

**Aaron Tornell**

## **Summary of Published Research**

During my professional career I have worked in academia (Columbia, Harvard, UCLA), government (deputy to Mexican Finance Minister, responsible for privatization) and finance (Soros Fund, Assoc. Managing Director). My research agenda has been inspired by my work experience. In my research papers, I have contributed to three areas of the Economics literature: (i) Financial liberalization, lending booms and crises; (ii) exchange rate puzzles; (iii) political economy models of common access.

Part of my academic life has been devoted to participating in the economic policy debate by making presentations at Central Banks and International Organizations, as well as by writing policy-relevant op-eds for policymakers and the general public. In particular, I have participated in contentious debates about privatization, financial crises, and recently on the role of Target2 in the Eurozone crisis.

### **I. Published Papers**

Here, I summarize the six papers that contain my main contributions to the Economics literature.

#### **a. Financial liberalization, Lending Booms and Crises**

During the last several decades, many emerging markets have experienced boom-bust cycles (BBCs). Typically, along a lending boom there is: (i) a sharp increase in the credit-to-GDP ratio and (ii) a real exchange rate appreciation, i.e., an increase in the price of non-tradables (e.g., housing) relative to tradables (e.g., manufacturing). Many booms end in self-fulfilling crises, in which there is (iii) a sharp real depreciation and (iv) generalized defaults on foreign currency denominated debts. During crises (v) lenders typically are bailed-out by the government. In the wake of the crisis, it takes a long time for the credit-to-gdp ratio to recover. Along the typical BBC there is a sectoral asymmetry that I emphasize in my research: The non-tradables sector and tradables sector behave quite differently: (vi) while the N-sector grows faster along the boom than the T-sector, it falls harder during the crisis and it takes longer to recover than the T-sector. I have documented these stylized facts in [Tornell and Westermann \(2002\)](#). Several of them have been reproduced in latter literature and have parallels in the recent US housing crisis.

## Balance Sheet Effects, Bailout Guarantees and Financial Crises

Schneider and Tornell

*Review of Economic Studies (2004)*

This paper proposes a novel theory of boom-bust cycles generated by the interaction between contract enforceability problems and systemic bailout guarantees. The former imperfection may lead lenders to impose borrowing constraints to disincentivize borrowers to divert funds. Meanwhile, the latter introduces incentives to take on systemic credit risk. While each of these imperfections has been analyzed before in the literature, to my knowledge this is the first paper to model them jointly. Moreover, our focus on sectoral asymmetries leads us to provide a new account of the self-feeding dynamics of BBCs.

When we wrote this paper in the early 2000s, bailout guarantees seemed a theoretical curiosity and borrowing constraints were not part of mainstream macro models. I believe that today both imperfections are well accepted by the profession.

The interaction of these distortions can generate both price risk and systemic credit risk endogenously. On the one hand, if the future real exchange rate (price) is expected to be volatile enough, N-sector borrowers may find it optimal to take on 'currency mismatch' by denominating their debt in T-goods. If a critical mass of borrowers do this, they will all go bust if there is a severe depreciation, triggering a systemic bailout that shifts debt repayment to taxpayers. This increases expected profits: expected interest costs are lower and borrowing constraints are relaxed. This mechanism captures the oft-heard business man strategy in emerging markets that it pays to borrow in foreign currency as interest rates are dirt cheap and loan amounts are larger.

On the other hand, given that there is currency mismatch, a "balance sheet effect" validates the expectations of large price volatility. Because bailouts are not idiosyncratic, lenders find it optimal to impose borrowing constraints. As a result, N-sector credit and investment depend on N-sector internal funds---a balance sheet effect.

A self-fulfilling crisis occurs as follows. Suppose that the price of N-goods falls. Since there is currency mismatch and borrowing constraints bind, the fall in price reduces credit and N-sector investment. If the N-sector is an important enough buyer in its own market, the price fall needed to clear the market may be large enough to bankrupt N-sector firms. This in turn validates the expectations of a severe depreciation. Of course this mechanism arises in equilibrium only if crises are rare.

What kicks off a boom? To account for a full BBC we make a 3rd assumption that the demand for N-goods is expected to increase in the future (say because of a structural reform). Such news kick off a boom during which N-sector output and its price rise hand-in-hand. Along the boom, the increase in N-output increases the internal funds of N-borrowers, which in turn increases credit and investment demand. Investment is profitable because prices are expected to rise fast enough.

Future expected prices in turn will be higher because higher investment leads to higher output and investment and so on. This self-feeding boom is sustainable because of the eventual increase in demand from other sectors. Of course, along this path there is a small probability of a self-fulfilling crisis because there is currency mismatch.

