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International Capital Flows in Developing Countries and Capital Market Inefficiencies, Applying the Three Gap Model to a History of Liberalization[1]

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Abstract

This paper applies the Three Gap Model developed by Bacha (1990) to the Heavily Indebted Poor Countries (HIPCs)[2], during the time frame 1960 to 2017 with yearly observations. Several predictions and assumptions of the Model are tested empirically with panel data regressions and tests for structural breaks in the relationship between investment and capital flows. Overall, limited support is found for the Three Gap Model and the results highlight the need for extensive customization and parametrization of the Model subject to country level characteristics in order for it to adequately advise policymakers. In addition to the empirical diagnostics on the Three Gap Model, this paper also endeavors to assess the exogeneity of capital flows in developing countries by considering the impact of US macroeconomic variables on the international reserves and real exchange rates in the HIPCs during the 2008 to 2019 time frame with monthly observations, by replicating the VAR model contained in Calvo, Leiderman and Reinhart (1993). The evidence supporting the influence of the US variables on the real exchange rates and foreign reserves in the HIPCs is deemed unconvincing.

[1] The views stated in this thesis are those of the author and not necessarily those of Erasmus School of Economics or Erasmus University Rotterdam.

[2] The list of HIPCs is made by the International Monetary Fund and the World Bank, it includes 39 low income developing countries as of July 2019.

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1. Introduction

Many of the economic theories which support the liberalization of capital markets have come under strain in the last few decades (Calvo, 2005; Krugman, 2009; Stiglitz, 2003). To illustrate this, in the years leading up to the Asian financial crisis, capital account liberalization was widely regarded by economists of all factions[3] as a catalyzer for growth in savings constrained economies (Prasad and Rajan 2008, p. 1). When the Asian Financial Crisis hit in 1997 and some of the liberalized economies with the highest savings rates in the world collapsed amidst a sudden stop of capital inflows[4], it became clear that the savings constraint was only part of a larger story. Subsequent developments in the literature pointed to the currency denomination of public and private debt, the maturity mismatch in the public accounts created by the issuance of short-term debt and capital market inefficiencies as the fundamental threats to the solvency of developing countries (Calvo 2005).

Although there have been strong developments in the literature pointing to the risks of financial liberalization at least as early as the first paper by Calvo, Leiderman and Reinhart (1993) who found a strong influence of foreign factors on capital inflows during the second Latin American debt crisis; Easterly (1999), Stiglitz (2003) and, more recently Hickel (2018), have accused the international financial institutions (IFIs), including the World Bank (WB) and International Monetary Fund (IMF), of turning a blind eye to structural factors which could imply market inefficiencies. In practice, the liberalization of an inefficient market could lead to higher price volatility and/or the failure to provide essential goods and services, both of which entail welfare losses (Stiglitz, 2003). Stiglitz (2003) calls the approach of the IFIs "market fundamentalism", which is the belief that markets are in *all* cases more efficient at allocating resources than government provision, regardless of the structural framework in which the market is embedded. A consequence

[3] And actively promoted through conditionality attached to loans issued by the international financial institutions. See Easterly (2005)

[4] A sudden stop of capital inflows consists in a reversal of capital flows which depreciates the value of the domestic currency, aggravating or engendering a balance of payments crisis.

of market fundamentalism is that financial liberalization can and will lead to investment and growth because the free flow of capital is more efficient than a system in which capital controls are imposed and the financial accounts of the country are managed by the government. This view on financial liberalization is supported by the Models in the endogenous growth literature known as Gap Models, which posit investment as a positive function of capital inflows. In this paper I will contribute to the debate by running a number of tests on the latest generation of Gap Models: the Three Gap Model (TGM henceforth) developed by Bacha (1990). The sample countries are the Heavily Indebted Poor Countries (HIPCs), which were chosen explicitly to fit the description of the countries the Model was meant to target (Bacha, 1990; p. 279)[5].

The TGM departs from the traditional view of capital account convertibility as a means for boosting savings in developing economies[6] by adding the fiscal and foreign exchange position of the country as potential constraints to investment, enabling it to explain a wider range of phenomena including response mechanisms to capital flow reversals and stoppages in the conversion of capital inflows into investment. The Model falls short however, of addressing the denomination, maturity mismatch and market inefficiency issues raised by Calvo (2005); as well as institutional factors which can affect credit market outcomes, such as the ability of a country's legal system to effectively handle the enforceability of complex financial contracts (Bae and Goyal, 2009). This creates a gap in its applicability on which I will attempt to shed some light by testing the predictions it makes in a wide variety of circumstances. Specifically, I will run a number of panel data regressions as well as tests for structural breaks in the relationship between investment, foreign transfers and other key macroeconomic variables in the HIPCs.

The main finding of this paper is that, although the TGM captures the fundamental relationship between foreign transfers and investment, the accuracy of its predictions varies substantially over the sample countries, especially when they are subdivided into groups based on prevailing economic conditions or compared to other countries with

[5] The Three Gap Model was conceived with highly indebted low-income countries in mind.
[6] The traditional view we refer to is that given in Prasad and Rajan (2008) p. 150.

higher levels of industrial development. This finding is consistent with the notion that country specific institutional and structural factors deeply affect market outcomes, thus creating the heterogeneity which is neglected by models which use the one size fits all approach such as the TGM.

Another task of this paper will be to address the exogeneity of capital flows to domestic policy in the receiving country. A stream of capital flows which is exogenous is more likely to finance consumption over investment and generate asset bubbles (Rodrik and Subramanian, 2009). The exogeneity of capital flows to domestic policy and economic fundamentals, is therefore crucial in understanding the limitations of models such as the TGM in which this issue is not addressed; that is, even though the TGM regards capital flows as exogenous, it assumes the exogeneity to be irrelevant in the asset allocation process following the capital inflow. We will assess to what extent the flows received by developing countries in the recent surge of sovereign and corporate debt following the Great Financial Crisis (see Guichard, 2017) were exogenous by replicating the vector autoregression model contained in Calvo, Leiderman and Reinhart (1993) for the period starting in 2009. The results will fail to provide convincing evidence pointing to the exogeneity of capital flows in the HIPCs over the 2009-2019 timeframe.

To my knowledge, both of these contributions: an empirical study of the TGM and the replication of the VAR in Calvo at al. on a different sample, are absent in the literature. This creates a substantial gap in the debate over the benefits and risks to capital account convertibility in developing countries, given that the former addresses the issue of financial liberalization as a conduit to boost investment, the potential benefits, and the latter quantifies the risks involved in liberalization, assuming that exogenous capital flows are more likely to lead to financial crises.

In the following Chapter, I will review the literature on liberalization, capital flows and market inefficiencies. I will also introduce the theory of the TGM, providing some background and intuition behind the relationships it models. In Chapter three I will explain the predictions the model makes which will be tested in this paper. Chapters four

and five will be dedicated to presenting the data and methodology used in both empirical sections of the paper. This will be followed by a discussion of the results for the TGM, and subsequently a chapter dedicated to the results of the replication of the VAR in Calvo et al. I will conclude the paper with some policy implications, limitations and suggestions for future research. Chapters three, five and six concerning, respectively the theory, methodology and results of the analysis on the TGM are divided into 5 subsections each which correspond to each other (i.e. the theory of Section 3.1 is relevant to Methodology Section 5.1.1 and Results Section 6.1), in order to ease the reference between Chapters.

2. Review of the Literature

2.1 Financial Liberalization and Gap Models: Conventional Wisdom and its Critics

The conventional wisdom behind financial liberalization as outlaid in Prasad and Rajan (2008) is that, given that capital has decreasing marginal returns, liberalization and financial integration should enable investors in developed countries to fund projects in developing countries; thereby unlocking growth opportunities while earning higher returns than would be possible in advanced economies which are generally characterized by capital abundance. In other words, lack of financial integration was seen as the main cause of the Lucas paradox (Lucas, 1990), which highlights the surprising empirical phenomenon that capital tends to flow out of developing countries and into developed ones, not the other way around as decreasing marginal returns and the conventional wisdom described in Prasad and Rajan (2008) would suggest. Recent research by Azémar and Desbordes (2013), shows that the Lucas paradox is still observed notwithstanding increased liberalization and financial integration.

The significance of this paradox is, to a certain extent, simple: if capital does not flow to developing countries how can they grow? As a matter of fact, the approach taken by multilateral development institutions, including the WB and the IMF, repeatedly emphasizes the need for capital as a *necessary* condition for growth (Easterly, 1999). As

mentioned previously, this conclusion is often reached in the strand of endogenous growth theory known as Gap Models of which the first was the Harrod-Domar Model, which focused on the gap between available savings and required investment to achieve a target growth rate. This model was then further expanded by Chenery and Bruno (1962) who included foreign savings as a source of capital and then by Bacha (1984; 1990) and Taylor (1994) who included the fiscal position of the government.

These models are however not exempt from criticism; the Neoclassical critique found in Easterly (1999) holds that the Harrod-Domar model is fundamentally flawed in that it focuses on the *quantity* instead of the *quality* of investments, whereas resource allocation is more important than resource quantities. This critique is however mainly directed at the first two generations of Gap Models, since the TGM of Bacha (1990) "drops the assumption that output is predetermined by capital accumulation" (Taylor, 1994; p. 19), treating it (output) as a "[short run] adjustment mechanism in a Keynesian fashion" (Easterly, 1999; p. 428).

Another element which could support this critique is found in Calvo et al. (1993) (from now on CLR), where the authors show that the extent of the role played by external factors in capital flows could be so strong as to threaten the stability of the global financial system. When external factors are found to be as relevant as in CLR, the neoclassical critique is stronger as capital inflows are likely to be independent of the fundamentals since they are by and large driven by exogenous factors. Financial liberalization can therefore be conducive to systemic risk if the exogeneity of capital inflows makes them vulnerable to sudden stops as Calvo (2005) has argued was a factor in several emerging market crises including Mexico in 1994 and Russia in 1998.

The last line of criticism of the Gap Models which support capital account liberalization as a way of achieving economic growth comes from the body of theory and evidence which holds that productivity, rather than capital accumulation, is the source of long term growth (for instance Solow, 1956; Hall and Jones, 1999). Unless capital inflows are conducive to productivity growth (which is in some cases a valid argument; see Prasad,

Terrones and Kose, 2008), this can also be used as an argument against capital account liberalization for the purpose of long-term growth. This critique is also mainly directed at the first generations of Gap Models for the same reason as the Neoclassical critique; the TGM models short-run interactions, it does not have much to say about long term economic outcomes.

2.2 Efficient Market Theory

In standard financial theory, efficient market pricing implies that the cross-sectional dispersion in the distribution of returns can be attributed to risk factors (Fama and French, 1992; Fama and French, 2006). A natural consequence of this is that, for instance, in the case of a developing countries' government issued bonds an increase in price must necessarily reflect a reduction in a risk premium, making an abrupt reversal of capital flows in the absence of a change in fundamentals, such as in the case of Mexico in 1994, difficult to explain (CLR).

The notion of efficient asset pricing has come under attack numerous times, most notably in Shiller (1981) and more recently in Shiller (2000 and 2017) but also by Barber and Odean (2008) and Jegadeesh and Titman (2001). Shiller (1981) found that the volatility of stock prices cannot be explained by changes in expected dividends, whereas in later works (2000 and 2017) he brings out the issue of stock market narratives. Jegadeesh and Titman (2001) presented what Eugene Fama called "the main embarrassment to the three-factor model" (Fama and French, 1996; p. 81): the momentum effect, an anomaly which efficient market theorists were not able to explain. In the following paragraphs, we will focus on the main assumptions of efficient market pricing which are relevant to the topic at hand.

One of the assumptions of efficient market pricing which has generated considerable debate has been the assumption of perfectly informed and rational agents (Malkiel, 2003; Shiller, 2000). This assumption is also an integral part of Krugman (1979), who put together the standard model on balance of payments crises which predicts that a crisis

occurs when the fundamentals behind the fiscal position deteriorate to the point that the central bank can no longer sustain a fixed exchange rate by depleting its international reserves. If agents are assumed instead to be irrational and have access to less than perfect information, increased capital flows, and balance of payment crises, may be driven by what Shiller (2017) has called a *narrative.*

A narrative is somewhat of an undefined concept as Shiller himself admits, but it provides a powerful tool for explaining economic phenomena such as asset bubbles and large swings in capital flows. The central insight of narrative economics is that information itself, such as valuation fundamentals, is not sufficient to explain how market participants actually form beliefs, generate expectations on those beliefs and enter into transactions; what is needed to explain market behavior according to Shiller (2017) is an account of how the disclosure of new information affects how we *feel* about the asset to which the information is pertaining. The way our feelings spread from one person to another is through a conversation in which we communicate a narrative, which only becomes relevant in explaining economic fluctuations when it goes viral[7]. For example, in the wake of the 2008 financial crisis when interest rates in the US and Europe dropped to historically low levels, instead of a rise in credit and inflation what happened was that capital started fleeing the developed countries: why didn't the demand for money respond to the lower interest rates?

