THIRLWALL'S BALANCE OF PAYMENTS CONSTRAINED GROWTH (BPCG) MODEL WITH CAPITAL FLOWS AND DISAGGREGATED IMPORTS SECTORS FOR THE TURKISH ECONOMY FOR 1998-2019 PERIOD

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PLAGIARISM

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ABSTRACT

In this thesis, we considered an extended version of the BPCG model incorporating the capital inflows, the disaggregated imports and allowing also for some possible structural changes. We estimated the demand for imports separately at a disaggregated level: intermediate, consumption and capital goods for the 1998-2019 period for Turkey. Both the extended BPCG model and the basic Thirlwall Law provided quite close yearly average predictions, 4.33% and 4.29% (using the bounds testing and the first differences methods), and 6.04% and 5.57% (using Johansen cointegration test), respectively, compared to the actual average growth rate of income of Turkey, 4.37% for the 1998-2019 period. However, we pointed out that the short-run variations may be more important from a policy perspective. Even though the real exports increased by an average of 6.01%, its relatively small contribution to the rate of growth of income may have been since we took into account the rise in intermediate imports due to an increase in manufactured exports. Our finding that the relative price changes are not important for the growth rate of income in the long run was also consistent with the basic Thirlwall hypothesis. There seems to be two stylized facts. The first one is that in the Turkish economy there seems to be abrupt decreases in capital flows before/during the recessions. The second stylized fact seems to be that the periods when the GDP grew rapidly have been associated with heavy increases in capital inflows, generally after the recessions. Finally, we compared the income elasticity for imports from our study and those found in the literature for Turkey. We found this elasticity to be 1.40 and 1.08 whereas those from the other works were in the range of 1.82-2.60.

Key words Thirlwall's balance of payments equilibrium growth rate model; intermediate, consumption and capital goods imports; capital flows; components of growth of output; short-run variations.

ÖZET

Bu tezde BPCG modelinin sermaye girişlerini, ayrıştırılmış ithalatı içeren ve olası yapısal değişikliklere izin veren genişletilmiş bir versiyonunu ele aldık. Türkiye'nin 1998-2019 dönemi ithalat talebini ara malı, tüketim ve sermaye malları şeklinde ayrıştırılmış bir seviyede tek tek tahmin ettik. 1998-2019 dönemi için Türkiye'nin reel GSYH'sinin ortalama büyüme oranı olan %4.37 ile kıyaslandığında hem genişletilmiş BPCG modeli hem de temel Thirlwall kanunu, %4.33 ve %4.29 (sınır testi ve ilk farklar yöntemini kullanarak) ve %6.04 ve %5.57 (Johansen eş bütünleşme testi kullanarak) olmak üzere birbirine daha yakın tahminler sağlamıştır. Bununla birlikte kısa vadeli değişikliklerin politika açısından daha önemli olabileceğine dikkat çektik. Reel ihracat ortalamada %6.01 artmış olsa bile gelir artış hızına görece küçük katkısının sebebi imalat sanayi ihracatına bağlı olarak ara malı ithalatındaki artışı dikkate almamızdan kaynaklandığını düşünüyoruz. Göreli fiyat değişikliklerinin uzun vadede gelirin büyüme oranı için önemli olmadığına dair bulgumuz da temel Thirlwall hipotezi ile tutarlıdır. Görünüşe göre, şekillenen iki gerçek var. Birincisi, Türkiye ekonomisinde durgunluk öncesinde veya durgunluk sırasında sermaye akımlarında ani düşüşler görülmektedir. Şekillenen ikinci gerçek ise, GSYH'nin hızlı büyüdüğü dönemlerin genellikle durgunluklardan sonra gerçekleşen sermaye girişlerindeki yoğun artışlarla ilişkili olduğu görülmektedir. Son olarak, bizim çalışmamızdan elde ettiğimiz ithalat talebinin gelir esnekliği ile Türkiye için yapılan çalışmalardan elde edilenleri karşılaştırdık. Diğer çalışmalardan elde edilen esneklikler 1.82 ile 2.60 aralığında iken biz 1.40 ve 1.08 esnekliklerini bulduk.

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1. INTRODUCTION

In this thesis we will adopt a Keynesian approach to the growth rates of national income of countries stressing the demand side of the economy as opposed to the Neo-classical approach which focusses on its supply side. The latter uses the notion of the aggregate production function, and the growth of income is allocated among the growth of labor, the growth of capital and the growth of factor productivity which is gained as a residual. The former, on the other hand, places emphasis on the aggregate demand which influences the economic system to which supply adjusts within limits. Harrod and Thirlwall, adopting a demand-side approach, contended that the balance of payments was a major constraint to domestic spending on goods, domestically produced or imported goods in the context of an open macro economy (Harrod, 1933; Thirlwall, 1979). Virtuous circles based on rapid export growth with cumulative causation may not be possible to be kept in the long run because the resulting fast growth of income could make a country's imports rise too rapidly to be in line with an equilibrium in the trade balance (TB). This deficit in TB could not be financed indefinitely in the long run, since the countries where the TB deficit approaches some critical limit will tend to experience ever-increasing difficulty in attracting capital flows from abroad. Hence, this lack of availability of foreign currency would eventually force adjustments in domestic expenditures that limit the rate of growth of income (output) that is compatible with an equilibrium in TB. In such cases, the policy makers would sooner or later have to implement some fiscal and monetary strategies to decrease the aggregate demand. Harrod (1933) and Thirlwall (1979) were able to independently formulate a simple rule stating that the long-run growth rate of income could be approximated by the ratio of the growth of exports to the income elasticity of imports of the country, assuming away foreign capital inflows and changes in the terms of trade

(Harrod, 1933; Thirlwall, 1979). This model has become to be recognized as the balance-of-payments-constrained growth model (BPCG). A large empirical literature has applied the BPCG model to a variety of developed and developing countries, and these workings generally showed that this simple rule approximated quite closely the real growth rates of the countries over the post-war period.

The Thirlwall's basic model of BPCG assumes that there are two goods: a domestically produced good that can be either purchased at home or exported and a foreign produced imported good. Both the demanders and suppliers observe their schedules in their own currencies. It also assumes that the supplies of imports and exports are infinitely price elastic so that the quantities traded are solely determined by their demands.

Later, many extensions to the basic BPCG model were explored. In this thesis, we will consider those with respect to the capital inflows and to the disaggregated imports allowing also for some possible structural changes. We will also consider time varying weights for the disaggregated imports sectors and for the composition of exports and capital flows in financing the imports bill. Another contribution of the thesis is that we will define the trade balance (TB) in terms of foreign currency ($), as opposed to trade balance (TB) defined in terms of domestic currency as considered in the original BPCG model by Thirlwall and in many others. Our formulation of the TB seems to be more appropriate for countries financing their TB deficits with continual foreign capital inflows, at least in the medium run. We will abstain from the services imports and exports, incomes earned/paid on investments at home/abroad and unilateral transfers so that the current account reduces to the trade balance of goods only (merchandise trade balance).

In Section 2, we will briefly mention the history of supply side economies, and we will investigate the Thirlwall's approach to demand side economies in more detail perspective, involving its policy implications and critiques. Then, we will review the related researches which are the extended BPCG models with capital account and with multi-sectors.

In Section 3, we will descriptively investigate the Turkish economy for the 22-year period (1998-2019), considering 2001 and 2008 recessions which correspond to changes in Turkey's economic conditions. Therefore, we will divide the 22-year data set into three periods: Collapse of the exchange rate-based stabilization program (1998-2001) and 2001 crisis; Recovery from the 2001 crisis, 2008 global crisis (2002-2008) and Recovery from the 2008 global crisis (2009-2019). We will show the percentage changes in real GDP, in trade aggregates (manufactured exports and three types of imports), the shares of these trade aggregates in total exports or imports, the terms of trade and the balance of payments (percentage of GDP) over time using descriptive statistics and graphs. Later, we will mention whether Turkey's manufactured exports consist of high-tech or low-tech products and we will mention the shares of sectors in the value of imports of intermediate goods, using graphs.

In Section 4, we will show our extended BPCG model. Our derivation of the rate of growth of income consistent with a disequilibrium merchandise trade balance (TB) financed by capital flows and total imports apportioned among intermediate, consumption and capital goods imports (Eq. (61)), will correspond to neither the weak nor the strong version of BPCG. We will not assume that the relative prices (purchasing power parity) are constant. However, we will keep the rate of growth of exports since we have not collected data on the world income. The formulation in Eq. (61) below can

then be termed as a weak version of BPCG without assuming that the relative prices (the ratio of exports prices to imports prices) are constant.

In Section 5, we will define the estimation methods applied in this thesis (Bounds Testing and First Differences estimation methods) and show the estimation results of the regression equations (imports of intermediate, consumption, capital and final (sum of the consumption and capital goods)goods) where we paid attention to possible structural breaks. In this section, we will also compare the calculated rates of growth of income for the Turkish economy from our extended BPCG model, y_B, as given by Eq. (62) below, and that obtained from the basic Thirlwall Law, against the rate of growth of actual income of Turkey. We will also investigate the association between the rates of growth of the Turkish GDP and the nominal capital flows.

In Section 6, we will implement the Johansen cointegration test technique (as a multivariate method based on a Vector Autoregressive (VAR) model) to Turkish data in order to capture possible presence of more than one cointegration relationships between the disaggregated imports (intermediate, consumption and capital goods imports) and the domestic income, the terms of trade and the manufactured exports which are very important variables for testing our extended BPCG model. Then, to clarify if there is a long run relationship or not between our variables, we will implement Engle-Granger cointegration test technique. Later, we will calculate the rates of growth of income for the Turkish economy from our extended BPCG and the growth rate of income for the basic Thirlwall Law.

Turkey has been a developing country which has always attracted foreign capital inflows. Moreover, it seems to be important to consider the imports industries (intermediate goods, consumption, and capital imports) in a disaggregated fashion.

Therefore, in this thesis, we will concentrate on simultaneously incorporating these two extensions to the basic BPCG model and apply it to the Turkish economy.

2. LITERATURE REVIEW

2.1. A Brief History of Supply Side Economics

2.1.1. Mercantilism and Physiocracy

The important ideas concerning international trade in economic thought have sprang up literally with mercantilism from the 16th century onwards. Mercantilism reached the top of its popularity in 16th and 17th century economic thought and national economic policy. Mercantilists (Misselden, 1623; Mun, 1664) argued that a country must focus on exports at a higher rate than imports from abroad. When the balance of payments is in excess, and money is fruitful through the inflows of precious metals, the wealth of the country will inevitably increase. To achieve the accumulating of precious metals such as gold and silver (foreign exchange) in a country's treasury, governments promoted exports of manufactured goods and imports of only raw materials via price controls, tariffs, and other trade barriers. These policies were supposed to encourage the inflow of precious metals while preventing the outflow, insuring a favorable balance of trade (Dorobat, 2015). Increasing the welfare of one's own nation with precious metals and intervening in the economy by government policies to encourage gold to enter the country and to prevent gold from going out became to lead to decline in the welfare of other nations.