### Systemic Crises and Growth

Ranciere, Tornell and Westermann,

*Quarterly Journal of Economics* (2008)

This paper shows that, over the long-run, countries that have experienced (rare) financial crises tend to grow faster than countries that have experienced stable financial conditions. I believe this contribution has crossed the bounds of academia into journalism and policy making circles.

Needless to say, this finding does not imply that crises per-se are good for growth. Rather, the explanation we give is that systemic risk taking relaxes financing constraints, which leads to higher investment and growth. However, as a by-product, systemic risk taking also leads to crises that although rare can be severe.

How can one capture for a large panel of countries the link between crisis incidence and long-run growth? A contribution of RTW is to propose the negative-skewness of credit growth as the appropriate measure of crisis volatility. During a systemic crisis there is a large and abrupt downward jump in credit growth. Because financial crises only happen occasionally, these negative outliers tilt the distribution to the left. Thus, in a large enough sample, crisis-prone economies tend to exhibit lower skewness than financially stable economies.

The variance is not a good instrument to identify crisis volatility. High variance captures not only rare, large, and abrupt contractions, but also frequent or symmetric shocks. In contrast, skewness specifically captures the asymmetric patterns of credit growth and thus can identify the existence of rare financial crises. Notice that a country that experiences a crisis every other year--like Argentina or Brazil in the 1970s and 1980s---exhibits high variance, not negative skewness, as the mean of credit growth shifts to the left.

Excess kurtosis has also been used in the literature on rare disasters. Skewness better isolates rare severe crises as excess kurtosis captures both the fatness of the tails as well as the peakedness of the distribution.

In panel growth regressions, we find a statistically significant negative link between the skewness of credit growth and GDP growth across a large set of countries over the period 1960-2000. This link is economically important. For instance, our estimates indicate that a third of the difference in growth between Thailand and India can be attributed to systemic risk taking. We also find the negative link between growth and variance present in the macroeconomics literature.

Why not use de jure crisis indexes? We document a fairly close correspondence between our skewness measure and well-known De Jure crisis indexes. While skewness does not use information about the financial system, it is an objective measure of the incidence of severe crises and it can be computed for a large set of countries over long time periods. Unfortunately, de jure crises indexes are subjective, limited in their coverage over countries and time, and do not provide information on the relative severity of crises.

### [Financial Liberalization, Debt Mismatch, Allocative Efficiency, and Growth](#)

Ranciere and Tornell

*American Economic Journal: Macroeconomics (Forthcoming)*

While the case for trade liberalization is well established, the case for financial liberalization is not as it typically leads to crises. This paper presents a two-sector endogenous growth framework that allows for the decomposition of the gains and losses of FL in economies where financial frictions hinder the growth of sectors that are more dependent on external finance, and it derives a condition for the gains of FL that can be tested with readily available data.

The main message is that one should be cautious. From the finding that liberalization leads to more crises, one should not conclude that liberalization per-se is bad for either growth or production efficiency. Policies intended to eliminate all financial fragility might have the unintended effect of blocking the forces that spur growth. At the other extreme, the gains can be overturned in a regime with unfettered liberalization because bailout guarantees are present. The combination of an anything-goes regulatory regime with bailout guarantees forms a toxic cocktail.

In the model, financial liberalization may enhance growth and consumption possibilities because it improves allocative efficiency. By allowing for new financing instruments and the undertaking of risk, liberalization relaxes financing constraints. As a consequence, sectors more dependent on external finance can invest more and grow faster. The rest of the economy benefits from this relaxation of the bottleneck via input--output linkages, and hence there is an increase in aggregate growth. However---and this is key---the use of new instruments generates new states of the world in which insolvencies occur, and so a riskless economy is endogenously transformed into one with systemic-risk.

Our second result is that if there are regulatory limits on the types of issuable liabilities that ensure borrowers risk enough of their own capital, then financial discipline is preserved and there may be net growth gains from liberalization despite the occurrence of crises. Whether there are net growth gains depends on a simple testable condition: if the crises' output cost is lower than a threshold determined by the debt-to-assets ratio. We test this condition on a set of emerging markets over the period 1970-2012 and find that it is satisfied for the observed range of output costs of crises. We also show that under non-distortionary taxation, the increased resources

generated by faster growth suffice to cover the fiscal costs of bailouts. Furthermore, if the key parameters of the model are matched to their empirical counterparts for emerging markets, financial liberalization generates consumption gains net of the bailout costs.

Third, because of bailout guarantees financial discipline can break down in the absence of regulatory limits on the set of issuable securities. The possibility of issuing option-like instruments that concentrate all repayments in default states allows borrowers without any profitable investment opportunities to invest without putting equity down, thereby exploiting bailout guarantees. Even though agents are optimizing and average growth might be higher under such an anything-goes regime, the losses during crises more than offset private profits, resulting in net social losses.