Shiller (2017) points to the fact that the stock market crash and bank failures may have implicitly reminded people of the Great Depression, hence the name of Great Recession, which had been used before in the '81 to '82 crisis, stuck to the 2008 episode. The Great Recession narrative, which peaked shortly after the crisis, according to Shiller, had the effect of enticing people to hoard cash in alternative assets to equities, mainly corporate and government bonds, thus pushing yields down to historically low levels. A by-product of the lower interest rates in the search for fixed income could be, as CLR argue, increased

[7] A narrative goes viral in Shiller (2017), using the Kermack-McKendrick Model, when the ratio of the contagion rate (the probability that an encounter occurs and the communication of the narrative successfully impacts the receiver, per unit of time) to the recovery rate (the proportion of "infectives" which recover in a unit of time) is sufficiently large.

capital flows to developing countries without this necessarily being the result of an improved economic environment.

An element of support for narrative economics, is found in Barber and Odean (2008) who documented the impact of the appearance of a company in the popular news on its stock returns, suggesting that popularity and discussion through the press matters in explaining the cross section of returns.

Another line of criticism of the efficiency of financial markets, which is more recent and less explored in the literature, has stemmed from the questioning of the preference convexity of market participants. This critique was raised by Stiglitz (2010) who, in a theoretical model, has shown that when the convexity assumption is not satisfied financial integration is undesirable even with respect to a state of autarky. Stated simply, the convexity assumption implies decreasing marginal utility. The intuition behind financial liberalization, Stiglitz argues, is that greater integration enables greater risk sharing which in turn promotes efficient allocation of assets. However, this conclusion rests on the assumption of convex preferences; if preferences on the other hand are non-convex, for instance in the case of bankruptcy (where the more bankruptcies there are the more the system is perceived to be unstable, meaning an increasing marginal effect of each bankruptcy) financial integration leads to greater systemic risk. This is a stronger challenge to efficient market pricing since it implies that even if agents' valuations are individually rational, their behavior in a market may create speculative bubbles.

While the evidence against efficient market pricing has spawned decades of debate in the literature (see Krugman, 2009; for an overview) it has generally failed to inform macroeconomic models such as the TGM which simply assume that capital flows are homogenous, have comparable effects in different countries with different structural frameworks in place and that the allocative efficiency of the market is in the default case apt to transform capital inflows into investment.

2.3 Three Gap Model: Theory and Practice

The TGM is a predictive and prescriptive tool designed specifically for "highly indebted developing countries" (Bacha, 1990; p. 279). It pays particular attention to the effect of foreign transfers on potential GDP growth rates and investment, which, in keeping with previous Gap Models, it takes to be equivalent in the short-run. It is essentially a conceptualization of the short-run interaction between three constraints to investment faced by developing countries, which according to Bacha who authored it, are the main hurdles in achieving sustainable economic growth. These constraints are: the savings constraint, the foreign exchange constraint and the fiscal constraint.

In the Appendix of this paper I provide a detailed explanation of each of these constraints should a reader wish to gain a deeper understanding of the Model. The explanation provided in Chapter A.2 is somewhat similar to that in Bacha (1990), although less emphasis is given to the role of foreign transfers and more is placed on the intuition behind the building blocks of the Model (the three constraints). We will go over some of this intuition here.

The savings constraint is an original feature of the Harrod-Domar Model, in which output was found to be held back by the gap between available savings and required investment to achieve target growth rates. This also forms the theoretical basis for what are known in the literature as poverty traps, essentially a vicious cycle in which a chronic savings shortage translates into insufficient investment levels, leading to a stagnating economic environment in which savings will never be sufficient to lift the economy out of poverty through investment. Although this explanation for the persistence of poverty is persuasive in its apparent simplicity, little evidence in favor of the existence of poverty traps has been found (Kraay and Raddatz, 2007; Easterly 2005).

The lack of evidence for savings-based poverty traps raises the question of what alternative constraints hold back investment. Two such constraints are formulated in the TGM: the foreign exchange constraint and the fiscal constraint. The foreign exchange

constraint is based on the assumption that at early stages of development investment carries a relatively high import content, meaning that in order to grow countries must import complimentary capital goods. This entails that a weak foreign exchange position will make imported investment costly, a cost which would be reduced by a currency appreciation driven by a capital inflow, making investment a positive function of foreign transfers. The import content of investment m is usually taken to be less than the crowding in effect of government investment on private investment k^*; if this is the case there are two direct consequences: (i) the developing economy is relatively advanced since development is state lead and (ii) the country is capable of using the currency depreciation in a capital outflow as a shock absorber to expand exports (see A.2 or Bacha, (1990) to find out how this occurs).

The original feature of the TGM is the addition of the fiscal constraint, which incorporates seignorage and the primary surplus into the analysis of the effect of capital flows on investment. Bacha cites the Latin American debt crisis of the eighties as an instance of how a negative shock[8] in combination with previously accumulated debt levels, lead to capital flight and consequently a contraction in overall spending by the government on consumption and investment, as resources were diverted for the payment of the ever rising cost on debt. The possible responses to a negative shock in foreign transfers in the TGM are an inflationary course of growth or an austerity programme, the former is contingent on the preexisting inflation rate whereas the latter is only effective if $m < k^*$. From a comparison between the fiscal and foreign constraint we can deduce that if a country has $m > k^*$ then not only will austerity in combination with foreign transfers be ineffective, but it will also be unable to use the current account as a rebound mechanism to capital flight. In summa, the predictions differ wildly depending on the relative size of the parameters.

[8] In this case the drop in commodity prices, leading to the loss of export revenue for many developing countries, as well as the soaring interest rates in the US.

3. Application of the Model: Testing Predictions and Assumptions

3.1 Differentiating Between FDI, Portfolio Equity Flows and Public or Private Guarantor

An aspect of the TGM which could threaten its applicability is its lack of differentiation between capital inflows as portfolio and equity flows and foreign direct investment (FDI). FDI has a much longer planning span than portfolio flows and is less prone to sudden stops, making it a safer way for a country to receive capital from abroad without increasing the instability of its economy (Stiglitz, 2003). We will test this in a panel data regression of investment on portfolio and equity as well as FDI flows. Here we will also take the opportunity to include capital inflows directed through the private accounts in the regression on investment. There are various theoretical reasons to expect private sector accounts to be relevant (see for instance Calvo, 2005), the first of which is that in developing countries with a narrow financial infrastructure and shallow debt and equity markets, issues faced in many market economies such as asymmetric information and moral hazard, are much more relevant due to the high concentration of investors (making reversals occur more quickly) and the lack of appropriate supervisory and regulatory mechanisms. Naturally these issues also apply to the public accounts, albeit to a lesser extent given that the public finances attract a wider market.

3.2 Testing the Invariance of Consumption to Foreign Transfers

One of the main criticisms of traditional Gap Models, found in the literature at least as early as Griffin (1970) and Weisskopf (1972) is that they assume capital inflows do not affect consumption, going into investment one for one. This is a necessary assumption in the TGM as well because, in the case of consumption of the private sector, if C_p were allowed to vary the relationship between inflation and private sector savings, one of the pillars of the model, would not necessarily hold since monetary expansion by the public sector could imply higher consumption instead of extracting private savings through

seigniorage (which in the TGM leads to higher potential investment)[9]. Government consumption is also taken as given and independent of capital flows for the basic relationships of the model to hold.

As Rodrik and Subramanian (2009) have argued, whether capital inflows finance consumption or investment depends on whether the economy is saving or investment constrained, an investment constrained economy will lack profitable investment projects hence a stream of capital inflows will likely finance consumption. We will test whether in the HIPCs higher foreign transfers have been associated with higher consumption by using a panel data regression of total consumption on capital inflows directed through the public accounts.

3.3 The Effect of Austerity in Combination with Foreign Transfers

A prediction of the TGM which is debated in the literature is the effect of austerity in combination with higher foreign transfers, a mix often embraced in the conditionality attached to loans made by the IMF to developing countries (Stiglitz, 2003; Hickel, 2018; Harvey, 2005). The TGM provides an interesting defense of austerity when foreign transfers increase. The argument is derived by looking at the interaction between the fiscal and the foreign-exchange constraints, postulating a situation in which foreign transfers increase. This is best explored graphically in the way done by Bacha (1990). Below I draw the graph of the interaction between the fiscal (IT curve below) and the forex (IE) constraints.

[9] The reason why higher inflation implies higher savings in the model is given by the Laffer curve, where inflation acts as a tax rate and savings of the private sector are the tax revenue (the government extracts private savings by money printing). Bacha supports this by arguing that public sector investment crowds in private sector investment in the early stages of development and for mild inflation rates. When inflation rates rise beyond a certain undetermined threshold, the economy is under either the savings or foreign exchange constraint, both of which cap investment at the threshold since the increase in public sector investment crowds out private sector investment. For critically high values of inflation, in the descending part of the Laffer curve, the country is in a hyperinflationary state in which private savings go down as the profitability of future investment is threatened by hyperinflation. See Section A.2 for clarification.

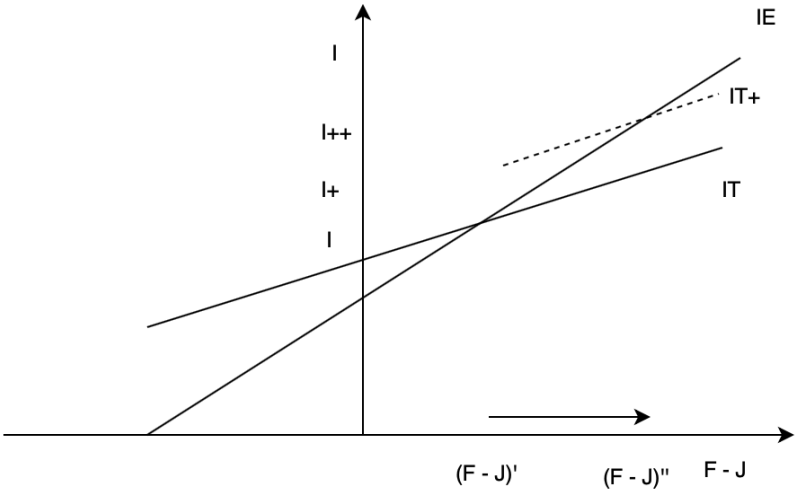

Figure 3.3.1 Relationship between foreign transfers and investment in the short run (forex and fiscal constraints). Note. The position of the two curves depends on the relative size of m and k ; Figure 3.3.1 depicts the scenario where k* is larger than m, meaning the import content of investment is smaller than the crowding in effect of government investment (this would be the case in a relatively large and industrialized developing country such as Brazil). See A.2 for an explanation of m and k*.*

The case for austerity emerges when foreign transfers increase from (F-J)' to (F-J)'' at which point the fiscal constraint becomes binding and investment is kept below I+. This is because if net exports are still at the critical upper level restricted by world demand E^* , then the balance of payments is in surplus and foreign reserves are accumulating. This will create a situation where part of the increase in foreign transfers is serving the purpose of reserve accumulation, so the actual level of investment will be below I+. The government could try to prevent this by narrowing the current account (CA) surplus[10] through an export quota or import liberalization scheme but both of these should find political resistance from the producers of tradables. Another alternative is to finance the acquisition of foreign reserves at the cost of money printing, resuming an inflationary course of growth (provided the country is still on the good side of the Laffer curve this is reflected by an upward shift in the IT curve to IT+). Fiscal austerity is another way to reach IT+ without money printing or export restrictions. Furthermore, it would make sense to expect austerity to have a different effect in combination with high foreign transfers even without the insights of the TGM, since the main critique of austerity in

[10] This would shorten the distance between the IT and IE curves.

Stiglitz (2003, p. 63) is that it raises interest rates making the cost of capital too high to sustain investment; however, when there are strong foreign transfers, this is unlikely to occur due to the upwards price pressure on the government bonds created by the capital inflow.

We will test the effect of fiscal austerity by performing a panel data regression in a sub-set of countries which are in a recession (as we are implicitly assuming since the savings constraint is not binding) and have seen an increase in foreign transfers in the previous period. The regression setup will be both GDP growth on primary budget surplus and investment on primary budget surplus.

