

## Nuri Yildirim

Department of Economics,  
Yasar University,  
Izmir,  
Turkey  
✉ nuri.yildirim@yasar.edu.tr

## Huseyin Tastan

Department of Economics,  
Yildiz Technical University,  
Istanbul,  
Turkey  
✉ tastan@yildiz.edu.tr

# Capital Flows and Economic Growth across Spectral Frequencies: Evidence from Turkey

**Summary:** This paper examines interactions and feedbacks between categories of capital flows and economic growth in Turkey for the 1992:01-2009:08 period. Our empirical analysis is based on a new version of the causality test of John Geweke (1982, p. 77) and Yuzo Hosoya (1991, p. 88) in the frequency domain proposed recently by Jörg Breitung and Bertrand Candelon (2006, p. 132). In addition, using standard methods in spectral analysis, we decompose the total covariance between capital flows and growth across main frequency bands and capture lead/lag interactions between them. Some of our findings are as follows: Variance decompositions over frequency bands reveal that variations in individual capital flow categories are largely concentrated over high (seasonal) frequencies. The nature of the interaction/feedback between growth and capital flows varies significantly over frequency bands and subcategories of flows. Over business cycle frequencies, two out of four subcategories of inflows, short-term external borrowings and portfolio investments on government bonds, drive growth whereas the other two components, long-term borrowings and portfolio investments on shares, are driven by growth. Furthermore, for the post-2001 financial crisis period we found significant bi-directional causality between long-term external borrowings and growth whereas portfolio investments, bond flows and short-term external borrowings do not affect growth in the long run.

**Key words:** Capital flows, Causality in frequency domain, Geweke's measure of feedback, Turkey.

**JEL:** C32, F21, F32, F43.

Beginning notably in the late 1980s many developing countries, in anticipation of reaping large benefits, have followed the natural policy prescription of the economic theory suggesting that financial liberalization is the “new engine of growth”<sup>1</sup> and lifted restrictions on capital accounts. Since then, however, many developing countries, including Turkey, have experienced severe financial crises leading to intense debate among academia and policy circles on the costs and benefits of capital account liberalization. Although the positive contribution of foreign direct investments on economic growth is relatively firmly established in the literature, there is still an ongoing debate concerning the growth effects of easily reversible short and long-term capital flows including portfolio investments, as well as bank

<sup>1</sup> See for example Pierre-Olivier Gourinchas and Olivier Jeanne (2006).

and non-bank borrowings from abroad. Far from being settled, the controversy surrounding unfettered capital inflows – especially more volatile short-term investments – centers on whether benefits outweigh costs in the long run.

Broadly speaking, there are two views on the desirability of financial liberalization. The first one, so-called allocative efficiency argument, relies on the neoclassical growth model in which capital inflows facilitate efficient allocation of international resources. Capital-scarce developing countries will benefit from resource flows from capital-abundant countries as they will contribute to investment and economic growth *directly* by reducing the cost of capital. Capital inflows, either in the form of physical or portfolio investments, will also have long term *indirect effects* on economic performance through encouraging regulatory and institutional reforms to attain financial deepening, enhanced human capital, improved corporate governance and increased competition (e.g. Ross Levine 2001; Peter B. Kenen 2007; Frederic S. Mishkin 2009 among others).

The second view stresses financial instability and frequent economic crises caused (or amplified) by international capital flows as illustrated by 1994 Mexican and 1997 Asian crises (e.g. Dani Rodrik 1998; Joseph Stiglitz 2000). It is argued that the undesirable macroeconomic consequences (such as local currency appreciation, asset price bubbles, rapid monetary expansion and inflationary pressure, consumption boom, widening current account deficits, growing external indebtedness of private sector, increasing vulnerability to external shocks, etc.) have a potential to annihilate the benefits of capital inflows as a complement to insufficient domestic savings. Mishkin (2005) emphasizes that capital inflows can potentially lead to domestic lending booms by banks, together with excessive risk taking, which in turn leads to huge loan losses and deterioration of balance sheets of financial institutions. Another source of instability that may arise in a fully liberalized emerging economy is a currency or a balance of payments crisis taking place simultaneously with capital flow reversals the so-called “sudden stop” phenomenon whose deleterious effects have been observed in several recent financial crises. Following the works of Guillermo Calvo (1998), Calvo and Carmen Reinhart (1999) several studies have offered theoretical and empirical links between sudden stops and economic growth. As mentioned in Graciela L. Kaminsky (2006) sudden stops can be classified as a distinct type of crisis and the adverse impact on output is much more pronounced for countries with fragile economies.<sup>2</sup>

Empirical evidence on the relationship between the degree of financial openness/financial integration and real economic variables from cross-sectional and panel country studies is rather mixed.<sup>3</sup> Among the studies finding positive association between capital inflows and economic growth are Dennis Quinn (1997), Helmut Reisen and Marcelo Soto (2001), Geert Bekaert, Campbell R. Harvey, and

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<sup>2</sup> In an attempt to distinguish the output costs of currency crises, capital account reversals and sudden stops, Michael M. Hutchison and Ilan Noy (2006) find that sudden stops have a negative and much larger impact on output than other forms of currency attacks. Their empirical analysis relies on a panel data from 24 emerging markets over the 1975-1997 period and estimates indicate approximately 13-15% output loss which is much larger than the output loss in currency crises without capital outflows.

<sup>3</sup> Peter B. Henry (2007), Edison et al. (2002a) and Barry Eichengreen (2001) provide critical reviews of the literature on financial openness and economic growth.

Christian Lundblad (2001, 2005), Miguel A. Ferreira and Paul A. Laux (2009). On the other hand, several studies have found no or negative association between capital inflows (or financial openness/integration) and economic growth including Rodrik (1998), Hali J. Edison et al. (2002b), Soto (2003), Lucio Laureti and Paolo Postiglione (2005), Ahmad Z. Baharumshah and Marwan A. Thanoon (2006)<sup>4</sup>, Gamba B. Saoussen (2009). On the relationship between capital flows and domestic investment Ashoka Mody and Antu P. Murshid (2005) following Barry P. Bosworth and Susan M. Collins (1999), conclude that foreign capital stimulated less domestic investment in the 1990s than in the preceding decade. Also, Joseph P. Joyce and Malhar Nabar (2009) note that the (negative) impact of banking crises on domestic investment tends to be more severe in more open economies. Recently, several studies highlighted the importance of the level of financial development in the recipient country to efficiently utilize foreign capital.<sup>5</sup> In addition to the level of financial development several country-specific characteristics such as the quality of institutions, the degree of legal development, the timing and intensity of financial sector liberalization and even the number of interest groups<sup>6</sup> can be important factors that may affect the way standard policy prescriptions work.