These results help rationalize the contrasting experience of emerging markets following financial liberalization and the recent US boom-bust cycle. Emerging markets' booms have featured mainly standard debt; while they have experienced crises, systemic risk taking has been, on average, associated with higher long-run growth. In contrast, the recent US boom featured a proliferation of uncollateralized option-like liabilities that supported large-scale funding of negative net present value projects in the housing sector.

## **b. Foreign Exchange Market Anomalies**

My research in this area has focused on the slow response of forecasts to account for the forward premium puzzle (FPP) and on exchange rate forecasting.

The FPP is the tendency for high interest rate currencies to appreciate relative to low interest rate currencies. This pattern generates predictable excess returns as investors can pocket on average both the interest rate differential as well as the subsequent gains from appreciation. Related to this anomaly, exchange rates often exhibit momentum--or delayed overshooting--in response to interest rate differential shocks. That is, when there is a positive innovation to the interest rate differential, the exchange rate appreciates at impact. The puzzle is that it continues appreciating for several months thereafter. Standard models predict an immediate appreciation followed by a depreciating path. These patterns have been exploited by foreign exchange market traders via the so-called carry trade.

### [Exchange Rate Puzzles and Distorted Beliefs](#)

Gourinchas and Tornell

*Journal of International Economics* (2004)

This paper proposes a new explanation for the forward premium and delayed overshooting puzzles. Using survey data, it finds that forecasts of interest rate differentials systematically

underreact to news, and shows that such forecast underreaction may account for these two exchange rate puzzles. A systematic under-reaction of forecasts to innovations implies that the forward premium is a biased predictor of future depreciation. The bias can be so severe as to generate a negative coefficient in the "Fama" regression if there is a large degree of forecast under-reaction and a large persistence of interest rate innovations. We show that for G-7 countries against the U.S., these puzzles can be rationalized for values of the model's parameters that match empirical estimates.

Our starting point is a setup where agents constantly learn about the duration of interest rate shocks: transitory versus persistent. In and by itself, the fact that agents constantly learn about the duration of interest rate innovations is not enough to rationalize the two exchange rate puzzles. Since rational agents cannot be systematically fooled, there cannot exist predictable excess returns, which are necessary for the anomalies. However, using a survey data set on interest rate expectations, published by the Financial Times Currency Forecaster, we find (i) no evidence of transitory shocks in the forward premium; (ii) yet implicitly market participants expect incorrectly a substantial share of interest rate innovations to be purely transitory. This contrast is striking: the relative variance of transitory shocks implicitly assumed by market participants is often significantly larger than that in the data.

We demonstrate that for values of the misperception implied by our empirical estimates, the equilibrium exchange rate in the model exhibits both delayed overshooting and the FPP in its most extreme form --i.e., a negative Fama coefficient.

To gain some intuition suppose that domestic interest rates increase vis-a-vis constant foreign short rates, then return gradually to their equilibrium value. If agents know the exact nature of the shock, the exchange rate immediately appreciates relative to its long run value up to the point where the expected future depreciation compensates for the interest rate differential. It then progressively reverts to equilibrium as the interest rate differential declines. This is the forward premium effect: there is overshooting and uncovered interest parity holds. Suppose now that agents misperceive the shock as transitory. On impact, agents believe the domestic interest rate will revert to its equilibrium value fairly rapidly. The exchange rate may initially appreciate moderately. In the next period, the interest rate is in fact higher than agents expected, leading to an upward revision in beliefs regarding the persistence of the shocks. This revision leads to an appreciation. This is the updating effect. However, the domestic interest rate is also reverting to its equilibrium value, leading to a depreciation. If the updating effect is strong enough so as to dominate the forward premium effect, there is a gradual appreciation of the currency. Eventually, there is not much more to learn and the forward premium effect dominates. Thus, the exchange rate reverts to its equilibrium value. Along this hump-shaped path, there are positive excess returns in the domestic currency, and the forward premium is negatively correlated with expected appreciation.

The previous intuition describing the conditional response to an interest rate innovation carries over to an unconditional statement about the forward premium. We show that while the forward

premium bias arises if there is misperception, the most extreme form of this puzzle, a negative Fama coefficient, arises only if there is a large degree of forecast under-reaction and a large persistence of interest rate innovations. These parameter values match empirical estimates in our sample.

This paper takes as given the underreaction of forecasts to news. In Li and Tornell (2014), we investigate whether a desire for robustness against model misspecification may generate such underreaction.