Mercantilism began to lose its relevance and was criticized by physiocrats who argued that the wealth of nations depends on development of the agricultural sector (e.g., Quesnay,1758; Turgot, 1766[1]). In his famous Economic Table of 1758, Quesnay

[1] Turgot's writings are combined in David Gordon's Turgot collection and can be found in references.

showed that the regulation of trade and industry constrained the economy by hindering the flow of income and commodities on which the economy depended, and all the Physiocrats advocated that wealth came ultimately from the land. Only land was important that contained the life-giving forces of nature. Manufacturing could only change the form of wealth derived from nature, and trade could only change its location and ownership, thus land alone could produce a surplus (Fusfeld, 2002). Contrary to Mercantilist belief that the wealth of nations depends only on generating balance of trade surpluses and accumulating precious metals, in the treatise entitled, 'Of Money' (Hume, 1752), the price-specie flow mechanism showed how trade imbalances can self-correct and adjust under the gold standard. An increase in precious metals would increase the price level in a country, discouraging exports and encouraging imports, thus automatically limiting the amount by which exports would exceed imports. That is, with the decrease in exports and the increase in imports, the trade surpluses will be lost, and the result expected by the mercantilists will not be realized (Iyibozkurt, Tonus, Erlat, Karluk & Erturk, 2013).

2.1.2. The Mainstream (Classical and Neoclassical) Approaches

The first theories of international trade originated from a liberal reaction to the Mercantilist domination from the 16th to the 18th century, that ended Mercantilist policies, government interventionism, barriers to trade and promoted free trade and free markets. Furthermore, the mainstream (classical and neoclassical) approaches explain the growth rate differences between countries in terms of resource availability and supply of factor inputs, and heavy emphasis is positioned on capital accumulation and technical advancement. The mainstream (classical and neoclassical) economists ignore the connection between trade, the balance of payments and growth. According to them,

the balance of payments is self-equilibrating through interior or exterior relative price movements.

The classical thought's well-known members were A. Smith, D. Ricardo, and J.B. Say. Smith's best-known treatise, 'The Wealth of Nations' (first published in 1776), became the masterpiece of the liberal economy, and thus the period of classical economic thought began. Smith strongly advocated a policy of Laissez-faire, Laissez passer and free trade between countries without government regulations that limit the efficient use of available resources in the economy. He emphasized the importance of the division of labor in increasing output and considered international trade as a particular case of specialization (international specialization among nations) (Smith, 1977). In a world of scarce resources and limitless wants, each country is bound to specialize in the production of goods that can be produced at a lower absolute cost (i.e. fewer hours of labor), thus these goods will be exchanged for the goods for which other countries have an *absolute advantage* in production. This idea was extended and described as a principle of *comparative advantages* in production (Ricardo, 1817). Countries should specialize in the production of the goods which can be produced at lower relative cost (relatively less hour of labor), and thus has a comparative advantage in the production of those goods. As a result, cooperation among nations was considered a positive-sum game, and international exchange mutually beneficial for all countries (Dorobat, 2015). In 1803, Jean Baptiste Say's 'A Treatise on Political Economy' was first published, and the widespread classical belief in 'Say's Law', that "supply creates its own demand" (Say, 1971). The source of demand is production, and the act of production simultaneously creates income and purchasing power. The act of supplying of one good implies the demand for some other good. Since the act of production simultaneously creates income and purchasing power, there could be no

impediment to full employment caused by a deficiency of aggregate demand. The law accepts that the possibility of the misallocation of resources can occur, and certain goods can be produced more than their demands, but this problem would be temporary, and no such excess supply could occur for all goods. Classical economists advocated that a capitalist market economy could deviate from its equilibrium level of output and employment and such disturbances would be temporary and short lived. The market mechanism would operate relatively quickly and efficiently to restore full employment equilibrium. Competition in the labor market ensures full employment, and at the equilibrium real wage no person who wishes to work at that real wage is without employment. The government intervention, in the form of activist stabilization policies, would be neither necessary nor desirable because such policies may be more than likely to create greater instability. The classical economy examined the behavior of the real variables in the economic system while ignoring the nominal variables that the quantity theory of money focused on (Hume, 1752). With the monetary expansion, price level, nominal wages and the nominal interest rate will increase but all the real values in the system remain unaffected. That is, money was neutral in the long run, and the quantity of money was irrelevant for the determination of the real variables (Snowden & Vane, 2005, pp.37-54).

From the second part of the 19th century to the first part of the 20th century, neoclassical thought emerged to overcome the shortcomings of the classical system. Neoclassical theories have formulized or elaborated the principle of comparative advantage. In 1895, Pareto created the first mathematical model of Ricardo's comparative costs principle, for two countries and two goods, and relative costs were expressed in terms of marginal utility (Pareto, 2008). In like manner, the principle of comparative advantage was formulated in terms of opportunity costs rather than hours

of labor (Haberler, 1935). Later in the century, Bertil Ohlin, inspired by his professor Heckscher, developed the theory of factor endowments in his treatise (Ohlin, 1933), and explained the international trade in terms of two factors of production, labor and capital. Ohlin suggested that countries relatively more endowed in capital produce and export capital-intensive goods, so that specializing in those sectors which use the factor of production the country is relatively more endowed with (Dorobat, 2015).

The neoclassical model became the dominant approach to the analysis of growth through the contributions of Solow (1956). Solow pointed out the growth of saving, population growth and technical progress in a closed economy setting without a government expenditure. The economy consists of one sector producing one type of commodity that can be used for either investment or consumption purposes, and the model is concerned with the long run. In the model, the rate of technical progress, the population growth and the depreciation rate of the capital stock are all determined exogenously, and Solow model explains the growth rates differences between countries in terms of the rates of capital accumulation (See Snowden & Vane, 2005, p.621).

Arrow showed how the productivity of labor increases with experience through the process of 'learning by doing', and how experience is a function of cumulative investment expenditures that change the work environment (Arrow, 1962). In short, a firm's accumulation of capital produces external effects on learning. During the mid-1980s, alternative models of growth were constructed where the long run growth of income per capita depended on investment decisions instead of unexplained technological progress (Romer, 1986; Lucas, 1988). Lucas emphasized the role of human capital formation, and Romer emphasized the role of investigate and investment. Romer extended the concept of capital to include investment in knowledge

(technology) gained by workers as well as the accumulation of the physical capital (Snowden & Vane, 2005, pp. 625-626).

2.2. Keynesian and Neoclassical Discussion

The neoclassical reasoning about the differences in the growth rates of the countries concentrates on the supply side of the economy using the notion of the production function. By this approach, growth rates differences arise from differences in factor supply and productivity. Although the approach is mathematically precise, it does not present an explanation about the variances in the growth of input supplies and the productivity among countries. To answer this question, a more Keynesian approach may be required stressing demand.

Countries' money supply was linked to the supply of gold before the First World War. The balance of payments equilibrating mechanism operated through the 'price-specie flow mechanism'. Deficit countries would experience a deflation of prices as the quantity of money declined while surplus countries would experience inflation. This process would increase the exports of the deficit country, thus restoring equilibrium to the international payments imbalances. The whole mechanism depended on the classical quantity theory of money and the assumption that markets would clear enough to restore full employment following a deflationary impulse. With the First World War, huge imbalances in the pattern of international settlements led to undermine the international economic system throughout the 1920s. The war transformed the United States from a net foreign debtor to a creditor nation (Eichengreen, 1992). "In 1928, in response to fears that the U.S. economy was overheating, the FED tightened monetary policy and the U.S.A. reduced its flow of lending to Europe and Latin America. As central banks began to experience a loss of reserves due to payments deficits, they

responded in line with the requirements of the Gold Standard and also tightened their monetary policies. And so deflationary process was already well under way at the international level by the summer of 1929 and well before the stock market crashed so dramatically in October" (Snowden & Vane, 2005, pp. 80-81).

The Great Depression in 1930s stimulated a great deal of thinking about macroeconomic issues, especially unemployment. Throughout the Great Depression, the unemployment level remained high for about ten years. The failure of the simple classical models to explain the persistence occurrence of high unemployment enabled the birth of macroeconomy in the 1930s. The General Theory was published in 1936 (Keynes, 1936). Keynesian theory would explain the unclear economic events of his period.

Full employment is guaranteed in the classical model providing that competition prevails in the labor market, and prices and wages are perfectly flexible. According to Keynes (1936), the labor market did not work in a way that would always ensure market clearing. Involuntary unemployment tends to be a feature of the labor market only if money wages are rigid. Keynes rejected Say's Rule that "supply creates its own demand" and suggested that demand creates its own supply when the economy is at underemployment equilibrium. In Keynes's theory, output and employment are determined by effective demand, and the labor market cannot guarantee full employment. The principle of effective demand is that, in a closed economy with spare capacity, the level of output (and hence employment) is determined by aggregate planned expenditures (E) which consist of consumption expenditures from the household sector (C) and investment expenditures from firms (I); E=C+I. From the view of mainstream (classical and neoclassical) approaches, consumption, saving, and investment are all functions of the interest rate, but in Keynes's theory, consumption

expenditures are endogenous and essentially passive, depending on income rather than the interest rate. The interest rate is determined in the money market rather than by saving and investment decisions. Variations in the marginal efficiency of investment bring about variations in real output through the multiplier effect (output changes by a multiple of the change in investment expenditures), thus saving adjusts to investment through changes in income (investment will then increase the national income by a multiplied amount) (Snowden & Vane, 2005, pp. 58-59, 65-69).

Fusfeld (2002) explained some fundamental relationships about Keynes's theory: Consumer spending is essentially passive, and it changes as income changes; In a private sector, employment depends on the total amount spent for consumption and investment; Private investment may fluctuate widely in response to changes in the rate of interest, and the expected rate of return on new investment; Rate of interest depends on the quantity of money, controlled by the monetary authorities, and the desire of people and business firms to hold cash; In addition, contrary to mainstream (classical and neoclassical) approaches, in order to maintain economic stability and promote economic growth, government should intervene in the economy by using monetary management and an active fiscal policies to raise or lower total spending through changes in government expenditure or tax receipts (Fusfeld, 2002).

2.3. Harrod's Foreign Trade Multiplier and Kaldor's Contribution

According to McCombie and Thirlwall (2004), "Harrod first introduced explicitly the idea of the foreign trade multiplier as the mechanism by which a country's balance of payments is brought back into equilibrium in his book International Economics" (Harrod, 1933). As stated by them, "a country's balance of payments would adjust through relative price movements induced by gold flows" and "economies somehow

maintained a continuous state of full employment and the aggregate price level was determined by the quantity of money. Harrod drew attention to the fact that classical theory assumed full employment, but the flow of gold clearly cannot automatically secure both a balance of trade and a full level of employment" (McCombie & Thirlwall, 2004).