An alternative to running country regressions, which may be prone to several sources of bias associated with omitted country-specific factors, is to focus on a specific country and to test the hypothesis that capital flows lead to economic growth in the long run. The present paper follows this route and contributes to this debate by focusing on the experience of an important emerging economy: Turkey. In our opinion Turkish experience is quite interesting and motivating in several respects. First, following the full liberalization of capital account in 1989, Turkey has attracted a significant amount of mostly short-term and easily reversible financial flows reaching approximately US\$223 billions over the 1992-2008 period, of which one-third is foreign direct, 13% is portfolio and the remaining 53% is other investments and flows including bank and private sector lending (see Table 1). Second, as mentioned in Oya Celasun, Cevdet Denizer, and Dong He (1999), unlike many other emerging market economies Turkey has not undertaken necessary fiscal and structural reforms before opening its capital account. In a manner of speaking, the Turkish full financial liberalization of capital accounts was “premature” (Roberto S.

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<sup>4</sup> Except for foreign direct investments which have positive impact on growth.

<sup>5</sup> Eswar S. Prasad, Raghuram G. Rajan, and Arvind Subramanian (2007) note that financial sector development is important because countries with underdeveloped financial systems are unlikely to be able to use foreign capital to finance growth as investment and consumption are largely constrained by the weaknesses in the domestic financial system. Sebastian Edwards (2001), Benson Durham (2004), Bekaert, Harvey, and Lundblad (2005), Michael W. Klein and Giovanni P. Olivei (2008) suggest that openness is beneficial for growth in financially and industrially developed economies. On the other hand Carlos Arteta, Barry Eichengreen, and Charles Wyplosz (2001) and Adam Honig (2008) provide weak evidence on the importance of financial development.

<sup>6</sup> Areendam Chanda (2005) suggests that the degree of ethnic and linguistic heterogeneity in a country, which is used as a proxy for the number of interest groups, has a significant impact on the relationship between capital controls and economic growth. He finds that countries with a relatively high degree of ethnic and linguistic heterogeneity have experienced greater inefficiencies and lower economic growth from capital controls. For countries with high degrees of homogeneity, capital controls actually have a net positive effect on economic growth.

Mariano et al. 2004) in an environment lacking political stability and the development of key institutions. This in turn augmented the fragility of already unstable economy with chronic fiscal deficits and high inflation rates in the 1990s. Third, Turkish economic growth phases closely follow periods of capital flow surges. As mentioned by Mariano et al. (2004) economic growth has become substantially dependent on volatile and reversible short-term capital inflows. During the financial liberalization period Turkey experienced severe capital reversals (so-called sudden-stops) during two financial crises in 1994 and 2001. Only after the 2001 crisis Turkey implemented widespread structural reforms in financial and banking sectors and attained a relatively sound macroeconomic environment.

In this paper we examine the nature and extent of interactions and feedbacks between private capital inflows and economic growth in Turkey using monthly time series data for the 1992:01-2009:08 period. To see the impact of structural reforms in financial and banking sectors following the 2001 crisis on the nature of this relationship we carry out the empirical analysis for two sub-samples of pre- and post-2001 periods as well as for the full sample. Our purpose is to provide empirical evidence on the extent of short-run and long-run causality between capital inflows and economic growth by taking into account their behavior at different frequency bands. To this end, we employ a new version of the causality test of Geweke (1982) and Hosoya (1991) in the frequency domain developed by Breitung and Candelon (2006). Since a time series consists of both high and low-frequency components, the extent and direction of causality can differ between frequency bands (Clive W. J. Granger and Jin-Lung Lin 1995). Spectral Granger-causality tests enable us to determine at which frequencies one time series causes (or helps predict) another so that we may distinguish between short-run and long-run impacts of various components of capital inflows on growth. Using Breitung and Candelon's frequency domain causality test, we will obtain information about the predictive contents of the four categories of capital inflows, namely, portfolio investments on shares and bonds, short and long term "other" investments, on economic growth. In addition, we make use of bivariate spectral analysis tools to determine the sign of feedbacks and lead-lag relationships between variables.

The paper is organized as follows: The next section gives a brief summary of Turkey's recent experience with capital inflows. Section 2 defines the data set. Section 3 presents empirical analysis and finally Section 4 concludes the paper.

## 1. Private Capital Flows to Turkey

Capital inflows have been one of the most important sources of financing of current account and public deficits since the beginning of the 1990s. The key liberal economic reforms made in the 1980's and the full deregulation of capital accounts in 1989 prepared the necessary infrastructure for opening to the international financial markets. However, the liberalization of domestic markets before securing fiscal discipline and bringing inflation under control have often been criticized (Yilmaz Akyüz and Korkut Boratav 2003, p. 2). Mainly due to an unfavorable investment climate, Turkey has not been successful in attracting substantial foreign direct investments (FDI) in the past up to the year 2005 (see Table 1). Over the 1992-2004

period the sum of FDI inflows to Turkey is only US\$16.2 billion which constitutes 0.7% of GDP of the period. Mostly due to comprehensive structural reforms made after the 2001 financial crisis and a large privatization wave, Turkey has finally begun to attract noticeable amounts of foreign direct investments after 2004. The sum of FDI inflows to Turkey during 2005-8 four years period reached US\$63.9 billion (2.9% of GDP).

Contrary to unsuccessful experience with FDI in the past, Turkey has attracted substantial volume of foreign capital of other types, namely, short term arbitrage-seeking international funds or so-called “hot money”. Portfolio investments have become a major source of financing of large current account deficits. In this respect, Turkey is similar to the Latin American countries rather than the East Asian countries. As can be seen from Table 1, over the 1992-2008 period, the net total of foreign capital inflows excluding FDI, which consists of (net) portfolio investments plus (net) short and long term “other” investments’ lines in the balance of payments (BOP) sheet, amounts to US\$147.5 billion or 3.3% of the period’s GDP (see Table 1). However, it would be more accurate to look at the total gross volume (i.e., the sum of absolute values of monthly inflows and outflows) of capital flows and not the net inflows (because of cancellation of inflows and outflows each other) to assess their impact on the economy.

Over the period under consideration, the sum of monthly inflows and outflows of these three categories of capital flows (last line in Table 1) has reached US\$392.2 billions or 8.9% of the period’s GDP. Only one-third of this amount consists of long term “other” capital movements whereas the remaining two-thirds is made of short term flows. Furthermore, highly volatile nature of short term capital flows can also be clearly seen from Table 1. Large outflows are observed in portfolio and short term “other” investments during two major Turkish financial crises (1994 and 2001), the year of Russian crisis (1998) and also in 2008. During the 205-month-long sample period, 1992:01-2009:08, short term “other” investments, the most volatile component of flows, change sign by 49 times, that is, the average length of a boom/bust phase is only 4.2 months. This is 5.0 months for portfolio and 7.3 months for long term “other” investments. In 105 out of 205 months, i.e., in 51.2% of time, the net inflows of short term “other” investments are negative (net outflows). This ratio is 39.5% and 20.5% for portfolio and long term “other” investments, respectively.