3.4 Short Run Adjustment to a Capital Flight: Using the Current Account as a Shock Absorber

One of the main praises of the TGM is that it allows for short run adjustment mechanisms to shocks in the capital stock of a country. An example of such an adjustment mechanism is a positive response in export revenues to an adverse shock in foreign transfers, in which output contracts in a Keynesian fashion because of the fall in foreign transfers but thereafter expands due to the positive effect on exports driven by the currency depreciation. Higher exports lead to foreign currency accumulation and higher investment capacity, an essential requirement being that the country disposes of a decently advanced industry and is thus capable of expanding production of tradables to gain export revenue. Since we are well aware that the HIPCs may fail this requirement, we will add the IDS[11] countries to the sample for this test and perform the regression analysis on different groups to see how the HIPCs compare to other countries.

3.5 Testing for Structural Breaks between Investment and Foreign Transfers

Another interesting testable hypothesis concerning the TGM is given by Prasad and Rajan (2008), who observe that the failure of capital inflows to generate growth could indicate

[11] IDS stands for International Debt Statistics, this IMF database includes 134 lower and middle income countries.

that a savings constraint is not always the relevant constraint to expanding investment. The TGM addresses this by adding the fiscal and foreign exchange constraints to the original Harrod-Domar Model. In other words, according to the TGM the effect of capital inflows on growth changes according to which constraint is binding, since each constraint is defined by a different slope quantifying the effect of foreign transfers on investment. We will test this prediction by conducting tests for structural breaks in the relationship between investment and foreign transfers on each country separately.

4. Data

4.1 Data Collection

The data for the empirical analysis concerning the TGM was collected from the IDS and HIPC databases[12]. For the second part of the paper concerning the impact of foreign factors on the real exchange rates and international reserves in the HIPCs, data was also gathered from the IFS database[13]. Table 4.1.1 presents all the variables used in this paper except those used to construct the index of foreign factors used in the vector autoregression (VAR) in Chapter 7, which are presented separately for ease of reference in Table 4.1.2. Table 4.1.1 specifies whether the mentioned variable was used in the context of the TGM or the VAR replicational study. The "Indicator Name" gives the reader the exact reference of the variable used in the data source. This is done in order to avoid confusion since multiple definitions are possible for most variables. In the VAR model, real exchange rate and international reserves fluctuations are used instead of foreign transfers due to the lack of data with monthly frequency on foreign transfers, this is consistent with the original paper by CLR.

[12] HIPC stands for Heavily Indebted Poor Country, data published by the World Bank. IDS is International Debt Statistics; this database is available from the IMF's data portal. IFS is also published by the IMF and stands for International Financial Statistics.
[13] See supra.

Table 4.1.1 List of al variables used in this paper except the series used to construct the index of foreign factors used in the VAR, which are in Table 4.1.2.

Variable Name	Indicator Name in Data Source	Source	TGM or VAR
INV	Gross Fixed Capital Formation (USD current)	HIPC	TGM
FDI	Foreign direct investment, net inflows (BoP, current USD)	HIPC	TGM
PEF	Portfolio equity, net inflows (BoP, current USD)	HIPC	TGM
PNG(F-J)	Net transfers on external debt, private nonguaranteed (PNG) (NTR, current USD)	IDS	TGM
PPG(F-J)	Net transfers on external debt, public and publicly guaranteed (PPG) (NTR, current USD)	IDS	TGM
FINCONS	Final consumption expenditure (current USD)	HIPC	TGM
GDP	GDP (current, USD)	HIPC	TGM
FIS	Author's calculation: [Tax revenue (current LCU) - General government final consumption expenditure (current LCU)]/GDP	HIPC	TGM
CA	Current account balance (BoP, current USD)	HIPC	TGM
REX	Exchange Rates, Real Effective Exchange Rate based on Consumer Price Index, Index	IFS	VAR

RES	International Reserves, Official Reserve Assets, US Dollars	IFS	VAR
SHOCK	Authors calculation: Dummy variable = 1 if $PPG(F-J)_t <$ $PPG(F-J)_{t-1}$ and 0 otherwise	IDS	TGM

Table 4.1.2 shows the variables used to construct the index of foreign factors in the replication of the VAR contained in CLR. The NAREIT stands for National Association of Real Estate Investment Trusts and the indicator used is an index tracking the value of all real estate investment trusts. N.A. indicates that the name in the data source is the same as the one reported as the variable name.

The interest rate on certificates of deposit, which was present in CLR, was omitted due to lack of data availability.

Table 4.1.2 Indicators used in the construction of the Index of foreign factors for the VAR model in Chapter 7.

Variable Name	Indicator Name in Data Source	Source
Detrended Disposable Income	N.A.	BEA, US Government
1-month Capital Gain on the S&P 500	N.A.	Yahoo Finance
12-month Capital Gain on the S&P 500	N.A.	Yahoo Finance
1-month Capital Gain on the US NAREIT	Monthly Index Values & Return	NAREIT
12-month Capital Gain on the US NAREIT	Monthly Index Values & Return	NAREIT

3-month Treasury Bill Rate	Financial, Interest Rates, Government Securities, Treasury Bills, 3-month, Percent per annum	IFS
Interest Rate on Commercial Paper	Financial, Interest Rates, Corporate Paper Rate	IFS
Treasury Long Bond	N.A.	Federal Reserve Bank of St. Louis

4.2 Testing for Stationarity and Difference in Group Means

All variables were tested for stationarity using the Fisher type unit root test for panel data: Investment, Final Consumption and FDI were the only variables found to be non-stationary. This can be confirmed by observing Figure 4.2.1 which plots the average value across the panel countries for these variables over time. This issue was solved by taking the first differences of the non-stationary variables in order to ensure the appropriate distribution of the t-statistic of the regression coefficients. The only other transformation which was applied to the data, aside from the within transformation applied in the fixed effects estimator, was scaling the primary budget surplus by GDP to ease the interpretation of the regression coefficients in Section 6.3.

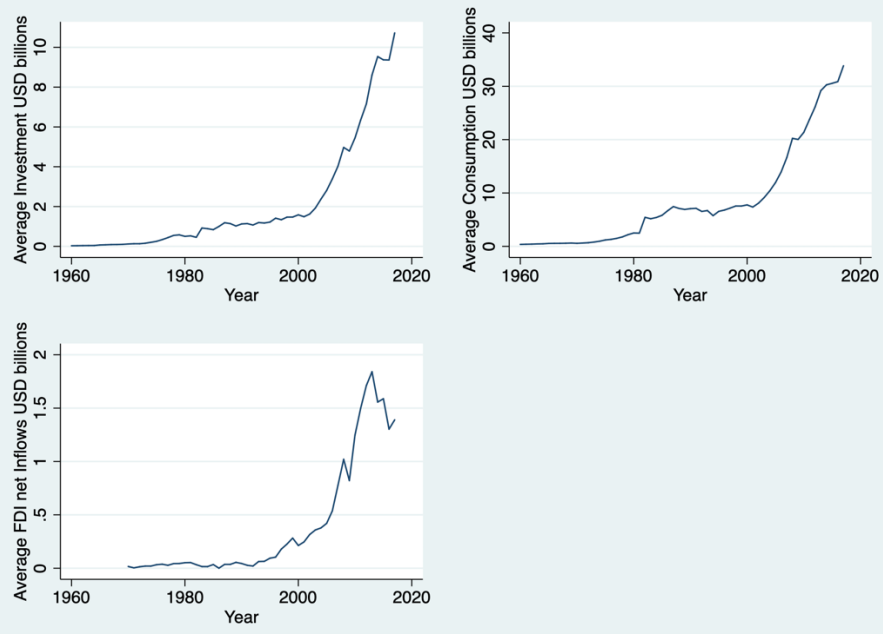

Figure 4.2.1. Time series line of the average Investment, Final Consumption and FDI in the HIPCs.

To check for the need to include country fixed effects in the regression analysis, we plotted the average of the dependent variable in the TGM (the first difference of Investment) across the countries in the sample. The resulting chart is displayed in Figure 4.2.2.

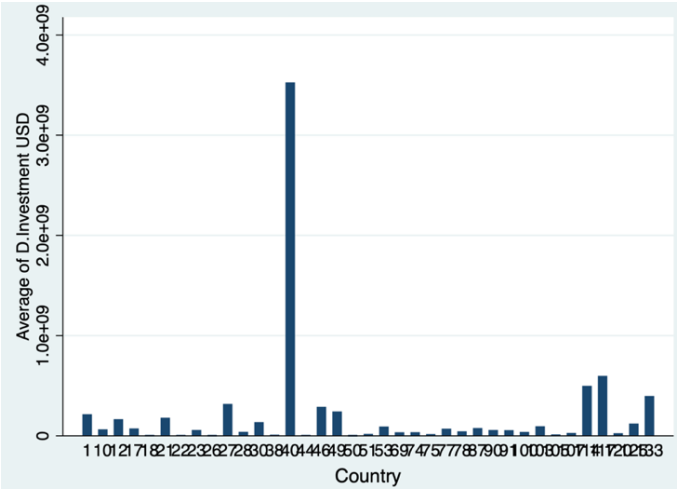

Figure 4.2.2 Average of the first difference of Investment by country

As shown in Figure 4.2.2, the means of the dependent variable vary considerably across countries suggesting the use of country fixed effects would be useful. Ethiopia displays

the largest average difference in Investment by a long shot, this is due to the fact that data on this country only became available starting in 2011, at which point volatility in many macroeconomic series across the globe was higher than average in the aftermath of the Great Financial Crisis; furthermore, Ethiopia is also one of the larger countries in the group. Similarly, plotting the mean in the dependent variable against time yields an equally variable pattern as shown in Figure 4.2.3.

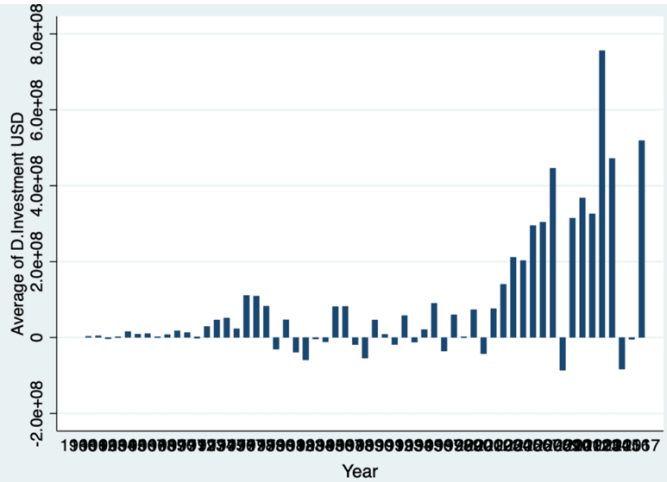

Figure 4.2.3. Average of the first difference of Investment over the years 1960 to 2017

This variation in means across country and time also applies to the GDP growth and Current Account, the other two dependent variables used in Chapter 6 (see Figure A.2 and A.3 in the Appendix).

4.3 Principal Component Analysis of Foreign Factors and Capital Flows

Figure 4.3.1 shows the graphs of the indexes constructed from the principal components of the foreign factors contained in Table 4.1.2 along with the graphs of the same constituent factors. PC1 is the index constructed out of the first principal component and PC2 out of the second. As can be seen, PC1 captures the movement in equity and real estate returns (the 12 month returns in particular), whereas PC2 relates to a greater extent to the different interest rates and disposable income (excluding the movement in the

long bond, which is more closely related to PC1). This is also the case in Table A.2 which shows the correlations between the indexes and their constituents. In all principal component indexes, the constituting series were standardized to ensure equal treatment.