The original Harrod trade multiplier assumes that the terms of trade are constant and there is no saving and investment, and no government activity. Output or income is produced by consumption goods (C) and exports (X) and spent either on home consumption goods (C) or imports (M), thus trade is always in balance, and income adjusts to preserve equilibrium:

$$Y = C + X \tag{1}$$

$$Y = C + M \tag{2}$$

$$X = M \tag{3}$$

and import function is:

$$M = \overline{M} + mpY, \tag{4}$$

where $\overline{M}$ is the level of autonomous imports and mp is the marginal propensity to import, and

$$X = \overline{M} + mpY,$$

$$Y = (X-\overline{M}) / mp \tag{5}$$

and

$$(\Delta Y/\Delta X) = (\Delta Y/ -\Delta \bar{M}) = \frac{1}{mp} \quad (6)$$

The principle of the multiplier mechanism is that "with no change in relative prices, an autonomous change in exports or imports will change the level of income so as to bring exports and imports into line with each other again. This is the principal of the multiplier mechanism. In this simple case, the foreign trade multiplier is the reciprocal of the marginal propensity to import (1/mp), analogous to Keynes's closed economy multiplier of 1/s which equilibrates saving and investment, where *s* is the marginal propensity to save. Harrod recognizes that his analysis relates only to a static equilibrium, whether of the short or the long period" (McCombie & Thirlwall, 2004). When it is made dynamic, Eq. (6) turn out to be the simple growth law, that growth approximates to $y = x/\pi$ (growth approximates the rate of export volume divided by the income elasticity of demand for imports) in the long run (Thirlwall & Hussain, 1982):

$$\frac{\Delta Y}{Y} = \frac{\Delta X}{X} / \pi \quad (7)$$

where $\Delta Y/Y$ is the proportion of growth of income, and $\Delta X/X$ is the proportion of growth of export volume. Multiplying the left-hand side of Eq. (6) by X/Y and the right-hand side by M/Y gives us:

$$\frac{\Delta Y}{\Delta X}\frac{X}{Y} = \frac{\Delta Y}{\Delta M}\frac{M}{Y} \quad (8)$$

or

$$\frac{\Delta Y}{Y} = \frac{\Delta X/X}{(\frac{\Delta M}{M})/(\frac{\Delta Y}{y})} = \frac{\Delta X}{X}/\pi \quad (9)$$

which shows the equality of the static Harrod rule in Eq. (6) to its dynamic version in Eq. (7). Only two factors may cause a country's growth rate to diverge from the rate given in Eq.(9): firstly, changes in the real terms of trade and secondly capital flows permitting to be a difference between domestic expenditures and income and a current account disequilibrium. If Eq. (9) predicts well, these two factors may either become relatively unimportant, or work in reverse directions, and by the identical amount to counterbalance each other.

In his treatise, Kaldor (1970) drew attention to the regional problem that different regions are growing at unequal rates; some regions develop relatively fast, and others tend to be left behind. To explain why certain regions have become highly industrialized, why others have not, Kaldor put forward an export-led growth model comprising four equations: "output growth as a function of export growth; export growth as a function of changes in relative prices and world income growth; relative price changes as a function of wage growth and productivity growth; productivity growth as a function of output growth (Verdoorn's Law). The model is 'circular and cumulative' model (Mydral, 1957), and the principle because the faster export growth, the faster is the output growth, but the faster the output growth, the faster export growth because output growth improves competitiveness through Verdoorn's law" (McCombie & Thirlwall, 2004). Kaldor's export-led growth model was formulized (Dixon & Thirlwall, 1975) as follows: the rate of growth of output is fundamentally determined by demand and, by exports; the rate of growth of export is determined by growth in relative prices, and growth in real output of the world; the rate of growth of domestic prices, inflation, is determined by the rate of growth of wages and real output. Kaldorian model (1970) contained no balance of payments requirement, and since the balance of payment equilibrium is a long-run requirement, growth was modelled within

such a framework by Thirlwall (1979): Under Harrod's assumption that real terms of trade remain constant, $y = x/\pi$, and here, y is the growth of output, x is the growth of export volume, and π is the income elasticity of demand for imports. This is the dynamic analogue of the static Harrod trade multiplier (which has been revived by Kaldor, 1975), Y = X/mp, where Y is the level of income, X is the level of export, and mp is the marginal tendency to import.

2.4. Thirlwall's Approach to Demand-Side Growth Theory

Thirlwall's balance of payments constrained growth (BPCG) model emerged as an alternative to the supply side models of neo-classical growth theory which are close economy models with no demand constraints. However, in the context of open economies, Keynesian demand-oriented highlighting the exterior constraints to growth is the supposed model of balance of payments constrained growth, known also as 'Thirlwall's Law'. The definition, policy implications, and criticism of the Thirlwall's law are in the following sections.

2.4.1. Thirlwall's Balance of Payments Constrained Growth Model

In his treatise, Thirlwall (1979) drew attention that the neoclassical approach to the question of why growth rates differ between countries focusses on the supply side of the economy using the idea of the production function and as said by Thirlwall, "the growth of output is apportioned between the growth of capital; the growth of labor, and the growth of total factor productivity obtained as a residual. By this approach, growth rate differences are 'explained' in terms of differences in the growth of factor supplies and productivity". Nevertheless, the question of why the growth of factor supplies and productivity differs between countries cannot be answered in neoclassical approach.

According to Thirlwall (1979), the answer of this question is constraints on demand and in an open economy, the major restriction on demand is the balance of payments.

In his original chapter, Thirlwall (1979) said that “it is shown how closely the growth experience of several developed countries approximates to the rate of growth of exports divided by the income elasticity of demand for imports which, on certain assumptions, can be regarded as a measure of what I call the balance of payments equilibrium growth rate. In fact, the rate of growth of export divided by the income elasticity of demand for imports gives such a good approximation to the actual growth experience of major developed countries since 1950”. This is the new economic law expressed by Thirlwall.

The significance of a healthy balance of payments for growth is explained succinctly that if a country gets into balance of payments difficulties as it expands demand before the short run capacity growth rate is reached, then demand must be reduced; supply is never fully employed; investment is discouraged; technological improvement starts to slow down, and a country’s goods compared with foreign goods become less wanted so worsening the balance of payments. By contrast, if a country expands demand up to level of existing productive capacity, the pressure of demand upon capacity can increase the capacity growth rates without balance of payments difficulties. In this way, encouraging investments augments the capital stock bringing technological progress; the supply of labor increases by the entry into the workforce of people who are the outside from the workforce or from abroad; production factors may move from low productivity to high productivity sectors, and the ability to import increases capacity by making domestic resources more efficient. In export-led growth argument, only the expansion of exports raises the growth rate without balance of payments deteriorating at the same time and explains why growth rates differ between

countries. However, import requirements related to growth may differ between countries due to fact that the same rate of exports growth in different countries may not certainly permit the same rate of growth of output. Thus, some countries may have to limit demand quickly than others for balance of payments equilibrium. In his original chapter, Thirlwall (1979) tested the hypothesis that, if balance of payments equilibrium must be continued, a country's long run growth rate will be specified by the ratio of its rate of growth of exports to its income elasticity of demand for imports.

Balance of payments equilibrium on current account measured in units of domestic currency is stated as follows:

$$P_{dt}X_t = P_{ft}M_tE_t \qquad (10)$$

where X is the quantity of exports, P_d is the price of exports in home currency, M is the quantity of imports, P_f is the price of imports in foreign currency, E is the exchange rate (i.e. foreign currency in terms of home currency) and, t is time. The condition for balance of payments equilibrium in a growing economy is that the rate of growth of the value of exports equals the rate of growth of the value of imports, such as

$$p_{dt} + x_t = p_{ft} + m_t + e_t \qquad (11)$$

where lower case letters show continuous rates of change of the variables.

The quantity of demand for imports, M, is expressed as multiplicative function of the price of imports (measured in terms of domestic currency to involve the impact of exchange rates), the price of import substitutes, and domestic income. So,

$$M_t = (P_{ft}E_t)^{\Psi} P_{dt}^{\Phi} Y_t^{\pi} \qquad (12)$$

Where Ψ is the own price elasticity of demand for imports (Ψ<0), Φ is the cross elasticity of imports demand (Φ>0), Y is the domestic income, and π is the income elasticity of demand for imports (π>0). The rate of growth of imports is written as

$$m_t = \Psi(p_{ft}) + \Psi(e_t) + \Phi(p_{dt}) + \pi(y_t) \quad (13)$$

where lower case letters again show continuous rates of change of the variables.

As stated by Thirlwall (1979), "the quantity of exports demanded may also be expressed as a multiplicative function in which the arguments in the demand function are: the price of exports measured in foreign currency (to capture the effect of exchange rates), the price of goods competitive with exports, and the level of world income". Thus,

$$X_t = (P_{dt}/ E_t)^{\eta} P_{ft}^{\delta} Z_t^{\varepsilon} \quad (14)$$

where X_t is the quantity of exports demanded, P_{dt} is the domestic price of exports, P_{ft} is the price of competitive goods with exports, 1/E is the foreign price of domestic currency, Z is the level of foreign income, η is the own price elasticity of demand for exports (η < 0), δ is the cross elasticity of demand for exports (δ > 0), ε is the income elasticity of demand for exports (ε > 0), t is time, and the rate of growth of exports is expressed as follows:

$$x_t = \eta(p_{dt}) - \eta(e_t) + \delta(p_{ft}) + \varepsilon(z_t) \quad (15)$$

Substituting Eqs. (13) and (15) into (11), the rate of growth of domestic income consistent with balance of payments equilibrium that is called balance of payments equilibrium growth rate, y_{Bt} is obtained.

$$y_{Bt} = \frac{pdt(1+\eta-\Phi)-pft(1-\delta+\Psi)-et(1+\eta+\Psi)+\varepsilon(zt)}{\pi} \quad (16)$$

According to Eq. (16), there are some economic propositions:

(i) Rapid increase in world income raises the 'balance of payments equilibrium growth rate'.

(ii) An increase in income elasticity of demand for imports (π) leads to decrease in the balance of payment equilibrium growth rate.

As said by Thirlwall (1979), "the interesting question is how well does the actual growth experience of countries approximate to the balance of payments equilibrium growth rate? There may, of course, be an asymmetry in the system. While a country cannot grow faster than its balance of payments equilibrium growth rate for very long, unless it can finance an ever-increasing deficit".

To calculate the balance of payments equilibrium growth rate from Eq. (16) may be difficult, because for some countries, there may not be a significant amount of data readily available. If it is assumed that the own price elasticities of demand for imports and exports are equivalent to the cross elasticities ($\Psi = \Phi$ and $\eta = \delta$), Eq. (16) turns to

$$y_{Bt} = \frac{(1+\eta+\Psi)(pdt-pft-et)+\varepsilon(zt)}{\pi} \qquad (17)$$

In the long term there may be slight change in relative prices and if relative prices are measured in a common currency, they will not change in the long period, so Eq. (17) reduces to

$$y_{Bt} = \frac{xt}{\pi} . \qquad (18)$$

The model assumes that there are insignificant effects from real exchange rates movements on the balance of payments equilibrium growth rates. "Over the long period, there can be little movement in relative international prices measured in common currency, either because of the law of one price or because exchange

depreciation forces up domestic prices equiproportionately so that in the long run ($p_{dt} - p_{ft} - e_t) \approx 0$" (Thirlwall,1979).

