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Research Summaries

The Macroeconomics of Aid

Andrew Berg, Rafael Portillo, and Luis-Felipe Zanna



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macroeconomic effects of aid and of the policies that are typically implemented by recipient countries in response to such flows. This article summarizes recent research on this topic. As aid has failed to surge, the article also discusses extensions to the related topics of resource booms and debt-led scaling up.

Aid flows offer both opportunities and challenges to recipient countries. They may alleviate poverty and spur growth by financing much-needed public investment in infrastructure. But they may also hurt growth by inducing real exchange rate appreciation pressures, to the detriment of growth-promoting *(continued on page 2)*

The Building Blocks to Measure Inflation

Mick Silver



Price indices serve as measures of inflation, deflators for national accounts aggregates, the basis for escalation payments, terms of trade analysis, and much more. Good economic analysis requires a proper understanding of deficiencies in the practice of compiling these measures. Research by IMF economists has contributed to our understanding of what is good practice. An article in the IMF Research Bulletin in September 2006 outlined IMF research in this area. This article considers subsequent work, the focus of which is on the building blocks of price indices.

Consumer price indexes (CPIs) are compiled in two stages. The first stage is the measurement of (unweighted) average price changes of well-specified items—for example, a 500-gram, pre-packed and sliced loaf of white bread with soft crust—using prices collected from a sample of representative outlets. Then, as a second stage, the CPI is compiled as a weighted average of these elementary indices for bread, sugar, mangos, electricity, shelter, television sets, haircuts and, of course, much more. The first stage elementary price indices are the building blocks of a CPI.

Similar considerations apply to measuring purchasing power parity (PPP) across countries, with unweighted parity estimates for well-specified items forming the building blocks for the higher-level weighted aggregates. For export and import unit value indices (XMUVIs), the building *(continued on page 4)*



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The Macroeconomics of Aid *(continued from page 1)*

export industries (“Dutch disease”). This ambivalence is reflected in the empirical results found in the literature (Clemens, Radelet, and Bhavnani, 2004; Rajan and Subramanian, 2007).

Against this backdrop, researchers have studied actual policy responses implemented by recipient countries to address their concerns about aid, and how those policies can shape its macroeconomic effects. Berg and others (2007) document how, during episodes of aid surges, concerns about real appreciation induced several African economies to accumulate much of the additional aid-related foreign currency in reserves, even as fiscal policy entailed the full spending of the local currency counterpart to the aid. This response turned out to be problematic, as it led to either higher inflation in countries that did not sterilize or high real interest rates in countries that did.

The analysis of actual aid surges revealed two important insights. First, it is important to distinguish between the *spending* and the *absorption* of the aid, with absorption referring to the increase in the current account deficit net of aid. While spending is determined by the fiscal policy response, absorption is influenced by the reserve policy of the central bank, especially when access to international capital markets is limited. In practice, there is no institutional arrangement between the government and the central bank to ensure coordination between these two policies, and several policy mixes are equally possible. Aiyar and Ruthbah (2008) find that spending out of aid differs from absorption in a panel of aid-recipient countries.

Second, short-term responses aimed at offsetting potentially negative effects of aid can have unintended macroeconomic consequences, both in the short and medium term. Given the complex interrelationship between the structure of the economy, macroeconomic policies, and private sector decisions, IMF researchers have recently been building dynamic stochastic general equilibrium (DSGE) models to better understand these consequences and contribute to policy analysis. For example, Berg and others (2010a) build an open economy, new-Keynesian model with two sectors and no capital accumulation to analyze the short-term effects of aid in Uganda, conditional on the fiscal-reserves policy interaction. Contrary to the predictions of the literature on the transfer problem (dating to Ohlin, 1929), which implicitly assumes spending equals absorption, they find that an increase in aid that is spent but not absorbed—the typical policy mix during aid surges in Africa—can result in a temporary real exchange rate depreciation, even when the accumulation of reserves is

fully sterilized, a phenomenon that is also observed during these surges.