The present research on the effects of capital flows on the Turkish economic aggregates is exclusively based on time-domain techniques and most of these studies mainly use impulse-response analysis derived from recursive VAR models. Hasan Kirmanoglu and Omer Ozcicek (1999) find that capital inflows lead to an increase in economic growth and real wages. Using a VAR model Alpaslan Akcoraoglu (2000) finds no Granger causality from capital inflows to economic growth for the 1989:01-1999:04 period and provides evidence on adverse effects of capital inflows on capital accounts. Emre Alper (2002) finds that capital inflows in Turkey, especially long-term capital inflows, are strongly procyclical with real output and lead the cycle by one quarter. Using Turkish monthly data from 1992:01 to 2001:06, Hakan Berument and Nergiz Dincer (2004) find that positive innovations in capital inflows appreciate

domestic currency, and increase output and money supply, but decrease interest rates and prices in the short run. They also argue that the exchange rate regime does not influence the effects of capital flows on macroeconomic performance. Ahmet Cime-noglu and Nurhan Yenturk (2005) argue that a surge in capital flows helps the economy grow as a whole, by triggering private consumption demand first, and eventually leads to a rise in investment into nontradable sector which has a limited foreign exchange generating capacity. Hence, capital flows changing domestic relative prices in favor of nontradable goods cause real appreciation of the domestic currency. Then, unsustainable large capital inflows eventually end up in economic crises.

**Table 1** Annual Net Capital Inflows<sup>a</sup> to Turkey, 1992-2008 (US\$millions)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	FDI	Portfolio investments	Other investments	Change in official reserves <sup>b</sup>	Financial accounts balance (FAB) <sup>c</sup>	Net error and omissions (NEAO)	Current accounts balance (CAB) <sup>d</sup>	CAB/GDP (%)
1992	779	2,411	458	-1,484	2,164	-1,190	-974	-0.7
1993	622	3,917	4,364	-308	8,595	-2,162	-6,433	-4.5
1994	559	1,158	-5,634	-546	-4,463	1,832	2,631	2.5
1995	772	237	3,903	-5,005	-93	2,432	-2,339	-1.7
1996	612	570	4,301	-4,545	938	1,499	-2,437	-1.7
1997	554	1,634	4,753	-3,316	3,625	-987	-2,638	-1.8
1998	573	-6,711	5,067	-216	-1,287	-713	2,000	1.2
1999	138	3,429	1,782	-5,726	-377	1,302	-925	-0.6
2000	112	1,022	11,801	-354	12,581	-2,661	-9,920	-5.3
2001	2,855	-4,515	-2,667	2,694	-1,633	-2,127	3,760	3.1
2002	939	-593	7,191	-6,153	1,384	-758	-626	-0.3
2003	1,252	2,465	3,425	-4,047	3,095	4,420	-7,515	-3.0
2004	2,005	8,023	4,156	-824	13,360	1,071	-14,431	-4.7
2005	8,967	13,437	14,903	-17,847	19,460	2,628	-22,088	-6.1
2006	19,261	7,373	11,544	-6,114	32,064	-13	-32,051	-7.9
2007	19,940	717	23,997	-8,032	36,622	1,597	-38,219	-5.6
2008	15,750	-5,046	24,596	1,057	36,357	5,509	-41,866	-5.3
Sum	75,690	29,528	117,940	-60,766	162,392	11,679	-174,071	
Abs.Sum <sup>e</sup>	78,312	153,904	238,330					

**Notes:** <sup>a</sup> Calculated from monthly net flows. <sup>b</sup> Minus sign (-) indicates increases in official reserves. <sup>c</sup> FAB is the sum of the first 4 columns. <sup>d</sup> CAB is the sum of FAB and NEAO with the opposite sign. <sup>e</sup> Volume of capital movements, i.e., the sum of absolute values of monthly net flows.

**Source:** Authors' own calculations from the Turkish BOP data.

## 2. Data

Our data set includes the industrial production index (IPI) and four categories of capital flows as liabilities: portfolio investments of foreigners in stocks (*portS*) and in government bonds (*portB*) and short and long-term “other” investments (borrowings of Turkish private banks and non-banking private sector from abroad), *STC* and *LTC*, for the 1992:01-2009:08 period<sup>7</sup>. All variables were obtained from the Central Bank of the Republic of Turkey (CBRT) data delivery system, EVD. Since there is no monthly GDP series, we divided monthly net capital flows by monthly exports in order to normalize them. Due to normalization by exports, all four capital flows series are covariance stationary<sup>8</sup>. We used two alternative detrending methods to remove trend in the logarithms industrial production index, *IPI*: Hodrick-Prescott (HP) filter with a smoothing parameter  $\lambda = 14400$  (monthly data) and a full length asymmetric frequency (band-pass, BP) filter developed by Christiano-Fitzgerald (2003). Definitions of variables used in the following empirical analysis section can be summarized as follows:

Variable name	Description
<i>gHP</i>	Fluctuations of log industrial production index (seasonally adjusted), <i>log IPI</i> , around non-linear trend produced by a Hodrick-Prescott (HP) filter. Smoothing parameter $\lambda$ is taken as 14400 for monthly data.
<i>gBP</i>	Alternatively, <i>log IPI</i> is detrended using a full length asymmetric frequency (band-pass, BP) filter developed by Christiano-Fitzgerald 2003.
<i>portS</i>	Portfolio investments on Shares <sup>a</sup> measured as a fraction of exports.
<i>portB</i>	Portfolio investments on Bonds <sup>b</sup> measured as a fraction of exports.
<i>STC</i>	Liabilities on “short” term other investments <sup>c</sup> measured as a fraction of exports (credits used by CBRT and general government and IMF credits are excluded).
<i>LTC</i>	Liabilities on “long” term other investments <sup>d</sup> measured as a fraction of exports (credits used by CBRT and general government and IMF credits are excluded).
<i>TCF</i>	Total of four categories, i.e., <i>portS</i> , <i>portB</i> , <i>STC</i> and <i>LTC</i> , as a fraction of monthly exports.
<i>r</i>	Monthly % change in real exchange rate issued by CBRT.
<i>f</i>	Treasury forward real borrowing rate.