To sum up, Thirlwall's BPCG model concentrates on the demand side of the economy as Keynes had emphasized the aggregate demand (that consists of consumption of goods and services, investment by industry in capital goods, government spending and net exports). According to Thirlwall's Law, growth rates differences between countries are explained in terms of differences in the growth of demand between countries, and unlike mainstream economics suggested, a country's rate of growth cannot be explained solely by its terms of growth of factor supplies and productivity. In an open economy, the reason of differences in the growth of demand between countries is countries' balance of payments that constrains on demand (Thirlwall, 1979).

2.4.2. Policy Implications of Thirlwall's Law

In this section, we will mention the basic Thirlwall's law that has powerful policy implications such as the importance of exports in the growth process, the demand-side and the supply-side constraints for open economies, the non-price competitiveness of a country's goods compared with foreign products, as reflected in the income elasticities of exports and imports, rather than their cost competitiveness, the importance of the government strategies in the short term and the importance of doing trade liberalization correctly especially in developing countries.

First, Thirlwall's model stresses the importance of exports in the growth process, but for very different reasons from the Kaldorian export-led growth with cumulative causation model (Kaldor, 1970). The model implies that export growth is important since it is a critical ingredient in a process of cumulative causation in which

growing sales to external markets make it possible for a country to increase its productivity faster through dynamic economies of scale, and therefore to realize ever-widening competitive advantages. Yet, this type of cumulative causation is ruled out by the assumption that relative prices do not matter in the long term, which means that faster growth of productivity either does not translate into sustained advantages in cost competitiveness (if relative prices are constant in the long run) or alternatively, even if the country becomes more competitive, there is no resulting gain since the quantity responses of exports and imports to a lower relative price (real depreciation) are too small (elasticity pessimism).

Exports are so important in Thirlwall's approach because they are vital to counterbalance the otherwise constraining impact of rising import demand when an economy grows faster (an effect that is more severe, the higher is the income elasticity of demand for imports, π). $\pi > 1$ implies that when countries attempt to speed up their growth through domestic means, they tend to need additional imports more than proportionately to the rise in income, hence hinting growing trade deficits unless exports rise fast enough to prevent that from happening. This problem is especially severe in less developed countries, which may lack domestic resources for key products such as capital equipment and high-tech goods, or which may face constraints of insufficient resources or institutions that restrict domestic supplies of basic foods and energy products. Less developed countries face a binding foreign currency constraint because they must earn foreign exchange to pay for necessary imports. However, the same problems may also be found in more advanced economies that have large appetites for imported goods.

Second, the Thirlwall approach combines demand-side and supply-side determinants of growth for open economies. On the one hand, demand-side constraints

that must be imagined to keep actual output growing at the BP equilibrium rate (y_{Bt}) when a higher growth would cause a rising trade deficit. These constraints could be forced, for example, by contractionary fiscal policies which are introduced in response to increased trade (current account) deficit. The Thirlwall law focuses on the external constraints forced by a nation's export performance relative to propensity to import. As well, Thirlwall's law (explicitly in the strong form and implicitly in the weak form)[2] suggests that growth in an open economy is strongly affected (on the demand side) by the growth of the foreign countries that account for any given nation's main export markets. On the other hand, supply-side factors are also implicit in Thirlwall's law. If a country has limited domestic capacity to produce certain key goods (whether consumption, investment, or intermediate goods), that country may have a high-income elasticity of demand for imports. Relieving those supply constraints by increasing domestic capacity, removing domestic bottlenecks, or improving domestic institutions could help to lower $\boldsymbol{\pi}$ and hence increase y_{Bt}. From the view of export side, it is crucial for a country to have a high foreign income elasticity of demand for its exports, π_x. If the composition of a country's exports consist of staple foods and basic industrial goods (for example, cotton textiles), that country has a low income elasticity, and if the composition of a country's exports consist of advanced manufactures (for example, electronic products, transportation equipment), that country has higher income

[2] Strong form of Thirlwall's law: $y_{Bt} = (\pi_x z_t) / \pi$, where π_x is the foreign income elasticity of demand for exports, z is the foreign income, π is the home income elasticity of demand for imports and t is time. Here, it is foreign income growth, z_t that constitutes the exogenous driving force for domestic demand, but clearly it works through the export channel, and it should be recalled that exports must grow at the rate $x = \pi_x z_t$ if the real exchange rate does not change in the long run.

Weak form of Thirlwall's law: $y_{Bt} = x_t / \pi$, where x_t is the growth rate of export. Here, x is the exogenous component of aggregate demand that drives the growth of domestic income consistent with BP equilibrium, y_{Bt}. Implicitly the sum of domestic consumption, investment and Gov't spending must adjust endogenously to ensure that domestic demand grows at this rate if BP imbalances are to be avoided in the long term. Both versions of Thirlwall's law represent exports as the exogenous component of aggregate demand that drives growth in a BP constrained open economy (Blecker & Setterfield, 2019, pp. 430-431).

elasticity. Thirlwall's law suggests that a country may need certain types of supply-side policies (such as investing in capital stock, and paying attention to education, research and development) to relieve the demand-side BP constraint on its growth.

Additionally, the BPCG model permits that some countries (a few large ones) are not BP constrained, but rather are growing at the maximum rate made possible by the expansion of their productive capacity (or their domestic demand). For example, Japan was such a case, after finding that its long run average growth rates were significantly lower than its BP equilibrium growth rate from the 1950s to the mid-1970s. Similar thought may appeal to China in its years of most rapid growth (about 1980-present), as well as to major resource exporters such as Saudi Arabia or a large global demand driver like the U.S. (that has been able to support large current deficits indefinitely with little apparent penalty) (Thirlwall, 1979).

Third, what matters in the BPCG framework is the non-price competitiveness of a country's goods compared with foreign products, as reflected in the income elasticities of exports and imports, rather than their cost competitiveness, which would be reflected in relative prices. The BPCG model suggests that cost competitiveness is unimportant and non-price competition (in terms of product quality, product as opposed to process innovation, and so on) is what matters most to long run growth.

Fourth, BPCG model suggests that domestic demand-side policies cannot generally be fruitful in the long run, since any domestic stimulus (for example, through increased government spending) would lead to a BP trade deficit, which would then require a reversal of the stimulus policy. This does not mean that government policies are unimportant, but policies that focus only on expanding domestic aggregate demand can only be of short run benefit.

Finally, the implications of Thirlwall model are important and controversial for international trade policy. Contrary to Ricardian and neoclassical models of comparative advantage in which trade liberalization is mutually beneficial to all nations, the Thirlwall model represents a more mercantilist world in which export encouragement is generally beneficial, but countries have to be cautious about opening up their import markets too much lest they dissipate the gains from increased exports through higher imports. In BPCG model, it is not irrational for countries to seek lower trade barriers in foreign export markets while being unwilling to open their own markets too much to imports. This does not mean that countries should not take part in trade liberalization, but they need to make sure that the gains on the export side will not be outweighed by losses on the import side. According to BPCG model, export promotion (that requires active government efforts to help export industries) should not be confused with trade liberalization (that means tearing down existing barriers to trade). Each country's import restrictions (tariffs, quotas and so on) constitute barriers to other countries' exports and if all countries impose high tariffs and barriers on each other, their exports could not rise, and the type of growth envisioned in the BPCG model could not flourish. If trade liberalization is not done correctly, it may fail to achieve the promised growth gains or even possibly tighten BP constraints especially in developing countries. BPCG model suggests that trade liberalization should be carried out in a thoughtful and strategic manner, with reciprocal reductions in the trade barriers planned to allow all countries sufficient growth of their exports to make up for the increases in their imports, and that any trade strategy needs to be accompanied by industrial and technological policies to increase non-price competitiveness and encourage favorable shifts in income elasticities (higher for exports, lower for imports) (Blecker & Setterfield, 2019, pp. 436-440).

2.4.3. Critiques of Thirlwall's Law

In this section, we will discuss some of the critiques and the replies by protectors of Thirlwall's approach. First, most experiential tests of Thirlwall's rule have concentrated on determining whether real, long run average growth rates are close to the BP equilibrium growth rates forecast by the BPCG model (whether the most common empirical methods for testing Thirlwall's law are merely testing something that is a tautology or identity). Many experimental studies found that real growth rates are close to BP equilibrium growth rates for most countries and for long run.

Consider the strong and weak versions of Thirlwall's law (mentioned in Section 2.4.1): $y_{Bt} = \pi_x z_t / \pi$, $y_{Bt} = x_t / \pi$ (respectively). As said by the near-tautology (or near identity) argument, econometric estimates of the income elasticities π_x and π come close to the ratios of the growth rate of each trade variable to the corresponding income growth rate (foreign or domestic). Thus, if relative price effects are insignificant in the long run, $\pi_x \approx (x_t / z_t)$ and $\pi \approx (m_t / y_t)$. Then, it can be seen easily that either strong form or weak form is equivalent to $(y_{Bt} / y_t) \approx (x_t / m_t)$ and hence, a statistical test of whether $y_t = y_{Bt}$ is equal to a test of whether $x_t = m_t$. Thus, Thirlwall's law will seem to be verified (the null hypothesis is $y_t = y_{Bt}$ will not be rejected) for any data set in which $x_t \approx m_t$, the quantities of exports and imports grow at approximately the same rate. According to Blecker and Setterfield (2019, pp.472-479), "However, the longer the time period is considered, the more likely it is that $x_t \approx m_t$ will be true in almost any country's data. For example, even though the U.S. trade balance for goods and services shifted from a surplus of 5% of GDP in 1967 to a deficit of 2.9% of GDP in 2015, nevertheless the average annual growth rates of real exports and imports were nearly identical over the 1968-2015 period. As a very large economy, U.S. that experienced a shift of -3.4 percentage points of GDP in its net exports over this almost half-century

period, it is difficult to maintain that the U.S. economy was BP constrained in any meaningful sense. Clearly, the U.S. was able to obtain sufficient net financial inflows to sustain an increasing trade deficit as its growth exceeded a rate that would have been consistent with maintaining balanced trade (Blecker, 2013)". Furthermore, the U.S. economy is generally considered as a demand-driver for the whole global economy, constrained mostly by its own domestic aggregate demand. In Thirlwall' law, some countries must be unrestricted by their BP for other countries to be so constrained, and U.S. and China which are the largest economies are prime candidates for not being BP constrained[3]. Nonetheless, any standard experiential test of Thirlwall's law for the U.S. economy will seem to verify the law since $x_t \approx m_t$ in the U.S. long run data (Blecker & Setterfield, 2019, pp. 472-479).