### **c. Dynamic Political Economy Models of Common Access**

The Tragedy-of-the-Commons arises when a set of organized groups have the power to extract resources from the economy. In such a setup, the growth path of the economy and its response to shocks differs from that of a standard representative agent economy. I have written several papers where the commons' problem is modeled via a dynamic game where powerful groups have common-access to aggregate resources. I have analyzed the following issues: (i) Why does Capital tend to flow from poor to rich countries? (ii) Capital Account liberalization often leads to capital flight. Is this good for growth? (iii) Why do resource-rich countries tend to grow slower than resource-poor countries? (iv) Why are windfalls squandered in many emerging economies? Currently, I am working on: (v) The role of the Target2 mechanism in the Eurozone crisis and (vi) Are crises necessary for structural reform?

#### [The Tragedy of the Commons and Economic Growth: Why Does Capital Flow from Poor to Rich Countries?](#)

Tornell and Velasco

*Journal of Political Economy* (1992)

Capital flight occurs when resources flow from poor to rich countries. To the extent that capital has a higher physical marginal return in poor countries, this flow seems paradoxical. There are several reasons why capital may be less productive in poor countries (like a lack of human capital). This paper offers an alternative explanation: capital flight is the response to the tragedy of the commons. In equilibrium capital flight serves a social function: opening the capital account and the option of investing abroad introduces a floor on domestic equilibrium expropriatory policies. Even if capital flight results, growth and welfare may go up. While this paper was written to address the debate about liberalization policies in the 1990s, I believe it is relevant today in countries like China.

We consider a dynamic game among groups that have the power to appropriate resources from the rest of the economy. Each group has an infinite horizon and maximizes lifetime utility derived

from consumption. Two technologies can produce the consumption good: one has common access (i.e., every group can appropriate from a common capital stock); the other technology enjoys private access. Both technologies are linear, with the common access technology having a higher physical rate of return.

Consider the closed economy, as one with only the common access technology. Furthermore, consider opening the capital account as introducing the second inferior technology (such a policy allows a group to accumulate safely its resources at a private bank account abroad).

In the interior Markov perfect equilibrium of the open economy, the appropriation rate of each group must be such that the private rate of return (net of appropriation by others) on the common-access technology is equal to the rate of return of the private bank accounts abroad (the inferior technology). Otherwise, there would be unexploited arbitrage opportunities. It follows that opening the capital account puts a floor on the common-access domestic rate of return, and thus a ceiling on the appropriation rate of groups. If this constraint is binding, opening the capital account reduces the equilibrium appropriation of groups (i.e., reduces the degree of expropriatory policies). This increases growth and welfare.

### [The Voracity Effect](#)

Tornell and Lane

*American Economic Review* (1999)

Resource rich countries tend to grow slower than resource-poor countries (compare Venezuela and Korea). Furthermore, windfalls are squandered in many emerging economies. Puzzlingly, in response to windfalls, current accounts deteriorate and debt-to-GDP ratios increase. The contribution of this paper is to characterize the "voracity effect" to account for these perverse dynamic responses observed across several emerging economies.

We focus on the fiscal process as the arena where powerful groups interact to appropriate resources from the rest of society (think of provincial governments, industrial conglomerates, strong unions, etc.). We consider a two-sector economy, with a formal sector that employs an efficient production technology, but is subject to taxation, and an informal sector that is less productive but is free of taxation.

We start from the observation that if groups have the power to extract fiscal transfers, capital in the formal sector is not truly private. Since transfers must be financed by some form of taxation, higher transfers for some groups result in higher taxes for the formal sector. In order to protect their profits, agents transfer part of their resources to the informal sector, which is free of taxation.

We model the interaction of powerful groups as a dynamic infinite horizon game, where groups have access to the capital stocks that others have in the formal sector.

In an interior Markov Perfect equilibrium, an increase in the raw rate of return in the formal sector reduces the growth rate in the formal sector. This is the voracity effect. The intuition is as follows. An increase in the raw rate of return in the formal sector generates two opposing effects: a direct effect that increases the profitability of investment in the formal sector, and a voracity effect that leads each group to appropriate more fiscal transfers. This is reflected in a larger tax rate in the formal sector, which induces a reallocation to the informal sector. We prove that redistribution increases more than proportionally to the windfall---because each group does not internalize the externality generated by its higher appropriation. Hence, the direct effect is dominated by the voracity effect and the growth rate of the formal sector declines in response to a windfall.

I would like to emphasize that the voracity effect is distinct from the so called "Dutch disease" analysis in which a positive terms-of-trade shock leads to a contraction in the non-resource tradables sector. This is because of a crowding-out effect or a wealth effect that raises the demand for nontradables. Both phenomena have very different policy implications.