<sup>7</sup> We deliberately hold foreign direct investments (FDI) out of our analysis for two reasons: first, FDI inflows are negligible for the pre-2005 period in Turkey; second, we believe that the channels through which FDI affects growth are radically different than those of arbitrage-seeking capital movements.

<sup>8</sup> The results of commonly used unit root tests are not reported but available from the authors upon request.



<sup>a</sup> Reported in the “capital account” division of the BOP sheet under the title II-B221.

<sup>b</sup> Reported in the “capital account” division of the BOP sheet under the title II-B222.

<sup>c</sup> Reported in the “capital account” division of the BOP sheet under the title II-B32, calculated as  $STC = B3212 + BB32232 + B32242 + B3232 + B324$ .

<sup>d</sup> Reported in the “capital account” division of the BOP sheet under the title II-B32, calculated as  $LTC = B3211 + B32231 + B32241$ .

### 3. Empirical Analysis

#### 3.1 Breakdown of Total Variance of Capital Flows Series over Main Frequency Bands

The breakdown of total variances of the series over main frequency bands are given in Table 2. Total variances of all four categories of monthly capital inflows are concentrated over the high seasonal frequencies, especially, over periodicities of 9 to 2 months. In other words, the capital flows, even the subcategory titled “long term investments”, are mainly short term in nature. Business cycles (BC) frequencies<sup>9</sup> account for only 12-22% of the total variations in capital flows series whereas 44-50% of the variance of growth (depending on detrending methods) comes from BC frequencies. This inherent volatility of capital flows is well documented in capital reversals (sudden stops) (Calvo 1998; Calvo and Reinhart 1999) and hot money literature (Stiglitz 1999). The short term, unstable and highly speculative nature of international capital movements is one of the main sources of instability in host countries.

**Table 2** Breakdown of Total Variance over the Main Frequency Bands

Main frequency bands <sup>1</sup>	<i>gHP</i>	<i>gBP</i>	<i>portS</i>	<i>portB</i>	<i>STC</i>	<i>LTC</i>	<i>TCF</i>
Long-run trend ( $P \geq 60$ ) ( $\omega \leq 0.1047$ )	4.1	0.6	10.1	5.6	4.4	25.1	11.0
Business cycles ( $18 \leq P < 60$ ) ( $0.1047 \leq \omega < 0.35$ )	44.3	50.4	12.1	17.2	19.6	22.1	25.3
Seasonal I ( $9 \leq P < 18$ ) ( $0.35 \leq \omega < 0.698$ )	25.2	23.8	21.4	13.7	9.1	9.2	12.0
Seasonal II ( $2 \leq P < 9$ ) ( $0.698 \leq \omega < \pi$ )	26.4	25.2	56.4	63.5	66.9	43.6	51.7
Total variance	100.0	100.0	100.0	100.0	100.0	100.0	100.0

**Note:** <sup>1</sup>  $P$  represents period measured in months and  $\omega$  is frequency:  $\omega = 2\pi / P$ . <sup>2</sup> Sum of four subcategories of capital flows.

**Source:** Authors' estimations.

<sup>9</sup> According to the NBER classification business cycle frequencies include periodicities from 6 to 32 quarters (18 to 96 months). Since average full-cycle length is around 50 months for the post-1980 Turkish economy (see, Huseyin Tastan and Nuri Yildirim 2008, p. 326), our business cycle frequencies cover wave-lengths between 18-60 months.



## 3.2 Causality Analysis

### 3.2.1 Causality Test in Time Domain

We first carried out the usual time-domain Granger-causality (GC) tests between components of capital flows and economic growth,  $gHP$ , which is measured as deviations of industrial production index ( $\log IPI$ ) from HP nonlinear trend<sup>10</sup>. Table 3 summarizes the results of unconditional (first row) and conditional (second row) GC tests. The real exchange rate ( $r$ ) and treasury forward borrowing rate ( $f$ ) were used as conditioning variables. Results can be summarized as follows: there is no causality in any direction between portfolio investments on shares,  $portS$ , and  $growth$  with or without conditioning at lags selected by AIC (4 and 2, respectively). However, there is significant causality, conditional on real exchange rate and interest rate, from  $growth$  to  $portfolio$  investments at all lags between 3-6. Unconditional GC tests indicate that portfolio investments on government bonds,  $portB$ , precede growth, but when conditioned on the real exchange rate and the interest rate this result disappears. The “other” short term investments which include short-term borrowings of banks and firms,  $STC$ , strongly Granger-cause  $growth$  in both cases, conditional and unconditional. Surprisingly, long-term bank and firm borrowings,  $LTC$ , do not precede  $growth$ , on the contrary,  $growth$  conditional on  $r$  and  $f$  precedes  $LTC$ . In summary, out of four components of capital flows only two,  $portB$  and  $STC$ , Granger-cause  $growth$ . Furthermore, if we remove the feedbacks of the real exchange rate and interest rates on growth, only short-term borrowings ( $STC$ ) precede growth.

**Table 3** Results of Granger-Causality Tests in Time Domain

	<b>portS</b>	<b>portB</b>	<b>STC</b>	<b>LTC</b>
$gHP$	No GC ( $\ell=4$ )	← (p-value: 0.021) ( $\ell=4$ )	← (p-value: 0.000) ( $\ell=4$ )	↔ (p-values: 0.039 and 0.032 for directions → and ←, resp.ly) ( $\ell=4$ )
$gHP$ (conditional on $r$ and $f$ )	No GC at $\ell=2$ , but → at $\ell=3-6$ (p-value: 0.030-0.060)	↔ (p-value: 0.091 for both directions) ( $\ell=4$ )	← (p-value: 0.000) ( $\ell=4$ )	→ (p-value: 0.054) ( $\ell=2$ )

**Note:** \* Lag length ( $\ell$ ) is selected by the Akaike Information Criterion (AIC).

**Source:** Authors' estimations.

<sup>10</sup> We also used full length asymmetric band-pass filter developed by Cristiano J. Lawrence and Terry J. Fitzgerald (2003) as an alternative detrending method, but since it produced almost the same results with the HP filter, we did not report them here.