As stated by Blecker and Setterfield (2019, pp.472-479), according to Thirlwall's law, "econometric estimates of the income elasticities π_x and π need not equal to the observed ratios of growth rates x_t / z_t and m_t / y_t, respectively, as long as relative prices are controlled for in the estimated demand functions for exports and imports". As the defender of this argument, McCombie states that relative price impacts on export or import demand are slight or unimportant in most studies, and that addition of the 'relative price' term means that the law is not an identity (McCombie, 2011). But, if comparative price impacts are small or unimportant, then the estimated income elasticities should be closer to the observed ratios x_t /z and m_t /y_t than if relative price effects were large and important.

In their treatise, Blecker and Setterfield (2019, pp. 472-479) stated that, "Alonso and Garcimartin tested the two alternative hypotheses (income adjustment versus

[3] The U.S. and China are not BP constrained and the foreign (world) growth rate is unimportant in regressions for U.S. and Chinese income growth, after controlling for the rate of local capital accumulation (Razmi, 2016).

relative price adjustment) for ten industrialized countries" (see Alonso & Garcimartin, 1998-99) "and they found that the income adjustment mechanism was statistically significant and had the right sign (income grows more rapidly in response to a rising trade surplus, or more slowly in response to a widening deficit) in eight of the ten countries considered (the US and France were the two exceptions); in contrast, the price mechanism was statistically insignificant for all countries studied".

"Razmi (2005, p. 668) found that price variables were sometimes significant in cointegrating vector for India, but, in some estimates, they adjust 'in the "wrong"- that is, disequilibrating - direction', and he also found that equilibrium for the import relationship was reached in approximately four years" (Blecker & Setterfield, 2019, pp. 472-479).

Second, according to BPCG approach, 'elasticity pessimism' ($\varepsilon_x + \varepsilon_m \approx 1$) (mentioned in Section 2.4.1) or else that relative prices (RERs) do not change meaningfully in the long run. As said by Blecker and Setterfield (2019, pp. 472-479), "Empirical evidence on elasticity pessimism is mixed, however. Some studies (for example, Cline (1989), find that the Marshall-Lerner (ML) condition[4] ($\varepsilon_x + \varepsilon_m > 1$) is satisfied for most countries, while others (for example, Alonso and Garcimartin, 1998-99) find that it does not hold (and elasticity pessimism is validated) for most countries" and "While there are substantial shifts in RERs over short and medium horizons, there is increasing evidence that RERs are mean-reverting over very long periods, when non-linearities and shifting long run equilibria are taken into account (Taylor and Taylor, 2004), and it is not credible to view relative prices as continuously rising or falling in the very long run".

[4] This condition (named after Alfred Marshall and Abba Lerner) shows high the price elasticities of export and import demand is required for a devaluation of a country's currency to improve its trade balance (increase net exports).

As explained by Blecker and Setterfield (2019, pp. 472-479), “Even if relative prices (RERs) do not change continuously in the long run, this does not necessarily imply that the level of the RER may not have a significant effect on a nation’s growth”. But many experiential studies (for example, Rodrik, 2008; Ropetti, Scott & Razmi, 2012; Berg, Ostray & Zettelmeyer, 2012; Razmi, 2016), via a diversity of methodologies, have realized that RER levels have important effects on economic growth in many countries.

Third, the BPCG model assumes a ‘Keynesian small economy’ in the sense of Branson: a country that has infinitely price-elastic supply of both exports and imports (Branson, 1983). Supply curves are horizontal (infinitely elastic), and the demand curves are downward sloping (so the price elasticities of demand are finite). This assumption is not debatable for most countries, except the very largest (for example, US, China) whose demand can affect global prices. But critiques of the BPCG approach (for example, McGregor & Swales, 1985; Ros, 2013; Razmi, 2016) argued that the ‘small economy’ model is more suitable for many if not most countries (especially developing countries): they are price-takers in both export and import marketplaces, in other words, they have infinitely elastic supplies of imports and infinitely elastic demand for exports, and that the balance quantity of exports must be determined by supply limitations in the exporting country’s industries.

Small countries’ import market is the same as in the Keynesian small economy: the supply of imports is infinitely elastic, the price of imports is fixed in foreign currency, and the demand for imports depends on home income and the RER. But in a small country, demand is infinitely elastic in the export market. This means that a small country can sell all the export goods that it can possibly produce in global markets at a given world price in foreign currency. Therefore, the equilibrium quantity of exports is restricted by its natural resources, capital stock, technology, infrastructure and so on.

“In this situation, the strong version of Thirlwall’s law cannot apply because it requires a downward-sloping demand curve (with a finite price elasticity) for exports. Small countries may still be subject to BP constraints on their growth, but if so these constraints depend critically on the (exogenous) world terms of trade for the countries’ exports and the accumulation of capital in their export industries, rather than the growth rate of foreign income” (Blecker & Setterfield, 2019, pp. 472-479).

2.5. Extended versions of Balance of Payment Constrained Growth Models

The balance of payments constrained growth (BPCG) model originally developed by Thirlwall in 1979 has been extended and applied to a variety of countries and conditions. Some of the extended versions of Thirlwall’s Law described below incorporate international capital flows and multisectoral economies with structural change (respectively).

2.5.1. Extended BPCG Models with Capital Account

One key restriction of the original Thirlwall model is the assumption that trade in goods and services must be balanced in the long run, which ignores the possibility that long run capital flows could warrant some countries to sustain trade surpluses or deficits over long periods of time. Since the 1980s, more and more countries have opened their capital markets and persistent trade imbalances have become common among many countries, including advanced economies and natural resource exporters as well as developing countries. Therefore, this extended version of Thirlwall’s model is to allow for imbalanced trade matched by net capital flows.

Thirlwall and Hussain extend the BPCG model by including capital flows to see whether developing countries gain from capital inflows and lose by the adverse effects of relative price movements (Thirlwall & Hussain, 1982). They claim that if developing

countries often build up ever-growing current account deficits financed by capital flows, growth becomes constrained finally by the rate of growth of capital inflows, and the simple Harrod trade multiplier rule would not be a good forecaster of long run growth performance. Their article proceeds in two phases. Firstly, the balance of payments constrained growth rate starts from disequilibrium (with capital flows) and move further into disequilibrium over the time period under consideration. Secondly, both the simple and extended models are applied to a sample of developing countries.

Thirlwall and Hussain express that the balance of payments is in initial current account disequilibrium (all variables are in growth rate form):

$$\alpha_t (p_{dt} + x_t) + (1-\alpha_t) c_t = p_{ft} + m_t + e_t \quad (19)$$

where α and 1-α are the shares of exports and capital flows as a percentage of total receipts, x is the volume of exports, m is the volume of imports, P_d is the domestic price of exports, p_f is the foreign price of imports, c is the value of nominal capital flows, e is the exchange rate (measured in domestic price of foreign currency), and t is time. Thirlwall and Hussain also represent the import and export demand functions (in growth rate form):

$$m_t = \varepsilon_m (p_{ft} + e_t - p_{dt}) + \pi(y_t) \quad (20)$$

$$x_t = \varepsilon_x (p_{dt} - e_t - p_{ft}) + \pi_x z_t \quad (21)$$

where ε_m and π are the price and income elasticities of demand for imports (respectively), y is domestic income, ε_x and π_x are the price and foreign income elasticities of demand for exports (respectively), z is world income. Substituting Eqs.

(20) and (21) into (19), they describe the balance of payments constrained growth rate starting from initial disequilibrium of:

$$y_{Bt} = ((\alpha_t\varepsilon_x + \varepsilon_m)\ (p_{dt} - e_t - p_{ft}) + (p_{dt} - p_{ft} - e_t) + \alpha\pi_x(z_t) + ((1-\alpha_t)\ (c_t - p_{dt}))) / \pi \quad (22)$$

if $p_{dt} = e_t + p_{ft}$ (i.e. if relative prices measured in a common currency were to continue unchanged in the long term), Eq. (22) would reduce to:

$$y_{Bt} = ((\alpha_t\pi_x(z_t)) + ((1-\alpha_t)\ (c_t - p_{dt})) / \pi \quad (23)$$

Since there is no information on $\pi_x(z_t)$ for all countries, Thirlwall and Hussain assume that $\pi_x(z_t) = x_t$, thereby incorporating into the analysis from the start any volume changes in exports from price movements. The equation focused on is thus:

$$y_{Bt} = ((\alpha_t x_t) + ((1-\alpha_t)\ (c_t - p_{dt})) / \pi \quad (24)$$

The difference between the actual growth rate (y) and predicted growth rate (y_{Bt}) will measure the pure terms of trade effect on real income growth and any import volume response from relative price changes relaxing or tightening the balance of payments constraint on growth according to the direction of movement in terms of trade and whether the import volume response is normal or perverse.

Thirlwall and Hussain show that, for a sample of developing countries, the simple Harrod multiplier ($y_B = x/\pi$) gave a closer prediction of the actual growth rate (y) than that the extended model with capital flows (y_{Bt}) gave, and that the difference between the real growth rate and that predicted by extended model is a measure of the extent to which the BCPG rate has been affected by relative price movements in international trade. To shed extra light on the question of the comparative importance of capital flows

and relative price variations in accounting for deviations of growth from the Harrod trade multiplier result, Thirlwall and Hussain divide the countries into two groups. For those countries with $y>y_B$, real capital inflows grow faster than the volume of exports unless relative price changes are favorable to the reduction of the balance of payments constraint on growth. Inversely for those countries with $y<y_B$, it is expected that real capital inflows grow slower than export volume unless the negative difference is accounted for by the (adverse) effect of relative price changes. To explain the divergencies between y and y_B, Thirlwall and Hussain divide the countries again. For those countries with $y>y_B$, the mean difference was smaller and, in all countries, the rate of growth of capital inflows was greater than the growth of exports which, according to the extended model y_{Bt}, should have relaxed the balance of payments constraint on growth, but not because of the adverse effect of relative price movements. They show that in the countries with $y>y_B$, the effect of relative price changes was less adverse than in those with $y<y_B$. In their model, the effects of relative price changes on balance of payments constrained real income growth involve two components: a pure terms of trade, and the effect of relative price changes (implied effect of relative price movements) on the volume of imports (both divided by the income elasticity of demand for imports). A favorable pure terms of trade effect on real income is associated with an implied adverse relative price effect, suggesting that the unfavorable effect of the import volume response has outweighed the favorable pure terms of trade effect.

Thirlwall and Hussain (1982) conclude that “the experience of countries is very mixed. On balance, changes in the real terms of trade seem to have constrained countries in their growth by about 0.6 percent per annum, while capital inflows, on balance, have enabled the countries to grow slightly faster than the Harrod trade multiplier result, by about 0.05 percent per annum. In some countries, however, the real

terms of trade improved, while in many others the rate of growth of real capital imports did not keep pace with the growth of exports, thereby reducing the growth rate below that predicted by the Harrod trade multiplier result". They also show that although the average deviation of y from y_B may be observed as high, it is problematic to believe that the growth process, and restrictions on it, can be understood in most countries without reference to the balance of payments, and the dynamic Harrod trade multiplier offers a simple starting point for examination.