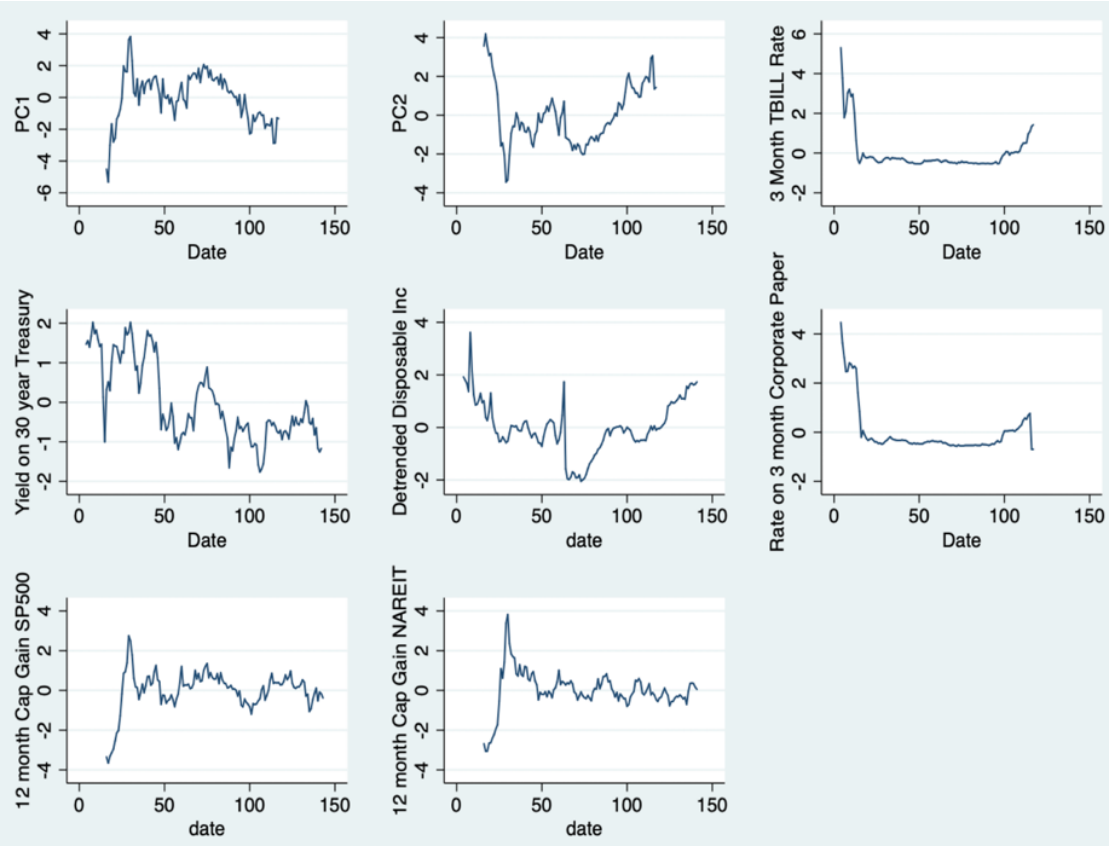

Figure 4.3.1, time series plot of the indexes of foreign factors constructed out of the first and second principal components of the variables in Table 4.1.2 and the constituting factors.

The one-month capital gains on the S&P500 and the NAREIT were omitted in Figure 4.3.1 for presentation reasons given that they do not exhibit a marked correlation to the indexes (refer to Table A.2).

In Figure 4.3.2 PC1 and PC2 are compared to the regional series constructed with the first principal components of the reserves and real exchange rate movements in the HIPCs.

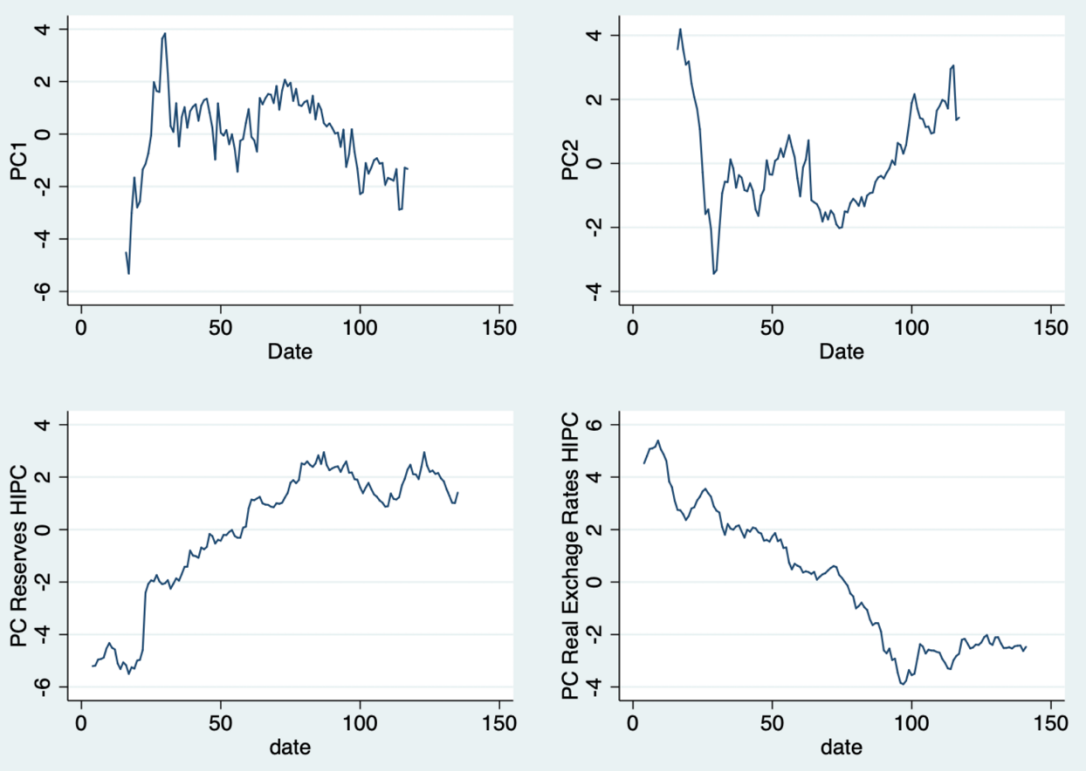

Figure 4.3.2 Indexes of foreign factors, real exchange rate and international reserves for the HIPCs in the period from January 2008 to January 2019 with monthly data

The second principle component of the foreign factors is negatively related to the index of international reserves and real exchange rates in the HIPCs. This is expected since the second PC index captures the movement in interest rates in the US and falling interest rates in developed economies should divert capital to developing countries, which would mean an accumulation of international reserves and an appreciation of the real exchange rate. Table A.3 shows the correlations between the foreign factor indexes and the regional series of exchange rates and reserves, a negative correlation of slightly over 25% is found between PC2 and the regional series in both cases.

4.4 Co-movement of Foreign Transfers in the HIPCs

An important feature of the VAR analysis which will be the topic of Chapter 7, is the presence of regional effects in capital flows. This feature of the data is crucial since it precludes the use of time fixed effects in the regression analysis in Chapter 6. The presence of such an effect is clear from the proportion of variation which is explained by the first

and second principal component of the capital flow variables shown in Table 4.4.1. In all cases the second principal component explains cumulatively more than 60% of the variation of the original 13 (in the case of the international reserves and real exchange rates) and 35 (in the case of the foreign transfers) series.

Table 4.4.1 Principal component analysis of the real exchange rate and reserves series in the HIPCs used to construct the regional indexes in Figure 4.3.2 and the foreign transfers variable of the Three Gap Model.

Variable Name	Proportion explained by the first principal component	Cumulative proportion explained by the second principal component
International Reserves	50.2%	66.11%
Real Exchange Rate	47.06%	78%
Foreign Transfers (PPG(F-J)	39.55%	62.67%

Note. The real exchange rate and international reserves are measured monthly from January 2008 to January 2019, whereas the foreign transfers are measured yearly from 2001 to 2012 (data was omitted due to missing observations). The sample was reduced due to data constraints and consists in 35 countries for the foreign transfers and 13 countries for the international reserves and real exchange rate. All series were standardized to ensure equal treatment.

The results of the PCA analysis in Table 4.4.1 indicate that there is a large degree of co-movement between the constituting series; hence regional effects cannot be ruled out.

5. Methodology

This Chapter will be divided in two parts, in Section 5.1 I will explain the methodology for the empirical analysis concerning the TGM, this will be followed by five subsections: one for each prediction outlaid in Chapter 3 in the same order. In Section 5.2 I will lay down the methodology used in the replication of the VAR model from CLR.

5.1 Methodology: TGM

We will be using two empirical techniques to test the predictions of the TGM which we summarized in Chapter 3: panel data regressions and tests for structural breaks.

The fixed effects estimator was chosen as the default option for the panel data regressions because the nature of the data implies that there should be a systematic difference in the dependent variable (investment) across groups even after first differencing; it wouldn't make sense to expect Haiti to have the same average change in investment over the years as Honduras (refer to Figure 4.2.2). Even though these two countries are from the same region of the world and relatively similar in some respects, the GDP of Honduras in 2017 was almost three times the GDP of Haiti, so taking out the country mean from the variables is absolutely crucial. Whether this variation in the group means is related to the regressors was tested with the Hausman test, which showed random effects to be more efficient in only two cases (Models 7 and 8, specifically which model the interaction between Investment and the primary budget surplus).

Although the mean of the dependent variables used in Chapter 6 vary across time as well as countries, we decided to not include time fixed effects given that capital flows present a large degree of co-movement in the sample countries, as shown in Table 4.4.1. Including time fixed effects prevents us from estimating the effect of capital flows on the dependent variable which is constant across countries (because of the co-movement of capital flows between countries) and varies through time. This could lead us to greatly underestimate the effect of interest, hence time fixed effects are ruled out.

The functional form of the variables included in the regression models will be linear in all cases, this is a direct consequence of the theoretical relationship we are modelling. The only non-linear relationship contained in the TGM is the relationship between inflation and private savings, which is not considered in this paper; all other relationships in the model are linear.

In all models except Models 7 and 8 the within transformation to the data has already been applied. For instance, in the case of the dependent variable in Model 1 $D.INV_{i,t}$ was transformed as $\left[(D.INV_{i,t} - \mu(D.INV_{i,t})\right]$ where $\mu(X_{i,t})$ indicates the mean of the variable X over time in country i. In Models 7 and 8 the Hausman test showed random effects to be more efficient. In order to avoid any ambiguity, the notation specifies the Model number before the lag number in each parameter.

5.1.1 Methodology: Investment on Portfolio Flows, FDI and Foreign Transfers

In Models 1 we performed the regressions with only the contemporaneous effects of FDI, and portfolio equity flows on investment; we then added foreign transfers in Model 2. In Model 3 we included lags, choosing between one and 2 year lags by minimizing the information criteria which yielded one lag as optimal. Including lags beyond the 2 year horizon would be a stretch to the purpose of the Model which is concerned with short run interactions. These Models can be summarized in the following equations.

$$D.INV_{i,t} = \beta_{10} + \gamma_{10} D.FDI_{i,t} + \delta_{10} PEF_{i,t} + e_t \quad \text{(Model 1)}$$

$$D.INV_{i,t} = \beta_{20} + \gamma_{20} D.FDI_{i,t} + \delta_{20} PEF_{i,t} + \varphi_{20} PPG(F-J)_{i,t} + e_t \quad \text{(Model 2)}$$

$$D.INV_{i,t} = \beta_{30} + \sum_{l=0}^{l=1} \gamma_{3l}\, D.FDI_{i,t-l} + \sum_{l=0}^{l=1} \delta_{3l}\, PEF_{i,t-l} + \sum_{l=0}^{l=1} \varphi_{3l}\, PPG(F-J)_{i,t} + e_t$$

(Model 3)

In Model 4 we assess the relevance of foreign transfers directed through the private accounts, which the TGM assumes to be negligible by running the following regression. Adding lags yielded worse information criteria and will not change the result.

$$D.INV_t = \beta_{40} + \varphi_{40} PPG(F-J)_{i,t} + \vartheta_{40} PNG(F-J)_{i,t} + e_t \quad \text{(Model 4)}$$

5.1.2 Methodology: Testing the Invariance of Consumption to Foreign Transfers

In Models 5 and 6, reported below, we assessed the effect of foreign transfers on consumption. Only the contemporaneous effect of foreign transfers was included since consumption is defined as expenditure on goods which have a duration of less than one year, so the lagged effect of foreign transfers cannot, by definition, influence consumption. The first lag of investment was included in Model 6 to isolate the effect of income earned from investment in the previous period on consumption: a high investment income could attract additional capital and entail higher consumption, acting as a confounder. As data on investment income was not available, we used the lag of investment from the previous period to proxy for this effect.

$$D.FINCONS_{i,t} = \beta_{50} + \varphi_{50} PPG(F-J)_{i,t} + e_t \quad \text{(Model 5)}$$

$$D.FINCONS_{i,t} = \beta_{60} + \varphi_{60} PPG(F-J)_{i,t} + L_1\alpha_{61} D.INV_{i,t-1} + e_t \quad \text{(Model 6)}$$

5.1.3 Methodology: the Effect of Austerity in Combination with Foreign Transfers

In Models 7 and 8, the lag choice was also guided by the theory since the effect of interest is that of the primary budget surplus on Investment and GDP growth in the year following a recession (measured as negative GDP growth at T-2) and in combination with a surge in foreign transfers (at T-1). The first lag of the primary budget surplus was included to

measure the effect of interest and the third as a control variable to isolate the negative effect of a stronger fiscal position before the GDP contraction, which could possibly indicate that the recession was not due to profligate spending but could have been the consequence of something more serious such as a global financial crisis. Again, given that the third and first lag of the budget surplus are expected to be positively correlated, the negative effect of the third lag on growth and investment could act as a confounder.