### 3.2.2 Causality Test in Frequency Domain

In a series of seminal papers Geweke (1982, 1984a, 1984b), and later Hosoya (1991, 2001) have proposed several measures of linear dependence and feedback between two variables. Widely known as Geweke's measures of linear feedback in the literature, these measures are closely related to the concept of Granger causality which provides information on whether one variable is useful in forming a one-period-ahead forecast of another variable. For example, if  $Y$  does not Granger-cause  $X$  then Geweke's measure of linear feedback from  $Y$  to  $X$  will be zero. Geweke's measure of linear feedback can also be calculated for each frequency by using Fourier transformation of MA representation of a finite order stationary VAR system. Frequency decomposition provides information on the degree of long-run association at low frequencies and of the short-run association at high frequencies. Since a times series consists of both high and low-frequency components the ability of one variable to predict another can be different across different frequencies. However, in order to test the null hypothesis that the measure of linear feedback from  $Y$  to  $X$  at frequency  $\omega$  is zero (which is equivalent to the null hypothesis that there is no Granger causality from  $Y$  to  $X$  at frequency  $\omega$ ), one has to resort either to a parametric bootstrap, as suggested by Geweke, or numerical derivatives, as suggested by Feng Yao and Hosoya (2000) which may be computationally demanding. Recently, Jörg Breitung and Bertrand Candelon (2006) proposed a practical test procedure in which the null hypothesis can easily be tested with the usual F-test.<sup>11</sup> The feedback between two variables across frequency bands can also be calculated conditional on a set of variables either using Geweke's (1984a) framework or Hosoya's (2001) method.

In this section we present the results of conditional and unconditional Granger-causality tests over frequencies from 0 to  $\pi$ . Figure 1 and Figure 2 present the results of Breitung-Candelon (2006) version of Geweke's (1982) causality tests in frequency domain together with 5% and 10% critical values.<sup>12</sup> The first column of Figure 1 reports unconditional test results between *portS-portB* and growth (*gHP*) whereas the second column reports results conditional on  $r$  and  $f$  (*gHP* |  $r, f$ ). Breitung-Candelon test statistics shown in Figure 1 and Figure 2 are equivalent to the Geweke's measure of linear dependence (feedback). Since this test statistic says nothing about the sign of feedback between variables  $X$  (here, components of capital flows) and  $Y$  (growth, *gHP*, with/without conditioning on  $r$  and  $f$ ), we make use of a real part of the cross-spectrum, i.e., the cospectrum,  $CrS_{xy}(\omega)$ , and coherence squared,  $K_{xy}^2(\omega)$ , values of control (input) variable  $X$  and output variable  $Y$  to determine the sign of feedback<sup>13</sup>. Figure 3 shows cospectrums and squared coherency values between pairs of variables. The statistically significant  $K_{xy}^2(\omega)$  values at 5% level are marked by an asterisk (\*). A positive (negative) and significant cospectrum value,  $CrS_{xy}(\omega)$ , at

<sup>11</sup> Technical details of Breitung-Candelon test procedures in the lines of Geweke and Hosoya are not presented to save space.

<sup>12</sup> We also calculated frequency domain causality tests using the method suggested by Hosoya (2001) for controlling the effects of third variables. Since the results are very similar to the Geweke's version we do not report them here.

<sup>13</sup> See James D. Hamilton (1994, pp. 270-275) for basic definitions of spectral analysis.

frequency  $\omega$  indicates that  $X$  and  $Y$  have pro-cyclical (counter-cyclical) common movements at this frequency. It would not be wrong to infer the sign of feedback at any frequency  $\omega$  by looking at the sign of the cospectrum at the same frequency.  $CrS_{xy}(\omega)$  is statistically significant if  $K_{xy}^2(\omega)$  is significant for any frequency  $\omega$ .

As can be seen from Figure 1/a, there is no statistically significant (at 10% significance level) feedback from portfolio investments on shares,  $portS$ , to growth at any frequency. Eliminating the effects of the real exchange rates ( $r$ ) and interest rates ( $f$ ), shown in Figure 1/a', we obtain slightly different results: now  $portS$  significantly Granger-causes growth at high frequencies indicating short-run association between  $portS$  and  $gHP$ . On the contrary, there is a highly significant feedback from  $growth$  to  $portS$ , conditional on  $r$  and  $f$  over all frequencies (Figure 1a'). Note also that the degree of association is significantly higher. This implies that portfolio investors on equities make their decisions to enter/exit pursuing the growth performance of the Turkish economy. From Figure 3/a we see that all statistically significant (marked by \*) coherence squared  $K_{xy}^2(\omega)$  values are concentrated at the seasonal frequencies  $1 < \omega < n$  (periods shorter than 6 months) indicating very short-run comovements of growth and share investments.

Lower panels of Figure 1 present the results for the  $portB$ - $gHP$  pair both unconditionally (panel b) and conditional on  $r$  and  $f$  (panel b'). Unlike the  $portS$ - $gHP$  relationship, portfolio investments on government bonds ( $portB$ ) Granger-cause growth both with and without conditioning on  $r$  and  $f$  at frequencies  $0 < \omega < 0.7$  which include business cycle frequencies ( $0.10 < \omega < 0.35$ , or in terms of periods,  $P$ ,  $18 < P < 60$  months) and seasonal frequencies corresponding to periodicities between 9-18 months. On the other hand,  $growth$ , both conditionally and unconditionally precedes  $portB$  over seasonal frequencies  $\omega > 1.5$  corresponding to periodicities shorter than 4 months. Since the GC test in time domain provides average causality over all frequencies, we find, above (Table 3), a bi-directional causality significant at 9% level between  $portB$  and  $gHP$  |  $r, f$ . From the sign of the cospectrum for  $portB$  and  $gHP$  given in Figure 3/b, we see that growth and portfolio investments on bonds have significant comovements in business cycles and counter-movements in seasonal frequencies around  $\omega = 0.7$  and  $2.1$  (periods of 9 and 3 months, respectively).

Short-term external borrowings of banks and firms,  $STC$ , very significantly affects growth both unconditionally and conditional on  $r$  and  $f$  over all frequencies (see Figure 2/a and a'). The cospectrum for  $STC$  and  $gHP$  given in Figure 3/c is also significant over all frequencies and makes an apparent peak at business cycle frequencies marking strong comovements between these two variables. As compared to portfolio investments, external short-term borrowings of private business establishments seem to be relatively more closely related to the Turkish business cycles.

A different picture emerges from the relationship between long-term external borrowings,  $LTC$  and  $growth$ , as displayed in Figure 2 panels (b) and (b'). A highly significant bi-directional causality between  $growth$  and  $LTC$  is detected at  $\omega < 1$  corresponding to business cycle and seasonal frequencies with periods longer than 6 months (Figure 2/b). However, removing the effects of  $r$  and  $f$ , this bi-directional

feedback disappears and a highly significant feedback with direction from *growth* to *LTC* emerges at frequencies  $\omega < 1$  (Figure 2/b'). This finding suggests that long-term foreign investors follow Turkish business cycles closely and make their decision of inflow or outflow according to their animal spirits about changing business conditions in the economy. From Figure 3/d we see that the significant coherence squared,  $K_{xy}^2(\omega)$ , values of *growth* and *LTC* are overwhelmingly concentrated over business cycle frequencies and the positive cospectrum makes an apparent peak at these frequencies. This indicates that growth and long-term external borrowings have, as expected, strong common business cycles fluctuations.