Atesoglu, by implementing Thirlwall and Hussain's (1982) model which is extended form of the original Thirlwall's (1979), analyses whether Canadian economic growth depends only on export growth, or also on the growth in capital inflows and relative prices (Atesoglu, 1993). To eliminate cyclical variations in the series, Atesoglu converts all annual series into long run series (sixteen years) by a moving average process. In doing so, he shows that the long run behavior of the series (economy) is the BPCG model intended to explain.

Atesoglu represents three equations based on Thirlwall and Hussain's (1982) model:

$$x_t = \varepsilon_x (p_{dt} - p_{ft}) + \pi_x z_t$$

$$\text{and } \pi_x > 0, \varepsilon_x < 0 \qquad (25)$$

$$m_t = \varepsilon_m (p_{ft} - p_{dt}) + \pi y_t$$

$$\text{and } \pi > 0, \varepsilon_m < 0 \qquad (26)$$

$$\alpha_t (p_{dt} + x_t) + \gamma_t c_t = p_{ft} + m_t \qquad (27)$$

where x is the growth in real exports, p_d is the growth in domestic prices, p_f is the growth in foreign prices measured in foreign currency, z is the growth in real world income, m is the growth in real imports, y is the growth in real income, c is the growth in nominal capital inflows, α is nominal exports divided by nominal imports, γ is nominal capital inflows divided by nominal imports $(1\text{-}\alpha_t)$, π_x and ε_x are the world income and price elasticities of demand for export (respectively), π and ε_m are the home income and price elasticities of demand for imports (respectively), and t is time. Eqs. (25) and (26) are the export and import demand functions, respectively. Eq. (27) is the balance condition of the model expressed in rate of change form. Nominal exports plus nominal capital inflows should be equivalent to nominal imports, a balanced of payments which contains both current and capital transactions (Thirlwall & Hussain, 1982).

Atesoglu solves Eqs. (25) through (27) for the growth in real income yields an equation for the determinants of balance of payments constrained real income growth:

$$y_{Bt} = 1 / \pi \, (\alpha\pi_x z_t + \gamma_t \, (c_t - p_{dt}) + ((\alpha\varepsilon_x + \varepsilon_m) + 1) \, (p_{dt} - p_{ft})), \qquad (28)$$

and substitutes for growth in real world income, z, from the export Eq. (25):

$$y_{Bt} = 1 / \pi \, (\alpha_t x_t + \gamma_t \, (c_t - p_{dt}) + (1 + \varepsilon_m) \, (p_{dt} - p_{ft}) \qquad (29)$$

where growth in actual income is determined by growth in real exports, growth in real capital inflows, $(c_t\text{-}p_{dt})$, and growth in relative prices, $(p_{dt}\text{-}p_{ft})$. Note that in Eq. (29), if relative prices are constant, $p_{dt} - p_{ft} = 0$, and nominal exports are equivalent to nominal imports, $\alpha_t = 1$, there are no capital inflows, $\gamma_t = 0$, then the balance of payments constrained actual income growth in determined only by the growth in real exports times the reverse of the income elasticity of demand for imports. With these limitations, Eq. (29) becomes the dynamic Harrod foreign trade multiplier result. For experiential

testing purposes, Atesoglu assumes that variables other than growth in exports, growth in real capital inflows, and growth in relative prices are constant parameters. And letting an intercept term, Θ_0, and a stochastic error term, u, he writes Eq. (29) as:

$$y_{Bt} = \Theta_0 + \Theta_1 x_t + \Theta_2 (c_t - p_{dt}) + \Theta_3 (p_{dt} - p_{ft}) + u_t,$$

$$\text{and } \Theta_1 > 0; \quad (\Theta_2, \Theta_3 \epsilon R) \qquad (30)$$

where $\Theta_1 = \alpha_t / \pi$, $\Theta_2 = \gamma_t / \pi$, and $\Theta_3 = (1 + \varepsilon_m) / \pi$. While the expected value of Θ_1 is positive, the expected signs of the Θ_2, Θ_3 can be positive, negative, or equal to zero.

Atesoglu (1993) concluded that "the growth in exports has been a significant and important source of Canadian economic growth during the post-Second World War period. The results also reveal that growth in relative prices has been an important determinant of economic growth performance during more recent decades. Capital inflows do not appear to play an important role in the economic growth of Canada".

Moreno-Brid provides a contribution to the extended version of BPCG model (Thirlwall & Hussain, 1982) by including the constant ratio of current account deficit to output in the long run equilibrium as a constraint since foreign capital may flow steadily (that brings the buildup of foreign liabilities), helping to finance short-run economic developments, and may be simultaneously powering an accumulation of foreign debt at a speed that will inevitably erupt into a foreign exchange crisis and bring a sudden stop to economy activity (Moreno-Brid, 1998-99). He argues that, in the context of the BPCG model, the equilibrium growth path of the economy is consistent with a constant long-term ratio of exterior debt to domestic income (terms of trade do not change and the long-run current account deficit to domestic income ratio is constant, then the long-run ratio of external debt to domestic income will also be

constant), and draws attention that, countries where these proportions are quickly approaching critical levels tend to experience growing difficulties in attracting capital from abroad.

Moreno-Brid's extended model is based on six equations (in growth rate form):

$$p_{ft} + m_t = \alpha_t (p_{dt} + x_t) + (1-\alpha_t) (c_t + p_{dt}) \quad (31)$$

$$\alpha_t = p_{dt}x_t / p_{ft}m_t \quad (32)$$

$$x_t = \varepsilon_x (p_{dt} - p_{ft}) + \pi_x z_t \quad (33)$$

$$m_t = \varepsilon_m (p_{ft} - p_{dt}) + \pi y_t \quad (34)$$

$$B_t = 0 = \alpha_t m_t - (\sigma_t -1) x_t - \sigma_t (p_{dt} - p_{ft}) - y_t \quad (35)$$

$$\sigma_t = p_{ft}m_t / (p_{ft} m_t - p_{dt} x_t) \quad (36)$$

Eq. (31) is the dynamic expression of balance of payments equilibrium, where x is real exports, m is real imports, and c is the net inflow of foreign capital in domestic nominal terms; Eq. (32) defines α as the initial export-import proportion at current prices; Eqs. (33) and (34) are the export and import demand functions, where ε_x and π_x are the price and income elasticities of demand for exports(respectively), ε_m and π are the price and income elasticities of demand for imports (respectively), p_d is domestic prices, p_f is foreign prices, y is domestic income, while z is foreign income, and t is time. Eqs. (31), (32), (33), and (34) are considered by (Thirlwall & Hussain, 1982). Eq. (35) is the long

run equilibrium condition for the balance of payments (assuming that $B_t \neq 0$), where B is the initial ratio of the current account deficit relative to domestic income, and $\sigma_t > 1$ is the proportion of imports to the current account deficit, measured at nominal prices. Eq. (36) corresponds to the expression for the initial import to current account deficit ratio. Solution of this system of equations gives the balance of payments constrained growth of domestic income y_{Bt}:

$$y_{Bt} = ((\sigma_t - 1)\, \pi_x z_t + (\sigma_t\, (\varepsilon_x + \varepsilon_m + 1) - \varepsilon_x)\, (p_{dt} - p_{ft})) / \pi\sigma_t - 1 \qquad (37)$$

where the sub index ca refers to dependence of this formulation of balance of payments constrained growth on the constraint of a fixed current account to domestic income ratio. By assumption $\pi\sigma_t - 1 \neq 0$, Moreno-Brid multiplies numerator and denominator of Eq. (37) by $(1/\sigma_t)$, and incorporated $\sigma_t = 1 / (1-\alpha_t)$. Thus, more familiar expression of long run economic growth y_{Bt} is obtained:

$$y_{Bt} = (\alpha_t \pi_x z_t + (\alpha_t \varepsilon_x + \varepsilon_m + 1)\, (p_{dt} - p_{ft})) / \pi - (1-\alpha_t) \qquad (38)$$

By assumption $\pi - (1-\alpha_t) \neq 0$. Eq. (38) shows that the BPCG, y_{Bt} could have been derived from Thirlwall and Hussain's model, adding to its Eq. (34)[5] a condition equating the growth rates of capital flows and of domestic income in nominal terms ($c_t + p_{dt} = p_{dt} + y_t$).

It is shown that Moreno-Brid's revised model involving a simple constraint on the evolution of domestic income and foreign capital inflows, may assurance that the BPCG rate of the economy is accompanied by a sustainable buildup of foreign debt (the inferences of Thirlwall's law are still binding). Moreno-Brid concluded that "including an endogenously determined ceiling for foreign capital flows, even in the simple way suggested here, altered the BPC model's typical identification-for the case

[5] See Thirlwall and Hussain's article in Section 2.5.1.

of constant terms of trade- between the long-term multiplier of exports and the inverse of the long-term income elasticity of imports. Indeed, it recognized the potential influence of the initial export-import ratio in the relation between these two long-term parameters" and suggested that "under plausible assumptions, regarding the dependence of investment on the imports of capital goods and the interrelations between foreign capital inflows, imports and output growth rates, the balance of payments constrained rate of growth of the economy is globally stable" (Moreno-Brid, 1998-99).

To sum up, Thirlwall and Hussain (1982) extended the BPCG model by including capital flows. Their prolonged model with capital flows did not give a closer guess of the real growth rate than the simple Harrod multiplier result, because adverse or favorable effects of comparative price movements work in the reverse direction tending to push the real growth rate back towards the forecast of simple rule. Likewise, Atesoglu (1993), by implementing Thirlwall and Hussain's (1982) model, analyzed whether Canadian economic growth depends only on export growth, or also on the growth in capital inflows and relative prices. The smoothing procedure that he used in the analysis successfully eliminated cyclical fluctuations and helped describing the long run behavior of the economy. Moreno-Brid (1998-99) incorporated the constant ratio of current account deficit to output into Thirlwall and Hussain's (1982) extended version of BPCG model and Moreno-Brid's extended model confirms the assumption that the long run growth of economy is constrained by the balance of payments.

2.5.2. Extended BPCG Models with Multi-Sectors

The composition of a country's exports is crucial in the BPCG approach since the growth rate of those exports (or, alternatively, their foreign income elasticity) depends on whether the country exports goods sell in more dynamic or more stagnant

global markets. Likewise, the composition of imports can also be important, as the income elasticity of demand for imports will be higher if a country imports goods whose demand is highly income-sensitive (for instance, energy products, capital goods or luxury consumption goods), and this in turn would reduce the growth rate compatible with BP equilibrium.

Structural Change is reflected in the fact that the composition of exports and imports is presumed to be time-varying, whereas the income elasticities are assumed to be more or less permanent characteristics of the products to which they concern (and hence are not modelled as time varying). If a country has rising shares of highly income-elastic exports (such as computers and other electronic products), then its BP equilibrium growth rate will be rising over time. On the other hand, if a country manufactures exports with low income elasticities (such as textiles and apparel, footwear and food products), while it has persistently large proportion of highly income elastic imports (say, capital goods), then that country will have a low BP equilibrium growth rate. Thus, the multisectoral BPCG model draws attention that a country must upgrade its export structure in the direction of goods with higher foreign income elasticities and produce domestic substitutes for highly income-elastic imports. (Blecker & Setterfield, 2019, pp. 447-448).