$$\frac{D.INV_{i,t}}{GDP}_{i,t} = \beta_{70} + L_1\theta_{71}FIS_{i,t-1} + L_3\theta_{73}FIS_{i,t-3} + e_t$$

$$if\ GDP_{i,t-2} < 0\ \&\ PPG(F-J)_{t-1} > PPG(F-J)_{t-2} \qquad \text{(Model 7)}$$

$$\ln\left(\frac{GDP_{i,t}}{GDP_{i,t-1}}\right) = \beta_{80} + L_1\theta_{81}FIS_{i.t-1} + L_3\theta_{83}FIS_{i,t-3} + e_t$$

$$if\ GDP_{i,t-2} < 0\ \&\ PPG(F-J)_{i,t-1} > PPG(F-J)_{i,t-2} \qquad \text{(Model 8)}$$

5.1.4 Methodology: Short Run Response to Capital Flight

In Models 9 through 13, which are dedicated to modelling the short run response mechanism in net exports to a capital flight, the lag choice was guided by the minimization of the Akaike and Schwartz criteria which showed two lags to be optimal in Models 11 through 13, and the one period lag in Models 9 and 10. Model 9 measures the effect of the current account on investment following a reduction in foreign transfers and starting from a savings constraint (the economy is not in a recession, we proxy for this with positive GDP growth).

$$D.INV_{i,t} = \beta_{90} + L_1\omega_{91}CA_{i,t-1} + e_t$$

$$if\ PPG(F-J)_{i,t-1} < PPG(F-J)_{i,t-2}\ \&\ GDP_{i,t-2} > 0 \qquad \text{(Model 9)}$$

In Model 10 the same regression as Model 9 is run on countries which started off from a recession, measured by negative GDP growth at T-2.

$$D.INV_{i,t} = \beta_{(10)0} + L_1\omega_{(10)1}CA_{i,t-1} + e_t$$

$$if \;\; PPG(F-J)_{i,t-1} < PPG(F-J)_{i,t-2} \;\; \& \;\; GDP_{i,t-2} < 0 \qquad \text{(Model 10)}$$

In Models 11, 12 and 13 the same regression is applied to different groups of countries to test whether the HIPCs and other countries differ in their ability to expand production following capital flight and a real exchange rate devaluation.

$$CA_{i,t} = \beta_{(11/13)0} + \sum_{l=1}^{l=2} L_2\, \omega_{(11/13)l} SHOCK_{i,t-l} + e_t \qquad \text{(Model 11, 12, 13)}$$

5.1.5 Methodology: Testing for Structural Breaks in the Relationship Between Investment and Foreign Transfers

The test for structural breaks will be performed with a Quandt likelihood ratio test (QLR) on the coefficient of capital inflows (directed through the public accounts as dictated by the model's assumptions) with investment as the dependent variable for each individual time series (each country separately) in a simple distributed lag (DL) model. The QLR test uses an unknown break date by performing the test at the date which presented the largest Chow statistic. This is an appropriate methodology since the TGM predicts that the break should occur at a threshold of foreign transfers, not a specific point in time. The test was performed on the individual time series (and not the panel as a whole) since relationship predicted by the TGM implies a time series break in the relationship between capital inflows and investment in a "highly-indebted developing country" (Bacha, 1990; p. 279), not a group of countries, so the information to be gained from the cross-section is limited. The lag choice of the foreign transfers variable was dictated by the theory, since the TGM

is meant for modelling short run response mechanisms the contemporaneous and one period lagged effects seemed appropriate. The resulting DL model is as follows:

$$D.INV_{i,t} = \beta_{(14)0} + \sum_{l=0}^{l=1} \varphi_{(14)l}\, PPG(F-J)_{t-l} + e_t \qquad \text{(Model 14)}$$

A disadvantage of the QLR test is that it does not allow for multiple breaks over the sample period, which in this case would be useful since according to the TGM, countries could theoretically go back and forth between constraints; however, a test allowing for multiple breaks was not readily available.

5.2 Methodology: VAR Replication (Calvo, Leiderman and Reinhart; 1993)

In Chapter 7 we will replicate the VAR from the CLR paper, which uses an unobserved index model, to test for the impact of foreign factors on capital flows to developing countries. The indexes are constructed with the first and second principal components of a selection of variables for the United States contained in Table 4.1.2, whereas, due to lack of data on foreign transfers at monthly frequencies, the real exchange rate fluctuations and the central bank reserves in the HIPCs are used as proxies for foreign transfers. Two systems will be constructed, one assessing the intertemporal effect with lagged values of all variables, and one with only the contemporaneous effects. Lag order was chosen by minimizing the information criteria as done by CLR. The model will be estimated for each country separately, as done by CLR. As a minor extension, we will estimate a model with the indexes constructed out of the first principal components of reserves and exchange rate fluctuations in the HIPCs as the endogenous variables to model the regional impact of foreign factors.

The system containing lagged values is as follows:

$$RES_t = \propto_1 + \gamma_1 t + \beta_{11} PC1_{t-1} + \beta'_{11} PC2_{t-1} + \delta_{11} RES_{t-1} + \delta'_{11} REX_{t-1} + u_t^{RES},$$

$$REX_t = \propto_2 + \gamma_2 t + \beta_{21} PC1_{t-1} + \beta'_{21} PC2_{t-1} + \delta_{21} RES_{t-1} + \delta'_{21} REX_{t-1} + u_t^{REX}.$$

(System 1)

Whereas the system for the contemporaneous values is:

$$RES_t = a_{11}PC1_t + a_{12}PC2_t + e_t^{RES},$$

$$REX_t = a_{21}PC1_t + a_{22}PC2_t + a_{23}RES_t + e_t^{REX}. \quad \text{(System 2)}$$

Where RES represents the foreign reserves and REX represents the real exchange rate, the two endogenous variables; $PC1$ and $PC2$ are respectively the index constructed out of the first and second principal components of the foreign factors. As in CLR, we impose temporal exogeneity on the foreign factors by not allowing them to receive feedback from the endogenous variables in both systems. In (2) we also impose the restriction that reserves are not allowed to respond to shocks to the real exchange rate consistently with the original paper, however changing this assumption will not alter the results. Although CLR do not give an explanation as to why they allow the exchange rate to respond to a shock in reserves, we believe this to be necessary because in the event of a sudden capital outflow, the depreciation in the real exchange rate will be preceded by an abrupt depletion of the international reserves as the country attempts in vain to avoid a balance of payments crisis.

6. Regression Results for the Three Gap Model

In this Chapter I will present the results from the regression analysis and structural break tests relevant to the TGM. A brief critical comment will be given for all results found, while acknowledging that conclusive explanations for the interaction between macroeconomic variables are hard to come by. Caution in the interpretation of these results is therefore advised. Unless otherwise noted, the sample countries in the models are part of the HIPC group. The countries included are therefore highly indebted and lower income developing countries, as targeted by the TGM. The timeframe is from 1960 to 2017 with yearly observations, although the panel in most Models is strongly unbalanced. Generally

speaking, in the years after the first Oil Shock of 1973, the data collection becomes more reliable. The Chapter will be divided in subsections to enhance readability and for ease of reference. Each block of Models which were discussed separately in the Methodology section will receive its own subsection in this Chapter.

6.1 Investment on Portfolio Flows, FDI and Foreign Transfers

Below are the results of the panel data regressions of investment on portfolio flows, FDI, and foreign transfers. Country clustered standard errors are in brackets.

Table 6.1.1 Panel data regression with country fixed effects of the relationship between investment and capital inflows distinguished as FDI, portfolio flows, and public/private account provenance.

	D.Investment			
Variable Names	Model 1 (27 countries)	Model 2 (27 countries)	Model 3 (24 countries)	Model 4 (14 countries)
D.FDI	.101 (.094)	.066 (.092)	.276** (.117)	
$\boldsymbol{L_1}$D.FDI			-.132 (.099)	
Portfolio Equity Inflows	.628*** (.156)	.594*** (.153)	1.151*** (.188)	
$\boldsymbol{L_1}$Portfolio Equity Inflows			-.756*** (.170)	
PPG (F-J)		.362*** (.096)	.280** (.120)	.275** (.069)
$\boldsymbol{L_1}$PPG (F-J)			-.053 (.123)	
PNG (F-J)				. 125 (.117)
# Observations	348	348	300	346
Overall $\boldsymbol{R^2}$	.026	0.085	0.164	0.083
F stat	8.17	10.44	8.77	8.46

Note. p<0.1*, p<0.05**, p<0.01***

As expected, most signs are positive and significant. The TGM capital inflows variable (PPG (F-J))[14] in particular has a consistently positive sign, except for the insignificant lag in Model 3, whereas inflows directed through the private accounts (which the Model assumes away) are not significant in Model 4 indicating that this is a reasonable assumption in this sample (the HIPCs) and timeframe. Interestingly, portfolio flows seem to exhibit the strongest relationship with investment being significant at the 1 percent level in all model specifications. This relationship however appears to be ambiguous since in Model 3 the lag effect has a negative sign (albeit the total effect is still positive). A reason for this ambiguity could be that portfolio flows require strong financial infrastructure and regulatory supervision to translate into profitable investments. FDI on the other hand has the advantage of a longer planning horizon and a more direct involvement of the foreign investor, which makes capital formation, knowledge transfers and other positive externalities more easily achievable (Rodrik, 2001; Stiglitz, 2003). This distinction makes it important to differentiate between the two when modeling capital flows (which the TGM does not do). Furthermore, in this dataset and model specification(s), they also have radically different coefficient sizes and levels of significance, with portfolio flows generally being more significant and having a larger effect[15].

6.2 Testing the Invariance of Consumption to Foreign Transfers

In this subsection we will test the relationship between inflows and consumption, which the model assumes will be invariant to capital inflows. We will include the lagged first difference of investment to avoid capturing increases in consumption which are attributable to investment income from the previous periods, which could potentially attract more capital inflows in the current period and therefore act as a confounding variable. Consumption was also first differenced due to non-stationarity throughout the panel.

[14] PPG stands for Public and Publicly Guaranteed; it indicates that the liabilities generating the capital flows are directed through the public accounts.

[15] One may think that this is because portfolio flows are not differenced, but a robustness check reveals the result is the same after differencing portfolio flows as well.

Table 6.2.1 Panel data regression of total consumption on capital inflows directed through the public accounts and investment, country fixed effects used.

	D.Final Total Consumption	
Variable Names	Model 5	Model 6
PPG (F-J)	0.500***	0.466***
	(.131)	(.146)
L_1D.Investment		.102
		(.071)
# Observations	1,426	1,234
Overall $\boldsymbol{R^2}$	0.074	0.071
F stat	14.50	7.42

Note. p<0.1*, p<0.05**, p<0.01***

As expected, capital inflows have a significant positive effect on consumption in this dataset. A small part of it is indeed driven by investment income from the previous period as can be seen from the change in coefficient on PPG (F-J) from Model 5 to Model 6. The effect of capital inflows on consumption could be driven, among other factors, by a political bias against investment in developing countries at an early stage of development where the import content of investment is still very high. If the producers of tradables manage to coax the government into spending capital inflows on consumption which is not import intensive, this could serve their short-term interests but greatly harm the long-term solvency prospects of the government. This could create a role for enlightened conditionality, which concedes capital inflows on the condition that the government will adopt a long-term investment plan.

6.3 The Effect of Austerity in Combination with Foreign Transfers

The next regression will examine the effect of the primary budget surplus on investment capacity, the topic of hotly debated conditionalities attached to capital inflows by multilateral development banks (Hickel, 2018). Bacha's model provides a theoretical defense of the IMF's first commandment, which is "put your house in order" or reach a primary budget surplus. The dynamic of how this should raise investment is better explored

in Section 3.3, where we showed austerity has the potential to raise investment capacity, in a recessionary economy with foreign transfer increases, without increasing inflation or imposing trade restrictions. Below are the results of a panel data regression of GDP growth and investment on the first and third period lags of the primary budget surplus scaled by GDP to make the interpretation more straightforward. Here the sample is limited to countries which were in a recession, as we assumed in Figure 3.3.1 since the savings constraint was not binding (being in a recession is expressed by negative GDP growth at T-2) and experienced an increase in foreign transfers in the previous period (T-1).

Table 6.3.1 Panel data regression with random effects of D.Investment and GDP growth on the primary budget surplus for countries in a recession (two period lagged GDP growth <0) and which had an increase in foreign transfers in the previous period. Hausman tests show random effects are more efficient.