As we mentioned earlier, following the 2001 financial crisis Turkey has put into effect widespread structural reforms in the financial and banking sectors which have helped to achieve a relatively stable macroeconomic environment. This brings up the question of whether the way capital flows interact with economic growth differs in the pre and post-2001 periods. To explore this issue we re-estimated four-variable VAR models and calculated test statistics for the two sub-samples, 1992.01-2001.12 and 2002.01-2009.08, using both Geweke and Hosoya frameworks. Figure 4 displays Geweke-Breitung-Candelon test statistics for the pairs *portS-gHP* and *portB-gHP* conditional on *r* and *f*. Similar to the full-sample results, *portS* does not Granger-cause *gHP* for both of the subsamples whereas *gHP* Granger-causes *portS* at 5% significance level in the first period for the frequencies greater than approximately 1.1. In the second period, the degree of feedback from *gHP* to *portS* is relatively weaker; *gHP* Granger-causes *portS* at both high and low frequencies at 10% significance level. As shown in Figure 4/b-b', the relationship between *portB* and *gHP* in the 1992-2001 period is similar to the full-sample case: there is significant feedback from *portB* to *gHP* at low frequencies ( $w < 1$ ) but no feedback from *gHP* to *portB* except for seasonal frequencies. In the 2002-2009 period, however, there is no feedback between *portB* and *gHP* over all frequencies. This result is slightly sensitive to the feedback formulation used: including the contemporaneous information on conditioning variables as suggested by Hosoya (results not reported), we found that there is no feedback from *portB* to *gHP* but *gHP* causes *portB* at high frequencies. Overall, there is no causality running from portfolio investments on both equities and bonds to economic growth in the post-2001 period.

Figure 5 presents the results for the short and long-term external borrowings (*STC* and *LTC*) over two sub-periods. The Geweke-Breitung-Candelon test results for the *STC-gHP* pair is markedly different for the two subsamples. In the pre-2002 period, we found that *STC* Granger-causes *gHP* at frequencies above 0.5 and there is no feedback from *gHP* to *STC* (Figure 5/a). On the contrary, for the 2002-2009 period *STC* does not Granger-cause *gHP*, and again there is no feedback from *gHP* to *STC* (Figure 5/a'). This result is also valid when we use Hosoya's framework<sup>14</sup>. The only difference is that the Hosoya test indicates strong feedback from *gHP* to *STC* over the frequencies greater than 1. Now concentrating on the relationship between *LTC* and *gHP* we see, from Figure 5/b, that there is no causality at any frequency from *LTC* to *growth* for the 1992-2001 period. On the contrary, *LTC* Granger-causes

<sup>14</sup> Test results are not reported to save space but available upon request.

*gHP* at frequencies below 0.8 at 10% significance level for the second period. Hosoya tests (not reported), on the other hand, indicate that *LTC* causes *gHP* over all frequencies at 5% significance level and the degree of feedback is markedly higher in the second period. In addition, for both periods there is significant feedback from *gHP* to *LTC* over low frequencies using both Geweke and Hosoya frameworks.

## 4. Conclusion

This paper examines the interactions and feedbacks between growth and four subcategories of private capital flows excluding FDI, namely, portfolio investments on shares and government bonds, and short and long term “other” investments (external borrowings of banking and non-banking sectors), in Turkey for the period 1992:01-2009:08 based on monthly BOP data. In this paper, in addition to a new version of the causality test of Geweke (1982) and Hosoya (1991) in the frequency domain developed by Breitung and Candelon (2006) we employ other spectral tools such as the cospectrum and coherence squared. Frequency domain techniques, by decomposing feedbacks over all frequencies,  $0 < \omega < \pi$ , provide us with a more detailed picture of the interaction between capital flows and economic growth as compared to time domain methods which give average interactions over all frequencies.

Some of our empirical findings are as follows: First, the breakdown of total variance over main frequency bands shows that variances of individual flows categories are, mainly, concentrated over the high seasonal frequencies, especially, over periodicities of 9 to 2 months. In other words, the capital flows to Turkey, even the subcategory “long term investments”, are predominantly short-term in nature. The inherent volatility in capital flows stressed by the sudden stop literature seems to be valid for the Turkish case, too.

Second, our findings from Breitung-Candelon (2006) causality tests reveal that the nature of interaction between growth and capital flows varies significantly over subcategories of flows. In other words, the type of foreign capital matters. Out of four components, only short-term bank and firm borrowings precede growth over all frequencies. Portfolio investments on shares and long-term bank borrowings contrarily, are Granger-caused by growth conditional on real exchange rate and treasury real forward borrowing rate at business cycle and seasonal frequencies. The feedback between portfolio investments on bonds and growth is mixed in nature, while it precedes growth at business cycle frequencies, *growth* Granger-causes bond investments at seasonal frequencies.

Third, the extent and nature of causality between types of capital inflows and economic growth are markedly different for the pre and post-structural reform periods (1992-2001 and 2002-2009 periods, respectively). Portfolio investments on Turkish equities do not Granger-cause growth in both periods whereas portfolio investments on bonds Granger-causes growth in the long run for the first period but no causality exists in the second period. We found statistically significant causality running from long-term borrowings from abroad to economic growth using Hosoya’s method in the relatively more stable macroeconomic environment.

The present paper makes clear that the idea that all kinds of capital inflows bring about growth in the long run does not seem to be valid for the Turkish case. During the last two decades, permanent policies of the Turkish government aimed at holding interest rate differentials (spreads) as high as possible and keeping TL as appreciated as possible have been the main reason for the attractiveness of Turkey for foreign capital. Governments should be aware of this heterogenous nature of feedbacks between growth and different components of arbitrage-seeking capital flows while making their economic policies. Otherwise, attracting foreign capital only through wide interest spreads will be very costly and unsustainable.

