	β_{sfor}	β_t	LR χ^2
H_1	0				26·707**
H_1	1				17·190**
H_2		0			0·407
H_3			0		10·157**
H_4			–1		2·217
H_5		0	–1		2·532
H_6				0	7·779**

**Hypothesis rejected at 1% level of significance.

Table A7. *Vector error correction model (OLS, constant and impulse dummy parameters not shown)*

Dependent variable	*dsbus (–1)*	*dipriv (–1)*	*vercorr (–1)*[a]
dsbus	–0·35	–0·14	–0·50
	(–2·36)*	(–0·95)	(–2·34)*
dipriv	–0·05	–0·34	0·49
	(–0·56)	(–4·01)**	(4·06)**
dsfor	0·40	–0·08	–0·40
	(4·58)**	(–0·93)	(–3·15)**

Significantly different from zero: *at the 5% level; **at the 1% level.

[a]*vercorr* is the vector error correction variable obtained from the restricted version of the cointegration vector [equation (10) in the text, assuming $\beta_{spub} = 0$ and $\beta_{sfor} = -1$].

Table A8. *Parsimonious vector error correction model (estimated by FIML for the three endogenous variables)*

Explanatory variable	Equation (1) *dsbus*	Equation (2) *dipriv*	Equation (3) *dsfor*
Constant	39·823	–21·133	
	(2·17)*	(–2·13)*	
dsbus (–1)	–0·303		0·411
	(–2·15)*		(5·45)**
dspub	0·423	0·222	
	(2·38)*	(2·39)*	
dipriv (–1)		–0·229	
		(–3·79)**	
vercorr (–1)	–0·449	0·501	–0·401
	(–2·15)*	(5·57)**	(–3·38)**
d46		118·82	
		(2·73)**	
d81		151·28	198·58
		(2·64)*	(3·32)**
d91		495·17	
		(2·13)*	

Significantly different from zero: *at the 5% level; ** at the 1% level.