	D.Investment/GDP	**GDP growth**
Variable Names	Model 7 (10 countries)	Model 8 (10 countries)
L_1Primary Budget	-.0006*	.080**
Surplus/GDP	(.0003)	(.038)
L_3Primary Budget	.0007	-.052
Surplus/GDP	(.0005)	(.064)
# Observations	17	17
Overall $\boldsymbol{R^2}$	0.209	0.181
Chi-square stat	3.69	4.86

Note. p<0.1*, p<0.05**, p<0.01***

The coefficients for the effect of the government budget on GDP growth are as expected in the TGM, with the one period lag having an average positive effect of eight basis points of growth per unit increase of the primary surplus relative to GDP. Interestingly, while the three period lag in this regression is not significant, removing it reduces the significance of the first period lag. This may be because in countries which had a relatively strong government fiscal position at T-3 and nonetheless experienced negative GDP growth at T-2, the recession may have been caused by something more serious than profligate spending such as a global financial crisis.

Unfortunately, the sample size in Models (7) and (8) is utterly decimated with only 10 countries and 17 observations. This makes interpretation of the results difficult, in particular the unexpected negative and significant effect of the first period lag of the government budget on the first difference of investment. A plausible explanation is that in the short run the increased credibility gained from tightening the public finances might affect GDP and investment differently, which contradicts the TGM's assumption that these two are interchangeable in the short run (Bacha, 1990 p. 286). GDP could grow as a result of higher spending on consumption by consumers and businesses which would expect a reduction in taxes (or that at least taxes will not increase) thanks to the improvement in the government accounts. Investment on the other hand necessitates an abundance of profitable investment projects other than the willingness to deploy capital pursuant to an expectation that taxes will decrease.

6.4 Short Run Response to Capital Flight: Does the Current Account Absorb the Shock?

If the TGM is an accurate description of how developing countries adjust to foreign transfer shocks, a country starting from full capacity (the savings constraint is binding) or from a recessionary state (either the fiscal or the forex constraints are binding) and hit by a negative foreign transfer shock, should see net exports rise as a response to the excess capacity generated by the output reduction. This occurs in two steps: (i) when foreign transfers go down exports rise in response to the currency depreciation and (ii) the foreign currency accumulated from the export revenue raises the IE curve leading to higher investment capacity. We will test (ii) by performing a panel data regression of the first difference of investment on the previous period's value (T-1) of the CA. In Model 9 the sample is restricted to countries which had positive GDP growth at T-2 (so the savings constraint was binding) and Model 10 shows the same regression for countries which started off from a recessionary state, having negative GDP growth at T-2 (in which case the fiscal or foreign exchange constraint would have been binding). The results are summarized in Table 6.4.1.

Table 6.4.1 Panel data regression of D.Investment on the Current Account balance, for countries with a negative foreign transfer shock at T-1 and positive GDP growth at T-2 (Model 9 only) and negative GDP growth at T-2 (Model 10 only). Country fixed effects were used.

	D.Investment	
Variable Name	Model 9 (36 countries)	Model 10 (36 countries)
L_1Current Account	.073***	-.151***
	(.022)	(.033)
# Observations	457	103
Overall $\boldsymbol{R^2}$	0.0082	0.2339
F stat	11.10	20.89

Note. p<0.1*, p<0.05**, p<0.01***

Models 9 and 10 show us that the effect of the CA on investment is different depending on which constraint was initially binding: the CA has a positive effect on investment in countries starting from the savings constraint and experiencing a negative foreign transfer shock, while it has a negative effect on countries in the same circumstance but which started off from a recessionary state (so from a fiscally or foreign exchange constrained level of investment). Although the reason why the CA would have a negative effect on investment in countries starting from a recessionary state eludes us, we take the main result to be that the initial condition matters in understanding the effect of the CA on investment. Both effects are significant at the 1 percent level and the negative effect in Model 10 is over twice the size of the positive effect in Model 9.

Now we will turn to (i) which is that the current account amortizes the shock in foreign transfers by expanding when a capital outflow occurs. This is what we will test with the following regression in which the current account is the dependent variable and is regressed on a dummy variable taking value one when the foreign transfers directed through the public accounts declined in that year and 0 otherwise. We will also assess whether the HIPCs behave differently by performing separate regressions on the different samples. Guided by the Theory (Noorbakhsh and Paloni, 1999) we will also construct a sub sample

excluding Sub Saharan African (SSA) countries which tend to have chronically low industrialization levels. The results are summarized in Table 6.4.2.

Table 6.4.2 Panel data regression of the Current Account on a dummy variable indicating whenever foreign transfers decreased relative to the previous year (2 lags included to allow for adjustments in industrial production), fixed effects were used.

Variable Name	**Current Account**		
	Model 11 IDS (134 countries)	Model 12 excluding SSA (92 countries)	Model 13 HIPC only (39 countries)
L_1Decline in PPG (F-J)	1.71e+09**	2.40e+09*	-7636093
	(8.29e+08)	(1.23e+09)	(6.37e+07)
L_2Decline in PPG (F-J)	1.78e+09**	2.45e+09**	5.53e+07
	(8.29e+08)	(1.24e+09)	(6.38e+07)
# Observations	4,688	3,124	1,138
Overall $\boldsymbol{R^2}$	0.0015	0.0019	0.0000
F stat	3.81	3.33	0.35

Note. p<0.1*, p<0.05**, p<0.01***

Consistently with Noorbakhsh and Paloni, (1999) we find that adding the Sub Saharan countries to the mix reduces the effect sizes of a foreign transfer shock on the current account. Interestingly, for the HIPC countries the response in the current account to a decline in foreign transfers is not significant. A potential explanation for this is that the HIPCs have not yet reached the level of industrial development required to expand production and use the currency depreciation as a shock absorber to boost the CA after capital flight. A starting point could be to parametrize the model in such a way that $m > k$, which would mean that the recovery process from a foreign transfer shock would have to imply a reaction in the fiscal constraint and not in net exports. This reaction could be an

inflationary course of growth (provided the country is still on the good side of the Laffer curve) or an austerity programme in combination with higher foreign transfers. Both of these could find strong resistance, the former from the producers of tradables and domestic bond holders and the latter from the general constituency.

A contradiction would seem to arise if one does parametrize the model so that $m > k$, since this means that the case for austerity in Figure 3.3.1 no longer subsists, provided that the level of foreign transfers is sufficiently high to reach the foreign exchange constraint (which at (F-J)'' in Figure 3.3.1 is the fiscal constraint since the model was set with $m < k$): foreign transfers are not accumulating as idle reserves since the economy is under the forex (and not the fiscal) constraint so the argument in Figure 3.3.1 is no longer valid. In summa, in order to make an accurate policy recommendation, the accuracy of the parametrization of the model is paramount.

6.5 Testing for Structural Breaks between Investment and Foreign Transfers

The next test is crucial to the validity of the TGM. It addresses the core purpose of the Model which is that there are breaks in the relationship between investment and foreign transfers depending on which constraint is relevant. The model is a simple DL model with the first difference of investment as the dependent variable regressed on the contemporaneous and one period lagged effect of foreign tranfers. The results are summarized in Table 6.5.1

Table 6.5.1 QLR break tests on the individual time series of D.Invesment regressed on the first and third lag of foreign transfers.

	Number of countries	**% of Sample**
Total	40	100
Contained one break at the 5% significance level	12	30
Contained one break at the 10% significance level	2	5

Not enough data to perform the test	15	37.5
No structural break detected	11	27.5

With an average of 40 years of data per time series on the countries for which there was enough data for the test to be performed, only 48 percent displayed a break at the 5 percent significance level. It could be that the change in size in the coefficients when passing from one constraint to another is not large enough to be detected by the QLR test, which also implies that the breaks found could be the result of other factors such as the inclusion in an IMF or WB program which boosted investment and/or foreign transfers. This however does not seem likely since the most popular break date by far is 2012 (5 out of 12), when only Sierra Leone experienced an abrupt drop in its debt forgiveness under the HIPC programme. In other countries, as can be seen in Figure 6.5.1, the break would seem to be driven by an abrupt surge in foreign transfers, consistently with what the TGM would predict.

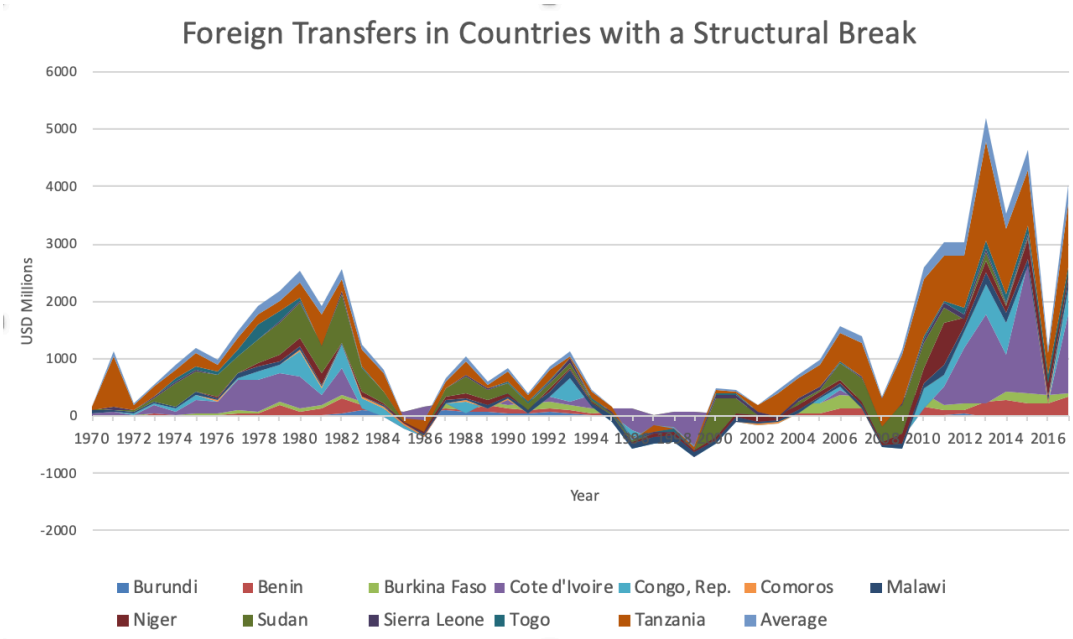

Figure 6.5.1. Foreign transfers (in USD), in countries which experienced a structural break in the relationship between investment and foreign transfers at the 5% significance level of the QLR test.

Table A.1 in the Appendix contains more detailed information on the countries which exhibited a structural break and an individual graph of each country's foreign transfers is also provided in Figure A.1. All but four of the twelve countries exhibiting structural breaks presented sharp rises in foreign transfers in the same period, in the way the model would predict. What is less convincing is the fact that many of the time series of foreign transfers exhibit shocks which do not lead to structural breaks in the relationship with investment. The QLR test is of course limited to finding one break, so in the countries where a break was found it could be that the Chow statistic for the other extreme values was also large enough to qualify as a structural break but still smaller than the largest one reported. For the countries which did not exhibit any structural breaks, the TGM becomes difficult to defend. A possibility is that the DL model for those countries was not well specified, but it is unlikely that this would be the cause of a type II error in the QLR test. The remaining hypothesis is of course that the change in constraints doesn't have a large enough effect to be detected by the QLR test in those countries, a distinct possibility since the parameters which determine the slopes of the constraints are to some extent arbitrary and could differ largely between countries. This would indicate that the Model should be parametrized at the country level before being used to recommend policy.

7. Replication of the VAR in Calvo, Leiderman and Reinhart (1993)

As mentioned previously, TGM assumes foreign transfers to be an exogenous variable. However, the Model does not allow this exogeneity to influence the convertibility of foreign transfers into investment. As discussed elsewhere in this paper, there are various reasons to assume that the exogeneity of foreign transfers affects whether the asset allocation process ensuing capital inflows will be successful (see Chapter 1). This Chapter will endeavor to measure the extent to which the HIPCs' capital flows are influenced by foreign factors, by considering their effect on the real exchange rate and international reserves at the country level.

Finding a strong influence of foreign factors challenges the TGM's position that exogeneity does not affect the asset allocation process. This is because in effect the TGM's position is actually that the flows are exogenous to a negligible extent, since it would be challenging to argue that if flows are completely exogenous, that is no fundamental, country or borrower specific factor is relevant in the investment process, an optimal allocation of assets will be achieved.

In Table 7.1 we report the results of the tests for exclusion restriction of the foreign factors in the two VAR systems for those HIPCs for which the necessary data was available, as well as the regional index constructed out the first principal component of the country level time series. The Chi-square statistic is reported with the corresponding probability value in brackets.

Table 7.1 Test for exclusion of foreign factors results for the VAR of reserves, real exchange rate fluctuations, and the indexes constructed with the first and second principal components of the foreign variables in Table 4.1.2. The indexes are the exogenous variables. System (1) includes one lag of all regressors and System (2) includes only contemporaneous effects. The test statistic and (p-val) are reported.