The intuition for why a real depreciation can occur is that spending but not absorbing the aid is akin to a domestically-financed fiscal expansion: public spending increases but the foreign exchange from the aid is not increasing the country’s external financing. The increase in spending must therefore come at the expense of the private sector, which is crowded out. But the resulting demand pressures, which are amplified when aid is not absorbed, can threaten external balance and require a real depreciation. This reversal of the real exchange rate response is facilitated by the fact that central banks typically receive all of the aid-related foreign exchange initially, so that a “passive” reserve policy implies the full accumulation of aid (no absorption).

The above result is highly sensitive to the degree of de facto capital account openness. As capital mobility increases, reserves policy becomes less effective—its effect on absorption is offset by capital flows—and the likelihood of a real depreciation is reduced. Moreover, Buffie, Adam, and O’Connell (2010) show that capital flows can either amplify or dampen appreciation pressures, depending on whether aid is used to reduce seigniorage revenues and on the credibility of fiscal policy.

Berg and others (2010b) study the medium-term implications of several spending and absorption policies. They do so in a DSGE model with traded and nontraded goods that captures two mechanisms for the medium-term effects of aid. First, the model features a learning-by-doing externality associated with the production of traded goods that captures the notion that real exchange rate appreciation may harm productivity growth. Second, it features a role for public capital in production, so that government can raise output directly and potentially crowd in private investment, as well as less-than-full conversion of public investment into useful public capital.

They find that, when learning-by-doing externalities are small, a policy mix that results in full spending and absorption of aid can have a positive effect on real GDP in the medium term through higher public capital. Full spending with partial absorption, on the other hand, may stem appreciation pressures but can also induce adverse medium-term effects on output through the crowding out of private investment.

Berg and others (2010b) also study how the presence of learning-by-doing affects the impact of aid and of various policy responses. Learning by doing raises the stakes: it may amplify the positive effects of aid on traded output and real GDP—which they refer to as “Dutch vigor”—but they may also make aid harmful, causing “Dutch disease.” Whether the externalities amplify the positive or negative effects of aid depends on the efficiency of public investment.

When efficiency is low and learning-by-doing externalities are strong, accumulating some of the additional aid inflows in reserves may be preferable even if aid is fully spent, although partial spending is preferred (see also Prati and Tressel, 2006). However, with high efficiency of public investment, the result is overturned, as there are large gains from fully spending and absorbing the aid as it accrues. More generally, coordination of fiscal and reserves policies improves the macroeconomic effects of aid.

Research on spending and absorption has contributed to the operational work of the IMF. The model in Berg and others (2010b) has recently been used to construct specific aid scaling-up scenarios in 10 African countries, in collaboration with the UNDP. Three of those scenarios are presented in Berg and others (2011).

Recent research has also focused on aid volatility and its macroeconomic implications (Arellano and others, 2005). But more work is needed to understand how macroeconomic policies may help counteract the adverse effects of aid volatility. In this regard, Portillo and Zanna (2011) analyze optimal (welfare-maximizing) and implementable fiscal and reserve accumulation rules in response to volatile aid flows.

Additional empirical work is needed to complement the case studies on aid surges. While the return to further aid-growth panel regressions may be low, more structured analyses would be useful, with an emphasis on how the policy responses to aid—differentiated across countries—have affected its macroeconomic impact. Kang, Prati, and Rebucci (2010) provide a useful starting point. Insights from the above literature can also be extended beyond aid flows: Dagher, Gottschalk, and Portillo (2010) apply the model in Berg and others (2010b) to the analysis of oil windfalls in Ghana, and emphasize the risk of uncoordinated fiscal and reserve policy.

It has become clear that the doubling of aid to sub-Saharan Africa pledged at the G-8 summit at Gleneagles in 2005 did not materialize. Countries are therefore exploring alternative sources of financing for their public infrastructure needs. Work by Buffie and others (2010) focuses on the macroeconomics of debt-financed-investment scaling-up scenarios.

Finally, from a methodological point of view, the research described above has shown the usefulness of building low-income-country-specific DSGE models to analyze relevant policy issues in these countries, both fiscal and monetary.

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The Building Blocks to Measure Inflation

(continued from page 1)

blocks are the unit value changes for the applicable tariff item codes, such as “prepared mustard”—the 10-digit code under the Harmonized Commodity Description and Coding System (HS) is 2103.30.20.00. More than 20,000 codes are available. The second stage is to take a weighted average of the unit value changes for each detailed HS code. Producer price indices (PPIs) are compiled at the elementary level using the price changes of well-specified goods and services averaged over different producing establishments; the overall PPI is the (second stage) weighted average of these elementary indices.