Araujo and Lima (2007) extend Thirlwall's (1979) BPCG rate within structural economic dynamics (SED) approach developed by Pasinetti. SED approach suggests that intercountry differences in the construction of production lead to intercountry differences in the rate of growth, and since sectors are characterized by different income elasticities, structure of production matters for aggregate economic growth (Pasinetti, 1981; 1993).

Araujo and Lima's (2007) model is SED method to Thirlwall's law to understand the external constraints on growth. As stated by them, their extended model is "disaggregated to allow for the existence of different sectors with different income elasticities of demand for exports and imports and different degrees of importance (in terms of their size, relative to that of the aggregate economy) for the economy as a hole", and it lets for the identification of key strategical areas of the economy (Araujo & Lima, 2007).

Araujo and Teixeira (2004) extend Pasinetti's study to the situation of an open economy and showed that SED is a beneficial context for analyzing instruments that produces uneven advance in a North-South system. As stated by Araujo and Lima (2007), "we employ a version of that model without capital goods to undertake a BPCG analysis in a multi-sector economy in which demand varies over time at particular rates in each one of the sectors of two countries: let A denote the advanced country and U the underdeveloped one". Both countries are supposed to yield n-1 consumption goods, and from the point of view of country U, four equations are represented:

$$x_{Uit} = \varepsilon_{xUi} (p_{dUit} - p_{fAit}) + \pi_{xUi} z_{At} + (\pi_{xUi}-1) PP_{At} \quad (39)$$

$$m_{Uit} = \varepsilon_{mUi} (p_{fAit} - p_{dUit}) + \pi_{Ui} y_{Ut} + (\pi_{Ui}-1) PP_{Ut} \quad (40)$$

$$(\xi x_{Ui} - m_{Ui}) \rho = 0 \quad (41)$$

$$y_{BUt} = ((\xi (\pi_{xUi}) x_{Ui} \rho) / (\pi_{Ui} (m_{Ui}) \rho \pi_{xUi})) (x_{Uit} / d_{Ui}) \quad (42)$$

where x_{Ui} is the per capita export demand coefficient for final commodity i (i = 1, 2,…n-1) produced in country U, p_{dUi} is the price of commodity i produced in country

U, p_{fAi} is the price of commodity i produced in country A, PP_A is the country A's population, PP_U is the country U's population, m_{Ui} is the per capita import demand coefficient for final commodity i produced in country A, π_{xUi} is the country A's per capita income (z_A) elasticity of demand for exports, π_{Ui} is the country U's per capita income (y_U) elasticity of demand for imports, and t is time. Eq. (39) and Eq. (40) assume that if p_{fAi} is greater than p_{dUi}, country U has a comparative advantage in producing good i and that if p_{dUi} is greater than p_{fAi}, country A has a comparative advantage in producing good i. Eq. (41) represents the trade balance equilibrium written not in terms of prices, as is usual, but in terms of labor coefficients. Here, ρ is the production coefficients of consumption goods that represents quantities of labor employed in each sector. This equation needs that exported merchandises expressed in terms of amounts of labor in country U must be equivalent to imported commodities also stated in terms of quantities of labor in U, and the sizes of population in both countries are linked to each other by coefficient of proportion ξ. In Eq. (42), d_{Ui} is the per capita domestic demand coefficient of final commodity i produced in country U. Assuming that the population in both countries remains constant and rate of change of price of commodity i is equal in both countries, Eq. (42) can be seen as a multi-sectoral version of what Thirlwall (1979) called the balance of payments equilibrium growth rate: Multi-Sectoral Thirlwall's Law (Araujo & Lima, 2007).

Multi-Sectoral Thirlwall's Law claims that a country's growth rate of per capita income is inversely (directly) related to sectoral income elasticities of demand for imports (exports). Although sectoral elasticities remain constant, changes in the composition of demand (evaluation of consumption tastes and preferences) or in the structure of production matter for growth performance. Araujo and Lima (2007) suggest that the original Thirlwall's Law infers that a country's growth rate will

increase only when the growth rate of foreign income increase while the Multi-Sectoral Thirlwall's Law suggests that a country still raise its growth rate even when such a rise in the foreign income does not occur, provided it can manage to change the sectoral structure of exports and/or imports accordingly. They also claim that "estimated growth rates could turn out to be closer to actual growth rates when the estimation is made using the Multi-Sector Thirlwall's Law than when it is made using the original Thirlwall's Law" (Araujo & Lima, 2007).

Gouvea and Lima (2010) contribute to the experiential literature on BPCG by inspecting how structural change, identified with variation in the sectoral structure of exports and/or imports, influences the extent of the external restriction. To do this, they test both the original (Thirlwall, 1979) and a multisectoral sectoral version of Thirlwall's Law (Araujo & Lima, 2007) described above, for a sample of Latin American and Asian countries for the period from 1962 to 2006 (Gouvea & Lima, 2010).

Gouvea and Lima (2010) show that "While the original Thirlwall's Law was found to hold for all sample countries but South Korea, the Multi-Sectoral Thirlwall's Law was found to hold for all of them. Though for some countries, the multi-sectoral version of Thirlwall's Law presented a higher absolute error than the aggregate version, for both groups of countries the absolute mean error was lower for the multi-sectoral version, implying that, at least in a mean sense, the multi-sectoral model fits better than the aggregate model". They also use another method to examine the evolution of income elasticities of exports and imports. As said by Gouvea and Lima (2010), "this alternative methodology makes it possible to capture the impact of structural change, identified with change in the sectoral composition of the international trade, on a change in the aggregate income elasticities. We then found that, unlike the sample of

Latin American countries (except Mexico), the sample of Asian countries has managed to change the composition of their exports and imports in a way that led their weighted income elasticity of exports to grow faster than their weighted income elasticity of imports" (Gouvea & Lima, 2010).

The BPCG model was extended by Blecker and Ibarra (2013) to explain slow growth performance of Mexico's economy for pre- and post-liberalization periods. In this extended model, the explanation for the BP-equilibrium growth rate takes account of the structure of imports and exports along with the income elasticities and other estimated coefficients. Their model especially focuses on the elasticity of intermediate imports with respect to manufacturing exports (with Maquiladoras and without Maquiladoras)[6]. Blecker and Ibarra (2013) highlight that the proportion of Mexico's imports that consists of intermediate goods has increased significantly in the post-trade liberalization, and during the same period, manufactured exports highly intensive in the use of imported intermediate goods have also risen to account for most total exports. They claim that trade liberalization may have contradictory effects on balance of payments equilibrium growth: with trade liberalization, access to foreign markets for intermediate inputs becomes easy. This may lead to an increase in production to export manufactured goods. At the same time, the intensive use of intermediate imports in manufacturing those exports may not relax the limitations on the rate of output growth consistent with the balance of payments equilibrium (Blecker & Ibarra, 2013).

[6] A Maquiladora is a Spanish term. It is a name of the factory located near the U.S.-Mexico border. With the Twin Plant Agreement established in the 1960s, these two countries have certain advantages in bilateral trade. While the main company is in the U.S., assembly plant is in Mexico (Kenton, 2018)

Blecker and Ibarra's model includes two different kinds of imports (intermediate and final goods) and two different kinds of exports (manufactures and others). The growth rate of demand for manufactured exports (x_n) is determined by the function,

$$x_n = \varepsilon_n (e + p_f - p_d) + \pi_n z \quad (43)$$

where, e is the rate of nominal depreciation of the home currency, p_f is the foreign inflation rate, p_d is the home inflation rate, z is the growth rate of foreign real GDP. Thus, $e + p_f - p_d$ is the rate of real depreciation, and ε_n and π_n are (respectively) the price and income elasticities for manufactured exports. For easiness, they assume that other exports (primary commodities, chiefly oil, and agricultural products) growth at the exogenously given rate x_0, and their prices change at the exogenously given rate p_{f0} denominated in foreign currency (i.e., U.S. dollars). The growth rate of demand function for imports of intermediate goods and final goods (consumption and capital) are given by

$$m_i = -\varepsilon_i (e + p_f - p_d) + \pi_i y + \beta x_n \quad (44)$$

$$m_f = -\varepsilon_f (e + p_f - p_d) + \pi_f y \quad (45)$$

where, y is the growth rate of home actual GDP, and ε_i, π_i, and β are the price, income, and manufactured exports elasticities of demand for intermediate imports (respectively); where, ε_f and π_f are (respectively) the price and income elasticities of demand for final goods imports.

Assuming no capital flows or transfers, and on the assumption of long run relative purchasing power parity, PPP ($e + p_f - p_d = 0$), they solved for the home country growth rate y_B and obtained (after much manipulation):

$$y_{Bt} = ((\mu_t - \beta\theta_t)\, x_{nt} + (1-\mu_t)\,(p_{ft0} + x_{t0} - p_{ft})) / \theta_t\pi_i + (1-\theta_t)\,\pi_f \qquad (46)$$

As stated by Blecker and Ibarra (2013), "the BP-equilibrium growth rate closely fits the actual, average growth of Mexico's GDP during the 47-year period from 1960 to 2006", and that "there are large differences between the actual and the BP-equilibrium growth rate in each of our sub-periods (pre- and post-liberalization). The sign of those differences suggests that the BP constraint was binding in first of those periods, and therefore, the actual rates of growth could not be sustained, while in the second period, the BP constraint was not binding and thus the fall in actual GDP growth must be attributed to other factors". They also show that Mexico outperformed its BP-equilibrium growth during the pre-liberalization years 1960-1986, and even more strongly when the oil boom and debt crisis years are omitted.

According to Blecker and Ibarra (2013), "the estimates in this paper do not support the hypothesis that a tightening of the balance of payments constraint can account for the slowdown of Mexico's economic growth in the post-liberalization years. On the contrary, our estimates show that the BP-equilibrium growth rate actually increased in the post-liberalization period, especially when maquiladora trade data are included". This means that trade liberalization was modestly fruitful in relaxing the Mexico's previous BP constraint, did not tighten it. Mexican economy underperformed compared to its BP-equilibrium growth rate during this period, even when maquiladora sector (the most dynamic parts of the country's economy) is included. They explain that the reason for underperformance may be since the changes in the real exchange rate were ignored and focused on income elasticities (particularly the elasticity of intermediate imports with respect to manufactured exports). The average levels of real exchange rate are similar during pre-and post-liberalization periods, and the average rate of change is very small over the whole period 1960-2006. This may explain why the BP-constrained

growth rate approximates the real average growth rate for the entire 47-year sample period. It is also showed that the direction of the real exchange rate is very different for the pre- and post-liberalization periods separately. In the first of those periods, overall trend is toward a real depreciation. After trade liberalization, this trend is reversal with a tendency for the peso to appreciate. The appreciation of peso may be an important factor in the underperformance of the Mexican economy during post-liberalization period.