	System (1)	**System (2)**			
Country Name		a_{11}	a_{12}	a_{21}	a_{22}
Bolivia	14.39 (0.0007)	0.17 (0.6810)	0.35 (0.5548)	3.79 (0.0545)	22.07 (0.0000)
Burundi	2.46 (0.2929)	0.01 (0.9078)	0.33 (0.5670)	0.03 (0.8577)	3.60 (0.0605)
Cameroon	9.86 (0.0072)	0.02 (0.8907)	0.00 (0.9907)	1.74 (0.1906)	1.07 (0.3042)
Central African Republic	2.23 (0.3279)	0.00 (0.9899)	0.00 (0.9621)	0.01 (0.9265)	0.30 (0.5863)
Democratic Republic of Congo	1.28 (0.5263)	0.24 (0.6269)	1.37 (0.2451)	1.24 (0.2675)	14.26 (0.0003)
Gambia	2.72 (0.2560)	0.00 (0.9897)	0.25 (0.6207)	3.28 (0.0733)	42.07 (0.0000)
Ghana	2.29 (0.3188)	0.02 (0.8763)	0.07 (0.7967)	0.24 (0.6225)	0.37 (0.5423)

Guyana	7.28 (0.0262)	0.01 (0.9076)	0.14 (0.7133)	0.29 (0.5883)	6.95 (0.0097)
Malawi	0.40 (0.8201)	0.50 (0.4791)	0.25 (0.6211)	0.52 (0.4738)	0.46 (0.4989)
Nicaragua	24.73 (0.0000)	0.05 (0.8321)	0.02 (0.8772)	0.30 (0.5826)	0.39 (0.5315)
Sierra Leone	5.04 (0.0806)	0.12 (0.7266)	0.27 (0.6057)	0.11 (0.7428)	1.80 (0.1829)
Uganda	0.30 (0.8592)	0.00 (0.9840)	0.00 (0.9438)	0.12 (0.7332)	0.00 (0.9823)
Zambia	10.92 (0.0043)	0.20 (0.6579)	0.45 (0.5041)	0.68 (0.4111)	1.37 (0.2446)
Regional index	7.17 (0.0277)	0.88 (0.3516)	1.84 (0.1775)	0.00 (0.9466)	5.45 (0.0216)

In this sample and timeframe, foreign factors have a weaker influence on reserves and the real exchange rate in the HIPCs than they did in the South American countries in the CLR paper.

Whereas CLR found that eight out of ten countries in System (1) and half of the coefficients in System (2) rejected the null hypothesis of an insignificant effect of foreign factors, in this sample only half of the countries in System (1) and eight out of 56 parameters in System (2) reject the same null hypothesis at the 10% significance level. This could be due to the fact that CLR's dataset spanned over a much tighter timeframe, from 1988 to 1991, in which there was a rapid surge of capital inflows in the South American countries in their study. Another possibility is that financial infrastructure in the HIPCs is still less developed than it was in the nineties in the countries in CLR's dataset, thus making capital inflows more dependent on factors such as foreign aid or the country's terms of trade than the US macroeconomic variables contained in $PC1$ and $PC2$.

8. Conclusion, Limitations, Policy Implications and Further Research

This paper focused on the impact and exogeneity of capital flows in highly indebted developing countries. We first used the Three Gap Model developed by Bacha (1990) to conceptualize and test empirically the economic effect that capital flows would have in different scenarios under a set of assumptions. Subsequently, we measured the exogeneity of capital flows in the sample countries, keeping in mind the body of theory and evidence which holds that exogenous capital flows are conducive to systemic risk.

The TGM's assumption of directing all capital inflows through the government accounts, thereby ignoring inflows through the private sector, in the sample countries was supported by the empirical analysis we carried out. The same cannot be said about the assumption of a constant private and government consumption, where we found that higher capital inflows were generally associated with higher consumption at standard significance levels. Notwithstanding this approximation, by many accounts the TGM fares reasonably well in predicting the relationship between capital inflows and macroeconomic variables in developing countries. The effect of foreign transfers directed through the public accounts, the key variable in the TGM, in all but one case is significant and positive in alternate model specifications. The TGM also makes a case for austerity in combination with increased foreign transfers which seems to be borne out in the data, where the primary budget surplus was found to have a positive effect on GDP growth in countries starting from a recessionary state and experiencing a surge in foreign transfers. Less inspiring, is the fact that the breaks in the relationship between investment and foreign transfers are often not found in the way the TGM would predict.

The response in net exports to a negative foreign transfer shock also does not occur in the way predicted by the TGM. While the CA does have a positive effect on investment after a capital outflow for countries starting from a savings constraint, its effect is negative for countries which started from a recessionary state where the fiscal or foreign exchange constraints were binding. Furthermore, in the HIPCs the CA does not respond to a negative shock in foreign transfers in the first place, indicating that their industry is not able to use

the currency depreciation following a capital outflow as a shock absorber to expand exports. This implies that in the HIPCs the TGM should be parametrized with $m > k^*$, meaning that the response to a negative foreign transfer shock should pass through the fiscal constraint as opposed to the foreign exchange mechanism. However, this invalidates the case for austerity in combination with high foreign transfers which was supported by the empirical analysis in this paper.

Overall, these tests indicate that while the TGM is a good starting point for modelling capital flows in developing countries, its parameters must be attentively calibrated to obtain a correct description of how the individual country's macroeconomic variables interact. This could be a fertile topic for future research, which would need to go through the painstaking task of parametrizing the Model for each individual country and then examine the benefits in terms of increased predictive and prescriptive power in the customized version with respect to the general one size fits all approach undertaken here.

In the second part of this paper we replicated the VAR model in Calvo, Ledeirman and Reinhart (1993) to measure the exogeneity of capital flows in developing countries with respect to policy and economic fundamentals. As mentioned in Section 2.1 of this paper, a stronger exogeneity of capital flows with respect to economic fundamentals of the receiving country, poses several problems to the efficiency of the financial system, the first of which is that appropriate resource allocation is unlikely when fundamentals are not the driving force behind investment decisions.

We were unable to find convincing results supporting the influence of exogenous factors on reserve accumulation and real exchange rate fluctuations. However, this cannot be interpreted in favor of the alternative hypothesis, being that the determinants of capital flows are endogenous to policy decisions in developing countries and allocative efficiency through financial liberalization is effective. There are several other potential reasons for this finding, including the sampling choice of the HIPC countries which are to some extent under the supervision and management of the IMF. At this point the question would be whether the IMF's granting of debt forgiveness, which is equivalent to an increase in

foreign transfers, and management of a long-term investment plan is indeed conducive to efficient resource allocation. This is beyond the scope of this paper and could be a topic for future research.

As a final remark, the analysis in this paper suggests that the effect of a policy involving foreign transfers may not be predictable if structural factors, such as a country's level of industrial development and the exogeneity of capital flows, and/or business cycle related factors such as prevailing economic conditions, are ignored. Most of these factors were in fact found to create significant heterogeneity in the effect of foreign transfers.

This issue, ironically, also feeds into the greatest limitation of the paper: which is that using aggregated variables and aggregated datasets spanning over countries with significantly different structural settings, presumably most of which we were not able control for in our regression analysis, cannot in principle lead to the determination of a causal mechanism. For this reason, the relationships observed in Chapter 6, beyond implying by uncovering inconsistencies and heterogeneity that consideration of certain country specific factors is needed, cannot be taken as causal mechanisms describing the interaction between the variables[16].

In any case however, the kind of empirical analysis conducted in this paper can lead to supporting evidence in favor of one policy over another. For instance, it becomes hard to argue that HIPCs can expand exports after a reversal of capital flows and would hence be in a position to curtail the risks of financial liberalization if, on average, this has not occurred in the past. It must be stressed however, that because of the aforementioned limitation, the fact that, in this example, a policy of capital account convertibility would have had undesirable consequences in the past is not a guarantee that the same will hold in the future in a different country. This will be determined by the unique factors at play at that point in time in the specific country, implying that the higher the customization of the model being used to predict the outcome of the policy, the more adequate will be the result.

[16] This issue has been explored both in the history of economic thought by the Lucas critique (Lucas, 1976) of Keynesian macroeconomics and more recently by Paul Romer (2016).

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Appendix

Table A.1 Detailed list of QLR tests for structural breaks performed on the individual time series of D.Investment for each country, regressed on the contemporaneous and one period lag of foreign transfers directed through the public accounts.

Country Name	**Country Code**	**Region**	**SSA**	**c_code**	**Break date**	**Break**
Afghanistan	AFG	South Asia	0	1	No data	
Burundi	BDI	Sub-Saharan Africa	1	18	1979	1
Benin	BEN	Sub-Saharan Africa	1	10	2012	1
Burkina Faso	BFA	Sub-Saharan Africa	1	17	1987	1
Bolivia	BOL	Latin America & Caribbean	0	12	2005	Not significant

Central African Republic	CAF	Sub-Saharan Africa	1	22	1987	Not significant
Cote d'Ivoire	CIV	Sub-Saharan Africa	1	30	1979	1
Cameroon	CMR	Sub-Saharan Africa	1	21	2011	Not significant
Congo, Dem. Rep.	COD	Sub-Saharan Africa	1	27	No data	NA
Congo, Rep.	COG	Sub-Saharan Africa	1	28	2010	1
Comoros	COM	Sub-Saharan Africa	1	26	2012	1
Eritrea	ERI	Sub-Saharan Africa	1	38	No data	
Ethiopia	ETH	Sub-Saharan Africa	1	40	No data	
Ghana	GHA	Sub-Saharan Africa	1	46	No data	
Guinea	GIN	Sub-Saharan Africa	1	49	2002	Not significant
Gambia, The	GMB	Sub-Saharan Africa	1	44	2008	Not significant
Guinea-Bissau	GNB	Sub-Saharan Africa	1	50	1986	Not significant
Guyana	GUY	Latin America & Caribbean	0	51	2006	Not significant
Honduras	HND	Latin America & Caribbean	0	53	1989	Not significant
Heavily indebted poor countries (HIPC)	HPC		0	0	No data	
Haiti	HTI	Latin America & Caribbean	0	52	No data	
Liberia	LBR	Sub-Saharan Africa	1	69	No data	
Madagascar	MDG	Sub-Saharan Africa	1	74	No data	
Mali	MLI	Sub-Saharan Africa	1	77	No data	
Mozambique	MOZ	Sub-Saharan Africa	1	87	2013	Not significant

Mauritania	MRT	Sub-Saharan Africa	1	78	2010	Not significant
Malawi	MWI	Sub-Saharan Africa	1	75	2004	1
Niger	NER	Sub-Saharan Africa	1	91	2012	1
Nicaragua	NIC	Latin America & Caribbean	0	90	No data	
Rwanda	RWA	Sub-Saharan Africa	1	100	2005	Not significant
Sudan	SDN	Sub-Saharan Africa	1	114	2002	1
Senegal	SEN	Sub-Saharan Africa	1	103	1981	1 at the 10
Sierra Leone	SLE	Sub-Saharan Africa	1	105	2012	1
Somalia	SOM	Sub-Saharan Africa	1	107	No data	
Sao Tome and Principe	STP	Sub-Saharan Africa	1	102	No data	
Chad	TCD	Sub-Saharan Africa	1	23	1993	1 at the 10
Togo	TGO	Sub-Saharan Africa	1	120	2012	1
Tanzania	TZA	Sub-Saharan Africa	1	117	2009	1
Uganda	UGA	Sub-Saharan Africa	1	125	No data	
Zambia	ZMB	Sub-Saharan Africa	1	133	No data	

The following table reports the graphs of the foreign transfers directed through the public accounts in the countries from the previous table. To identify a country with its graph the c_code can be used.