For each of these indices—CPIs, PPPs, XMUVIs, and PPIs—the accuracy of the final index critically depends on the adequacy of the aggregation procedure used for their building blocks. This has been the subject of much research at the IMF over the last five years. A defining feature of these elementary indices is that they are unweighted.

For CPI compilation there are three main aggregation methods used at the elementary level: the arithmetic mean of price changes (the Carli index), the change in arithmetic mean prices (the Dutot index), and the geometric mean of price changes, equal to the change in geometric means (the Jevons index). All three formulas have some intuition. Axiomatic index number theory clearly shows Carli to be biased and chained Carli, substantially so—the annual change in the CPI for Kenya for September 2009 was 17.9 percent using the (biased) chained Carli index, but only 6.7 percent with its replacement by the Jevons index. Such bias is not trivial.

Given the bias in the Carli index, the two principal formulas that should be used to calculate elementary indices are Dutot and Jevons. Silver and Heravi (2007a) provide an analytical framework, based on sample estimators, to show the difference between the Dutot and Jevons indices is determined by changes in the variance of prices. A deficiency of Dutot is that it is not invariant to the units of measurement (commensurable) and, thus, the extent of quality differences in items sold. We further decomposed the difference between the two formulas into a difference owing to product heterogeneity and a difference owing to essentially different types of averages in the index formula. This provided a theoretical and measurement framework for identifying why Dutot and Jevons differ after allowing (and correcting for) Dutot’s shortcomings with regard to commensurability.

Unit value indices based on customs information are widely used as the building blocks and surrogates for export and import price indices. In empirical work, Silver (2009a) demonstrates that they can seriously misrepresent inflation

in traded products. Moreover, the use of unit value indices leads to even more serious errors in terms of trade indices. Unit value indices should appropriately be used only for homogeneous items. It is argued that with increasing product differentiation, as well as the dwindling availability of national customs data due to customs unions and increasing trade in services, the use of unit value indices based on customs data is a disservice to price measurement. This position is in line with the recommendations for best practice given in ILO and others (2009), where it is suggested that countries using unit value indices move to establishment survey-based price indices and provides a strategy for doing so. This is an important departure from international recommendations from the United Nations (1981) that are nearly 30 years old.

Index number theory advocates the use of superlative price index number formulas, including Fisher and Törnqvist price indices, as target indices for heterogeneous goods and services. However, for homogeneous products and services, it is well recognized that superlative price indices can be misleading and unit value indices are the appropriate target index. Silver (2009b) provides a formal mathematical decomposition and understanding of why unit value and Fisher’s price indices differ, identifying both a levels and substitution effect. The paper draws attention to a continuum between homogeneous and heterogeneous products and a need to examine the issue of which index number formulas are appropriate for products within this continuum. There are many products that are only slightly differentiated to meet niche markets or to attain competitive advantage. The paper discusses the case of broadly comparable items and proposes a hedonically-based aggregator (see also Silver 2010a).

The building blocks for the measurement of PPPs by the World Bank’s International Comparison Program are similar to those of the CPI above—average prices across outlets for well-specified items, such as bread—but within and across countries in a region, as opposed to over time and covering all expenditure components of GDP and not just household consumption expenditure. Generally, country product dummy regressions are used to estimate elementary parity indices. The coefficients on the country dummy variables are estimates of the price parity for a product group between countries. These parity estimates are then aggregated to PPPs using weighted methods outlined in the World Bank’s (2007) International Comparison Program Handbook and Diewert (2008). Silver (2009c) considers deficiencies in the regression-based aggregation procedure using a panel-data framework and extends the analysis to panel estimators that incorporate quality adjustments for noncomparable products, primarily through the use of a hedonic

country product dummy framework. Work has also been undertaken on IMF uses of PPP estimates (Silver, 2010b).