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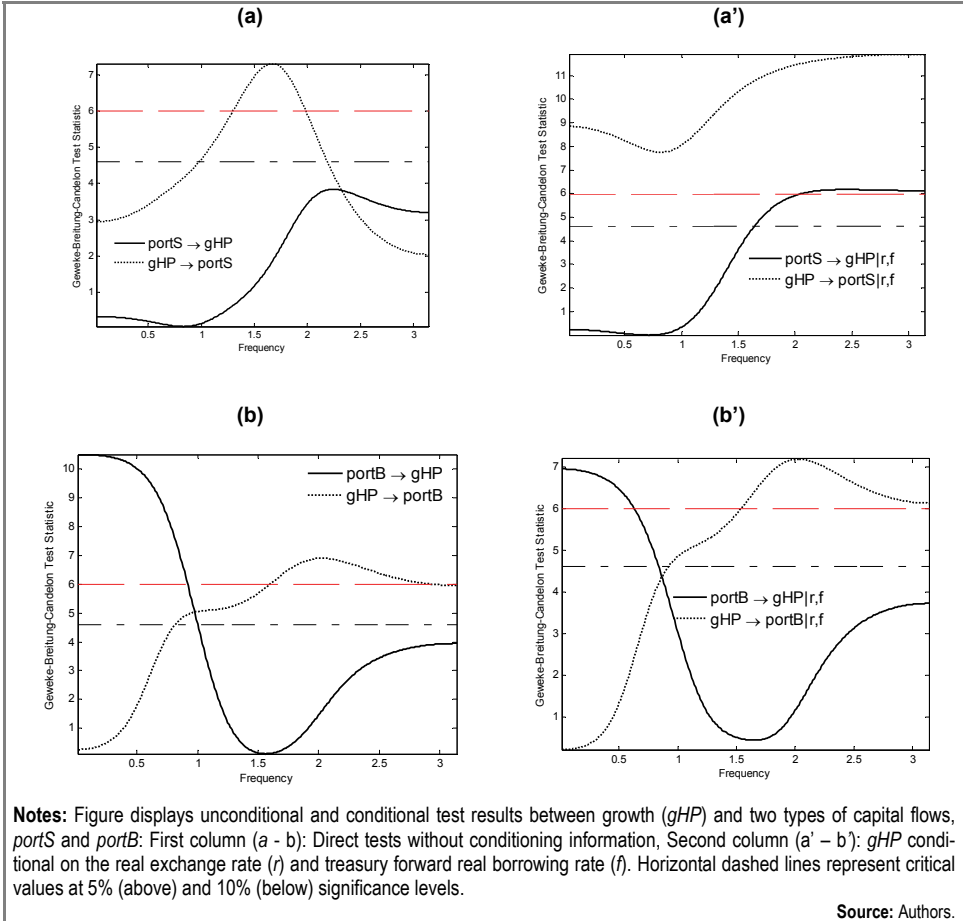
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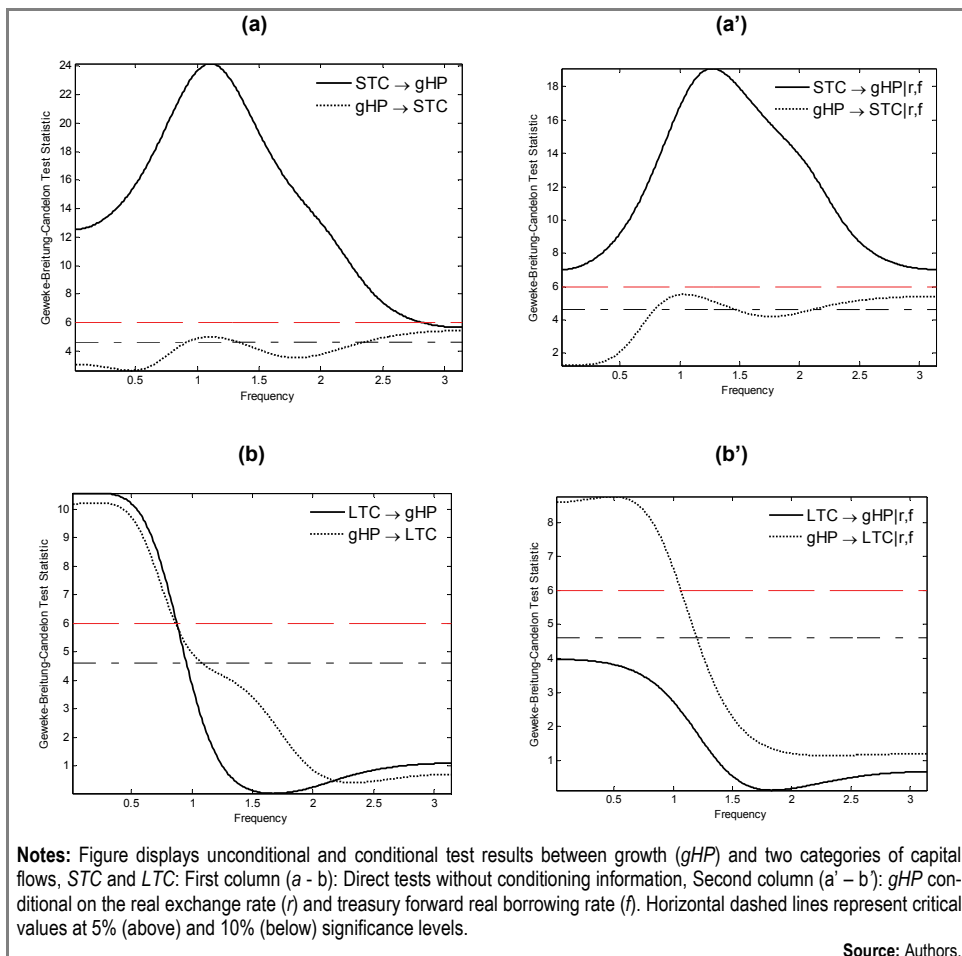
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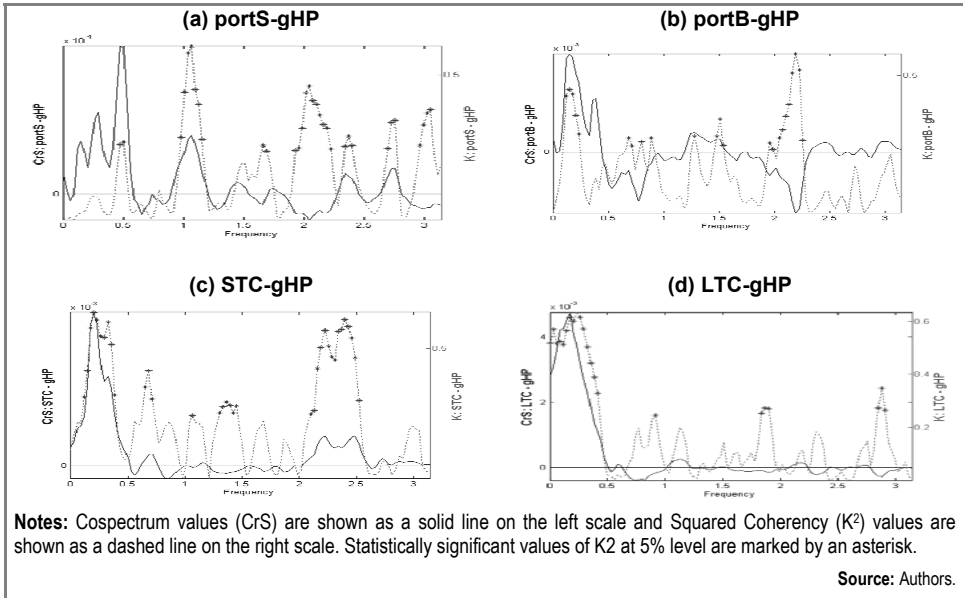
## Appendix