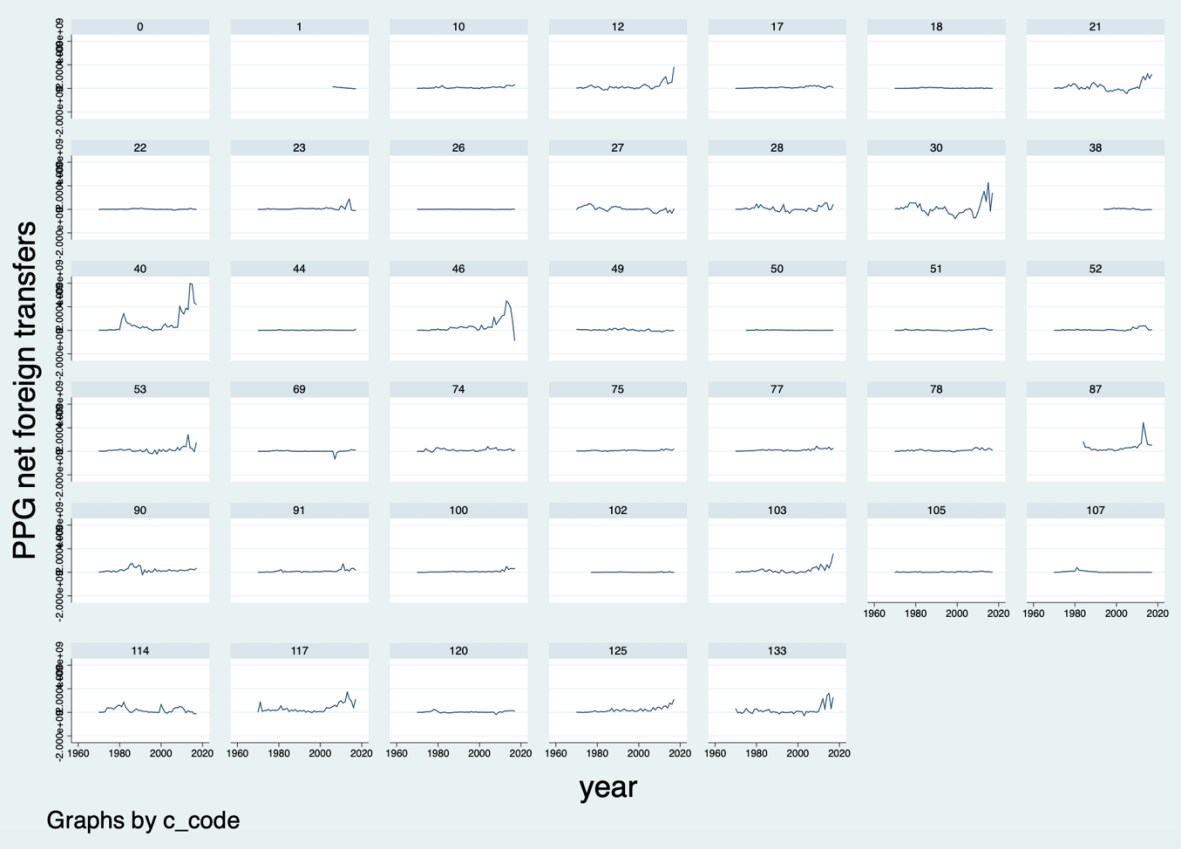

Figure A.1 Foreign transfer graphed by c_code for all the HIPCs.

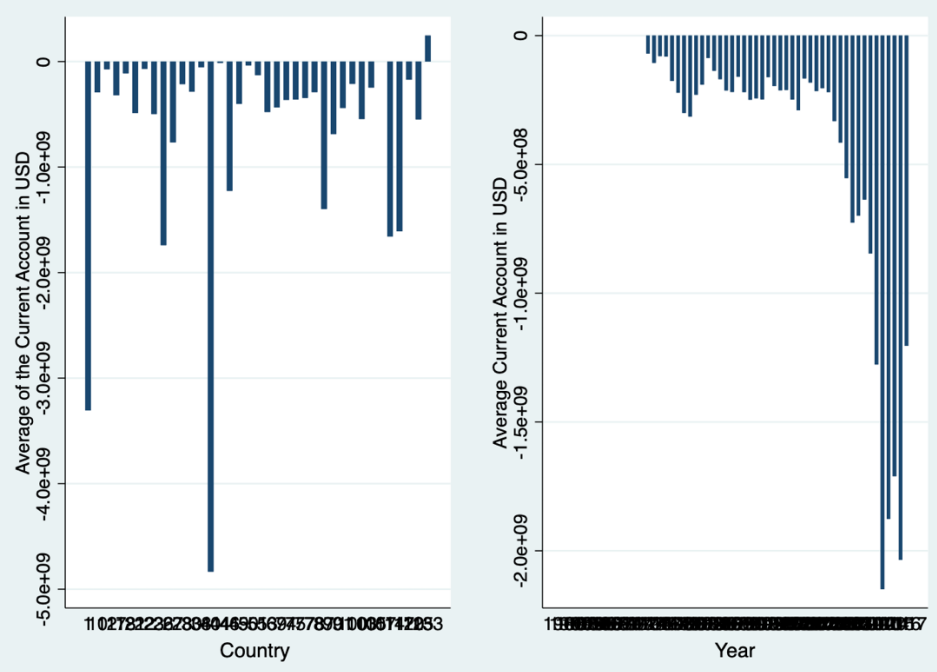

Figure A.2 Average Current Account value over country and year

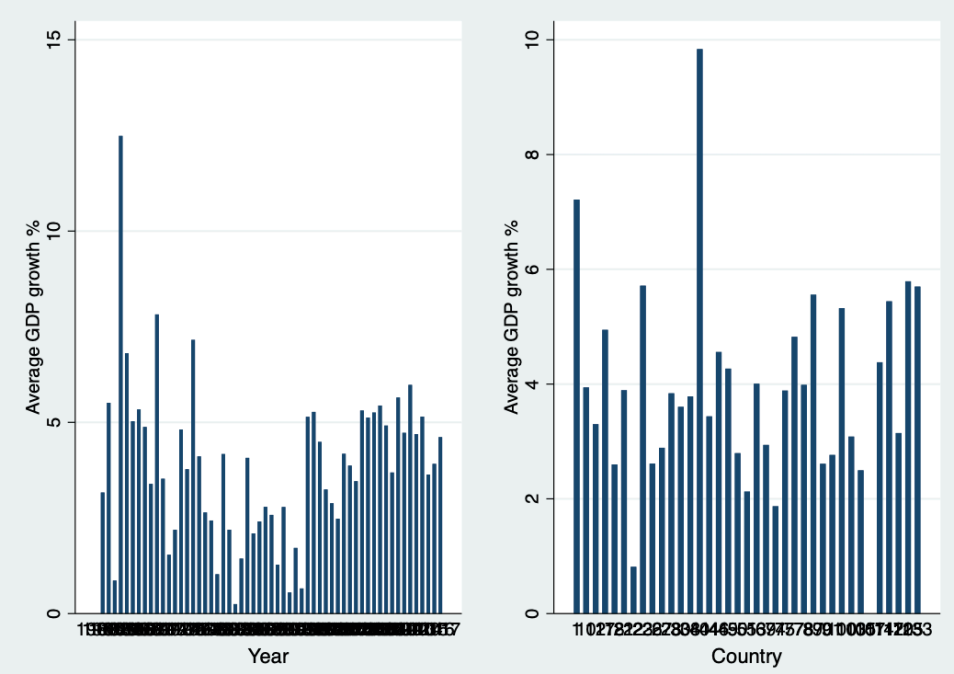

Figure A.3 Average GDP growth over year and country.

Table A.2 Correlation between the principal component indexes of foreign factors and their constituents.

Variable Name	PC1	PC2
Detrended Disposable Income	-0.573	0.599
1-month Capital Gain on the S&P 500	0.299	-0.079
12-month Capital Gain on the S&P 500	0.804	-0.819
1-month Capital Gain on the US NAREIT	0.308	-0.087
12-month Capital Gain on the US NAREIT	0.694	-0.700
3-month Treasury Bill Rate	-0.520	0.563
Interest Rate on Commercial Paper	-0.613	0.646
Treasury Long Bond	0.357	-0.323

Table A.3 Correlation between the foreign factors and the regional indexes of reserves and exchange rates for the HIPCs.

	PC1	PC2
Reserve Index	0.237	-0.276
Real Exchange Rate Index	0.281	-0.263

Chapter A.2: The Three Gap Model in Detail

A.2.1 The Savings Constraint

The savings constraint is an original feature of the Harrod-Domar Model, in which output was found to be held back by the gap between available savings and required investment to achieve target growth rates.

Assuming fixed consumption and that all capital inflows are directed through the government accounts, the savings constrained level of investment obtained from the accounting identity between income and absorption is:

$$IS = S_p^* + (T - G) + (F - J) \qquad (1)$$

Where $S^* = Y^* - C$ is the level of private savings when the economy is at full capacity. C_p is the level of private consumption, which is assumed constant, and Y_p^* is private income. T is government revenue and G is government consumption, while J is net balance of factor services with the rest of the world and F is the net capital inflows. $F - J$ are the net foreign transfers, that is net capital inflows less the net factor service payments, henceforth this will be referred to as "foreign transfers".

A way of interpreting (1) is by considering the identity from the balance of payments between net exports and foreign transfers, a country can have a negative balance of trade if it has a positive balance on the financial account, that is if it receives money from the rest of the world which it uses to finance its export deficit[7]. Considering this identity, the level of available savings are given by the difference between what a country produces (GDP) less what it spends (consumption) and what it's able to get from the rest of the world via net capital inflows (*F*) less what it pays (in the form of interest on loans and bonds) on these flows (*J*). Savings are a country's means of financing investment, hence (1) gives the savings constrained level of investment.

A.2.2 Foreign Exchange Constraint

The first step towards determining the forex gap is to divide imports into complimentary capital goods imports M_k (which are goods used for productive purposes) and other imports *M* (which are destined for consumption) and define the import content of investment as a constant *m* taking value between 0 and 1 (so $M_k = m\ I$). In the interest of brevity, we will gloss over the derivations which are done by Bacha (1990), and straight away define the foreign exchange constrained level of investment as:

$$IE = \left(\frac{1}{m}\right)[E^* + (F - J)] \qquad (2)$$

Where E^* is the upper bound of net exports given by world demand. An interesting feature of this model (which was already present in the Two Gap Model by Chenery and Bruno (1962)) is that, since $m < 1$ foreign transfers have a stronger impact for a foreign exchange constrained economy than a savings constrained one. Equation (2) shows that higher net exports and foreign transfers raise a country's ability to invest because they both enable a country to import complimentary capital goods through the accumulation of foreign currency.

A.2.3 Fiscal Constraint

The fiscal constraint is the original feature of the TGM. It is also the most complicated of the constraints to understand because it includes a non-linear relationship between inflation and investment. This is a result of two assumptions: that government investment props up private investment in certain circumstances (through complementarity and crowding-in effects) and that there is no domestic market for government bonds. Because of the second assumption if there are spare private savings going around (that is $S_p - I_p > 0$) the government can capture them through money printing, making investment a positive function of inflation for moderate levels of inflation. For high levels of money printing, investment will be crowded out either on the savings market or the foreign exchange market. To see why let's write down the equations of the fiscal gap.

$$IT = (1+ k^*)[f(p,h)+ (T-G)+ (F-J)] \quad (3)$$

$$S_p - I_p = f(p,h) \quad (4)$$

Here k^* is the crowding in coefficient which determines the maximum level of private investment at

$$I_p = I_g k^* \quad (5)$$

with $k^* > 0$, p is the price level, h is the propensity to hoard, I and I are the level of private and government investment and all other variables are consistent with previous definitions. Equation (4) can only be made consistent with (5) if private savings is a slack variable. However, under the assumption of constant private consumption, this will not occur when either the savings or the foreign exchange constraints are binding (since output and hence savings is constrained by either a foreign exchange or a savings restriction). What will actually happen is that (4) determines not private savings but the actual level of private investment (which will be less than $I_g k^*$). This relationship is best illustrated in the following graph which shows the relationship between private savings and the price level.

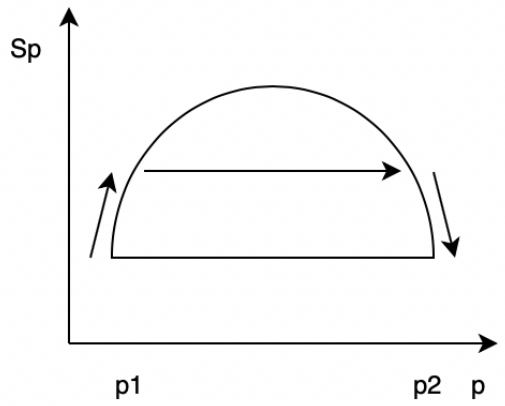

Figure A.2.3.1 Relationship between inflation and private savings in the fiscal gap

Figure A.2.3.1 shows the relationship between private savings and inflation in the TGM following the traditional Laffer curve shape. For low inflation levels, Bacha assumes that government investment crowds in private investment. However, there is a limit to how much the government can force the private sector to save, once p1 is reached either the savings or the foreign exchange constraints become binding at which point additional money printing will not raise output. At this point private savings are stuck at the level indicated in figure 2.1.3.1 by the horizontal arrow. At p2 and beyond the economy is in a hyperinflationary spiral signalling that either taxes will go up or inflation will keep going up; both of these effects have negative impacts on investment and savings.