There are specific measurement issues for particular products, that is, for hard-to-measure goods and services. Zieschang (2010) tackles the difficult area of indirectly measuring the price change of financial intermediation services by banks through the spread between the rate earned on assets and the rate paid on liabilities. Silver and Heravi (2007b) consider alternative hedonic-based methods for the price measurement of goods and services, such as personal computers, that have a rapid turnover in quality characteristics. Silver and Heravi (2007c) and Diewert, Heravi, and Silver (2009) provide mathematical decompositions to better understand the difference between two seemingly equally plausible, yet quite different, hedonic approaches. The difficult area of new outlet (Wal-Mart) bias that occurs when the effect of consumer substitution to new supercenters is improperly incorporated is considered by Hausman and Liebttag (2009) and commented upon by Silver (2009d). Armknecht, Diewert, and Nakamura (2007) consider seasonal goods and services for which month-on-month price change measurement is problematic.

The IMF's research usefully finds its way into practical recommendation contained in price index manuals (ILO and others, 2004a, 2004b, 2009; UN ECE and others, 2009). These manuals set out internationally-accepted standards for measuring inflation that are promulgated in the IMF Statistics Department's training, technical assistance, and report on standards and codes data missions. Similarly, a newly developed training course by the IMF's Statistics Department and Monetary and Capital Markets Department on core inflation measurement was also built on research work including Roger (2000, 2010) and Silver (2007).

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Seven Questions on the Role of Precautionary Savings in Open Economies

Damiano Sandri



Are precautionary savings important to understanding open-economy issues? This article reviews recent literature on the relevance of precautionary savings for global imbalances and more generally for the size and allocation of capital flows.

Question 1: Why should we consider precautionary savings in open economies?

The early literature on open economies has largely ignored precautionary savings, defined as the amount of wealth accumulated to self-insure against stochastic income fluctuations instead of to smooth deterministic income changes. Prior to the adoption of computational techniques in economics, researchers relied extensively on the assumption of perfect foresight to obtain analytical solutions. Even more recent contributions using numerical methods often use first-order linear approximations that eliminate precautionary motives. However, Ghosh and Ostry (1994, 1997) show that precautionary savings can significantly influence the current account, the understanding of which is of paramount importance in the study of open economies. Being equal to the difference between saving and investment, the current account should indeed improve during periods of higher volatility that stimulate the accumulation of precautionary savings. Supporting empirical evidence is found using data for the United States, Japan, and the United Kingdom.

Question 2: Did precautionary savings play a role in the surge of global imbalances?

Recent studies emphasize the importance of precautionary savings for understanding the growth of global imbalances. Fogli and Perri (2006) develop a two-country, business-cycle model to quantify the optimal reduction in US net foreign assets in response to the “Great Moderation.” Their results suggest that the decline in business-cycle volatility experienced by the United States between 1984 and 2005 accounted for 20 percent of US external deficits.

Precautionary savings are likely to have played an even stronger role in the accumulation of assets by emerging countries. Aizenman and Lee (2007) find empirical evidence for the hypothesis that the self-insurance motive

has been an important determinant for the hoarding of international reserves. Durdu, Mendoza, and Terrones (2009) provide further support using a calibrated and small open-economy model. They find that self-insurance motives against sudden stops can indeed lead to the accumulation of large precautionary reserves.

Finally, precautionary savings have also stimulated the accumulation of international assets by commodity-exporting countries. Bems and de Carvalho Filho (2009) use a calibrated model to show that oil and gas exporters should accumulate a considerable amount of foreign assets not only to deal with the exhaustibility of their resources, but also to self-insure against large fluctuations in commodity prices.

Question 3: What is the optimal amount of precautionary savings?

The growing interest in precautionary motives has raised questions about the optimal level of net foreign assets (NFA) that countries should hold to self-insure against shocks. Jeanne and Sandri (forthcoming) address this issue by considering the dynamic stochastic optimization problem of a small, open economy subject to GDP fluctuations. To guarantee the existence of an optimal finite amount of precautionary savings, a country needs to be “impatient” so that in the absence of uncertainty, it would prefer to frontload consumption by borrowing internationally. Otherwise, precautionary motives, by providing an incentive to accumulate savings, would lead to an infinite stock of foreign assets. The optimal NFA position is then given by the level at which the precautionary motive to save exactly counterbalances the impatience desire to borrow.