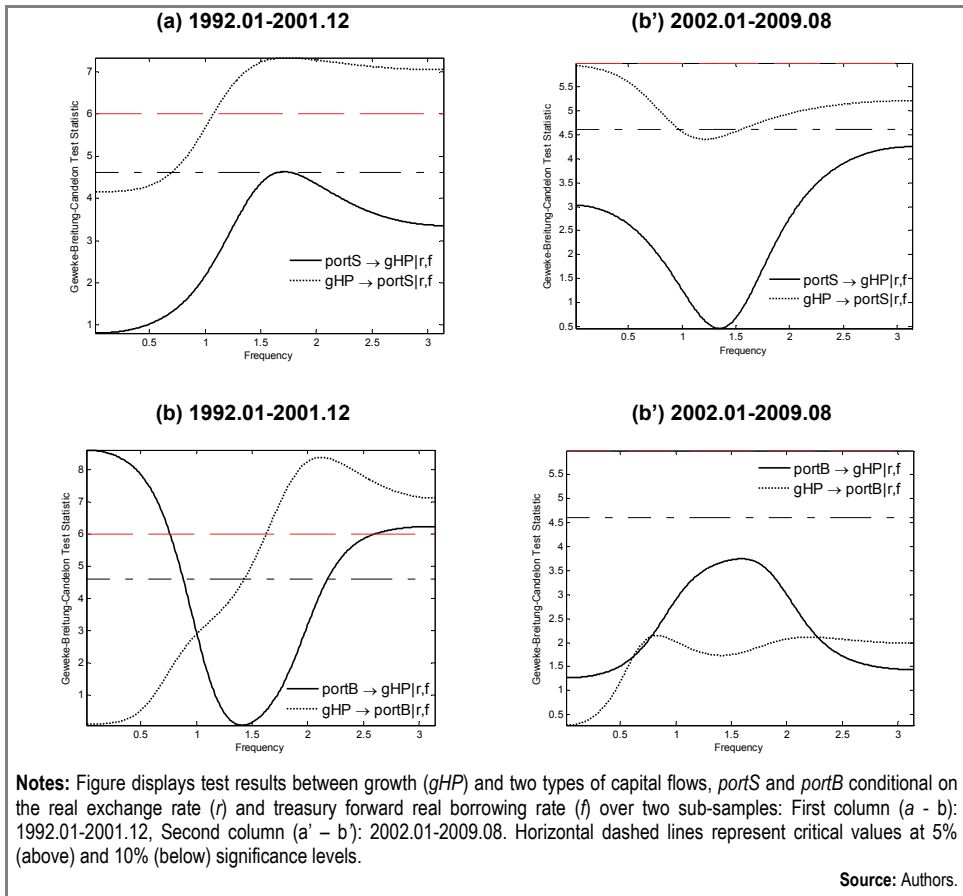
**Figure 1** Geweke-Breitung-Candelon Causality Test Results



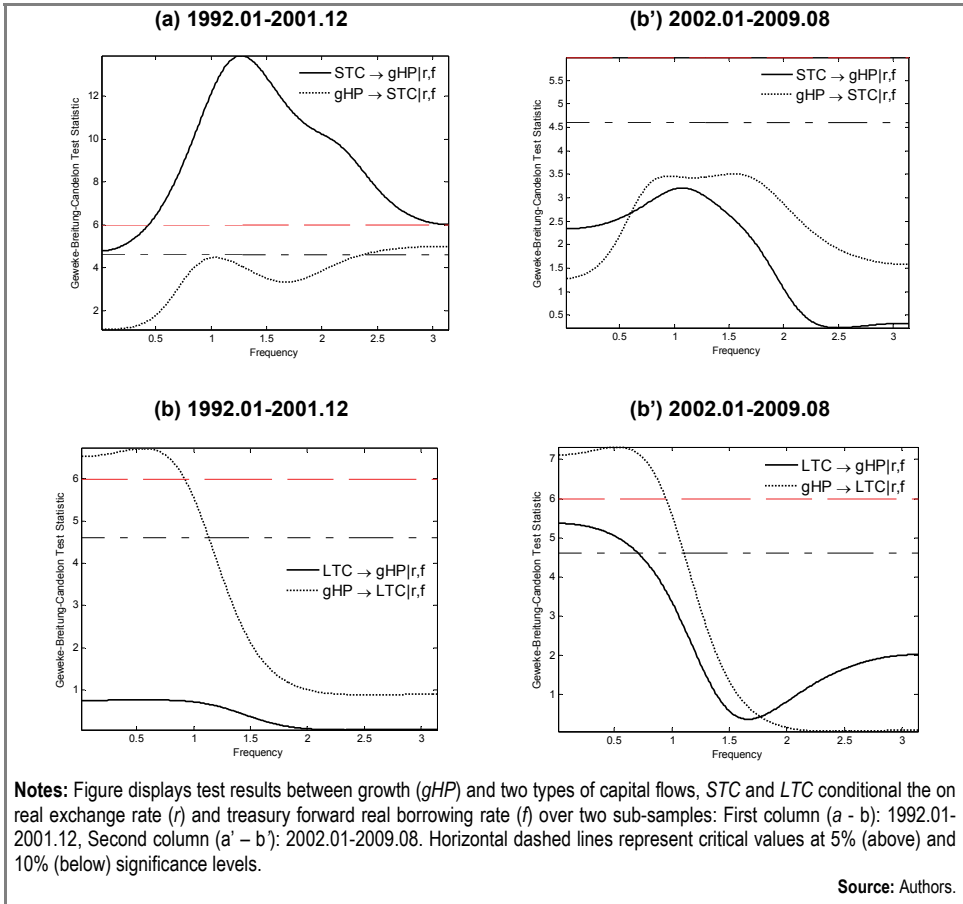
**Figure 2** Geweke-Breitung-Candelon Causality Test Results



**Figure 3** Cospectrum and Squared Coherency Between Growth and Categories of Capital Flows



**Figure 4** Geweke-Breitung-Candelon Causality Test Results over Subsamples



**Figure 5** Geweke-Breitung-Candelon Causality Test Results over Subsamples