Unfortunately, it is hard to provide a robust estimate for this level, since the degree of impatience crucially hinges on the relation between the unobservable intertemporal discount factor and the interest rate that is set exogenously in a small, open economy model. Sandri (forthcoming) addresses these issues by solving for a world general equilibrium in which the interest rate is pinned down endogenously and the discount factors are common across countries. This leads to fairly robust predictions for the optimal NFA positions of six regions, countries or country categories in the world (the United States, euro area, Japan, China, oil exporters, and the rest of the world) that are assumed to differ only with

respect to GDP volatility calibrated on 1980–2008 data. The observed heterogeneity in volatility creates a wide dispersion in optimal NFA positions, with the most volatile oil-exporting countries accumulating international assets up to several multiples of GDP.

Question 4: How important is it to reach the optimal amount of precautionary savings?

Jeanne and Sandri (2011) show that there is an important upside to the difficulty in pinning down a robust value for the optimal NFA. The extreme sensitivity of NFA to the degree of impatience implies that welfare-wise is not crucial to achieve the exact optimal level. Calibration exercises show that countries can rather effectively self-insure against income volatility by simply targeting whichever NFA positions they currently have, the key issue being to avoid drifting toward excessive borrowing. This insight is also confirmed in the general equilibrium analysis in Sandri (forthcoming), which reveals that while the heterogeneity in volatility across countries can lead to a wide dispersion in optimal NFA positions, it can account for only very small current account imbalances. This is because countries can already achieve substantial self-insurance with their current NFA positions and move only very gradually toward their optimal levels. An important exception regards countries close to their international borrowing constraints: given that negative shocks cannot be easily smoothed out by issuing additional debt, it becomes essential to run large current account surpluses to quickly accumulate precautionary savings. This is especially relevant for those countries that also face a possible tightening of the borrowing constraint.

Question 5: How large are the welfare gains from hedging instead of relying on precautionary savings?

Self-insurance through the accumulation of precautionary savings comes at the cost of postponing consumption. For some shocks, countries can more efficiently seek insurance by using hedging instruments. Borensztein, Jeanne, and Sandri (2009) consider the welfare gains that commodity exporters could seize by hedging against price fluctuations rather than accumulating precautionary savings. Hedging conceptually provides two distinct sources of benefits. First, it leads to more stable consumption by curbing export income volatility. Similar to the literature on the welfare costs of the business cycle, welfare gains from this channel are moderate. Second, it reduces the need to hold precautionary savings and allows the country to finance a temporary increase in consumption by borrowing internationally against more secure future export revenues. This can lead

to large welfare gains, equivalent to a permanent increase in consumption of several percentage points.

Question 6: Is within-country idiosyncratic risk relevant for international precautionary savings?

Precautionary savings in an open economy are often modeled as driven by self-insurance motives against aggregate shocks. However, given the limited extent of within-country risk sharing, idiosyncratic volatility is also relevant, especially because it is much larger than aggregate volatility. For example, Sandri (2010) shows that high idiosyncratic entrepreneurial risk can explain why—contrary to benchmark neoclassical growth models—growth accelerations in developing countries often lead to an improvement in the current account. This is because to self-insure against idiosyncratic investment risk, entrepreneurs accumulate precautionary savings that can sustain large and persistent capital outflows. On the contrary, if domestic financial markets are able to allow for sufficiently high risk sharing (e.g., through well-functioning equity markets), entrepreneurs need less precautionary savings and growth accelerations can actually involve large capital inflows.

Question 7: Can precautionary motives explain international portfolios?

Precautionary motives can be useful to explain not only countries' NFA positions, but also their portfolio composition. Mendoza, Quadrini, and Ríos Rull (2009) show that countries with lower domestic financial development tend to invest foreign savings in precautionary safe assets, while countries with better financial markets seek riskier foreign investment opportunities. As also discussed in Gourinchas, Rey, and Govillot (2010), this has important implications for the return performance of countries' international portfolios. Better domestic risk sharing or lower risk aversion can indeed lead to higher returns on assets than on liabilities, as the country invests in foreign high-return risky projects financed by issuing low-return safe liabilities.

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