Blecker and Ibarra (2013) conclude that it is important to define the other factors which explain that slowdown; the financial and fiscal limitations depress the nation's investment rate, and the real exchange rate also plays an important role, as a real appreciation may minimizes the profit margins in tradable sector and discourage private investment(see Ibarra 2008, 2011c). They address that supply side factors are also important: financial sector rigidities, rule of low, monopoly control of key industries, and deficiencies in human capital information, and since the 1990s, Mexico's monetary policy focused on reducing inflation, and its fiscal policy focused on balanced-budget target. Therefore, the country's actual growth rate may be chronically held blow its potential or BP-equilibrium rate (Blecker & Ibarra, 2013).

Ibarra and Blecker (2015) extend Thirlwall's (1979) BPCG model and as stated by them "This paper pushes the analysis of the BOP constraint and RER effects in Mexico in several new directions" and firstly "it estimates a disaggregated version of the BPCG, with two types of imports (final and intermediate goods) and two types of exports (manufactures and others), which includes the relationship between intermediate imports and manufactured exports and the effects of RER changes into alternative calculations of the BOP-equilibrium growth rate. Second, whereas many previous applications of the BPCG model to Mexico have treated exports as exogenous,

in which case it is only necessary to estimate an import function, we treat manufactured exports as endogenous and estimate a function for those exports. Third, as a sensitivity test, the BOP-equilibrium growth rate is calculated using the estimated coefficients from both a reduced-form trade balance equation and a structural model of imports and exports. Forth, the paper provides estimates of an extended Marshall-Lerner (EML) effect, i.e., the net impact of changes in the RER on the trade balance. Fifth, without involving them explicitly into the model, the paper analyses how changes in other components of the BOP besides merchandise trade have affected the country's growth". Finally, their estimations recognize four structural breaks, which correspond to familiar key changes in the Mexican policy rule and/or the worldwide economic environment. These four breaks implicit five distinct subperiods for the analysis: Stablishing and shared development, 1960-1974; Recurrent crises and oil boom-bust, 1975-1986; Initial trade liberalization and macro stabilization, 1987-1993; NAFTA, peso crisis and recovery, 1994-2000; China-World Trade Organization (WTO) and stabilizing stagnation, 2001-2012. As said by Ibarra and Blecker (2015), "the *structural change* analyzed in this paper consists of changes in the composition of Mexico's trade (modelled here as the percentages of manufactures in total exports and of intermediate goods in total imports)" and they show "how these structural changes have affected the BOP-equilibrium growth rate in Mexico across the five time periods and compares this rate with the country's actual growth to determine whether the BOP constraint could be considered to be binding during each period" (Ibarra & Blecker, 2015).

Ibarra and Blecker (2015) determine the demand functions (in growth rates) for manufactured exports, and for imports of intermediate goods and final goods (respectively):

$$x_n = \varepsilon_n (e + p_f - p_d) + \pi_n z + \lambda \quad (47)$$

$$m_i = -\varepsilon_i (e + p_f - p_d) + \pi_i y + \beta x_n \quad (48)$$

$$m_f = -\varepsilon_f (e + p_f - p_d) + \pi_f y \quad (49)$$

where λ is a time trend (the expressions of notations) are the same as in Eqs. (43), (44), and (45)). Considering no capital flows, factor income payments or transfers, the BOP-equilibrium condition shown in terms of foreign currency (U.S. dollars) is:

$$\mu (p_d - e + x_n) + (1-\mu) (p_{f0} + x_0) = \theta (p_f + m_i) + (1 - \theta) (p_f + m_f) \quad (50)$$

where μ is the share of manufactures in total exports, θ is the share of intermediate goods in total imports, x_0 the real quantity of other exports (primary commodities, mainly oil and agricultural products) that raises exogenously, and pf_0 is the price of other exports that increases exogenously. Substituting Eqs. (47) - (49) into Eq. (50) and resolving for the home country growth rate y, Ibarra and Blecker obtain:

$$y_B = [(\mu - \beta\theta) (\pi_n z + \lambda) + (1-\mu)(p_{f0}+x_0-p_f) + ((\mu-\beta\theta)\varepsilon_n + \theta\varepsilon_i + (1-\theta)\varepsilon_f - \mu) (e+p_f-p_d)] / \theta\pi_i+(1-\theta)\pi_f \quad (51)$$

Note that $(\mu-\beta\theta)\ \varepsilon_n + \theta\varepsilon_i + (1-\theta)\ \varepsilon_f - \mu > 0$ must hold for a quicker rate of RER depreciation to increase the BOP-equilibrium growth rate y_B. If relative PPP succeeds in the long term, then $e + p_f - p_d = 0$ and Eq. (51) shortens to:

$$y_B = [(\mu - \beta\theta)\ x_n + (1-\mu)\ (p_{f0}+x_0-p_f)] / \theta\pi_i+(1-\theta)\ \pi_f \quad (52)$$

where Ibarra and Blecker use the result (from Eq. (47)) that $x_n = \pi_n z + \lambda$ when $e + p_f - p_d = 0$. In this expression, none of the coefficients in the manufacturing exports function (Eq. (47)) is involved in the resolution for the BOP-equilibrium growth rate. Eq. (52) is the weak version of BPCG, as all export growth is treated as exogenous.

According to Ibarra and Blecker "As a sensitivity test, we will also present results obtained from estimating a reduced-form trade balance equation derived from this same model. We define the trade balance ratio as the value of exports divided by the value of imports", and they write the rate of change in this ratio as:

$$tb = \mu\,(p_d - e + x_n) + (1-\mu)\,(p_{f0} + x_0) - \theta\,(p_f + m_i) - (1-\theta)\,(p_f + m_f) \qquad (53)$$

Substituting Eqs. (47) – (49) into Eq. (53) and grouping terms, they obtain:

$$tb = (\mu-\beta\theta)\,\lambda + [(\mu-\beta\theta)\,\varepsilon_n + \theta\varepsilon_i + (1-\theta)\,\varepsilon_f - \mu]\,(e+p_f-p_d) -$$
$$[\theta\pi_i+(1-\theta)\,\pi_f]\,y + (\mu-\beta\theta)\,\pi_n z + (1-\mu)\,(p_{f0} + x_0 - p_f) \qquad (54)$$

Here, $[(\mu-\beta\theta)\,\varepsilon_n + \theta\varepsilon_i + (1-\theta)\,\varepsilon_f - \mu]$ measures the elasticity of trade balance percentage with respect to the RER. This corresponds to what Ibarra and Blecker called the EML effect. This weighted quantity of elasticities must be positive for a real depreciation to advance the trade balance as well as to increase the BOP-equilibrium growth rate. Eq. (54) is estimated econometrically using the following specification:

$$tb = \beta_0 + \beta_1\,(e_t + p_{ft} - p_{dt}) + \beta_2 y_t + \beta_3 z_t + \beta_4\,(1-\mu)\,(p_{f0t} + x_{0t} - p_{ft}) + \upsilon_t \qquad (55)$$

where $\beta_0 = (\mu-\beta\theta)\,\lambda$ represents the constant in the regression, $\beta_1 = (\mu-\beta\theta)\,\varepsilon_n + \theta\varepsilon_i + (1-\theta)\,\varepsilon_f - \mu$ is the EML effect, $\beta_2 = -\,[\theta\pi_i+(1-\theta)\,\pi_f]$ represents the weighted average income elasticity of demand for imports, $\beta_3 = (\mu-\beta\theta)\,\pi_n$ represents the weighted foreign income elasticity of demand for manufactured exports, β_4 (assuming to equal unity in the econometric estimates, for consistency with Eq. (54)) represents the effect of the variation in non-manufactured exports (involving terms-of trade-effects) weighted by their portion in total exports, and υ_t is a random error.

Setting tb = 0 in Eq. (55) and solving for y, Ibarra and Blecker obtain other estimates of the BOP-equilibrium growth rate, y_B, plus RER effects as defined in Eq. (51). Since

the estimation of Eq. (55) does not permit them to identify all the parameters required to calculate Eq. (52), they estimate an another version of the BOP-equilibrium growth rate (Eq. (51)) in which manufacturing exports are treated as endogenous but RER effects are overlooked (i.e. assuming $p_f + e - p_d = 0$):

$$y_B = [(\mu-\beta\theta)(\pi_n z + \lambda) + (1-\mu)(p_{f0} + x_0 - p_f)] / \theta\pi_i+(1-\theta)\pi_f \qquad (56)$$

This is the strong form of BPCG, in which PPP holds and the growth of manufacturing exports is explained completely by foreign income growth plus a time trend. Eq. (2.56) can be computed using the results from estimating either the reduced form trade balance Eq. (55) or the structural model consisting of Eqs. (47) – (49). Ibarra and Blecker (2015) suggest that, in any alternative solutions (Eqs. (51), (52) or (56)), the BOP-equilibrium growth rate is influenced by structural change (i.e. shifts in the structure of exports and imports as well as in the trade elasticities, both directly and through the EML effect).

Ibarra and Blecker (2015) suggest that "our empirical analysis led to the identification of four clear moments of structural breaks in 1975, 1987, 1994 and 2001 and five correspondingly distinct phases. These phases are closely related to the presence of structural change" that consists of changes in the composition of exports and imports and in the trade elasticities.

According to Ibarra and Blecker (2015) "A range of alternative estimates shows that the relationship between actual growth and BOP-equilibrium growth changed notably across the five phases. One important implication is that the BOP constraint cannot explain the slow growth of the Mexican economy during the entire period since trade liberalization in the late 1980s. Especially, the economy grew significantly below the BOP-equilibrium rate during the immediate post-NAFTA years (1994-2000), in

spite of booming exports at that time. In periods when the BOP-equilibrium growth rate did decline and approximated the actual growth rate, the decreases in the equilibrium rate were caused by factors". These factors may be such as the rising share of intermediate imports in total imports, slower growth of non-manufacturing exports and real appreciation of the peso in 1987-1993 and by slower growth of the U.S. economy and increasing competition from Chinese exports in 2001-2012.

Regarding the RER, Ibarra and Blecker's (2015) results suggest "caution in the advocacy of peso depreciation as a strategy for improving the trade balance or relieving BOP constraints. Our estimates show that the EML effect fell sharply and, depending on the specific method and set of estimates, may or may not be satisfied in the post-NAFTA period. Even the estimates showing that the EML effect is still positive suggest that real depreciation would bring only modest gains in the trade balance. Although peso depreciation would significantly reduce demand for final imports, the gains for the trade balance are muted by the fact that manufactured exports are largely assembled using imported inputs".

Ibarra and Blecker (2015), conclude that "our estimates of relatively low RER elasticities (and a relatively small EML effect) in recent decades are far from conclusive about the potential impact of RER depreciation on Mexico's long run growth" and as said by them "The BPCG model implies that the BOP-equilibrium growth rate depends only on the rate of change of the RER and not its level, which is why the theory discards the RER as a determinant of the long run growth rate"

To sum up, in Pasinettian structural economic dynamics (SED) approach, observed differences in growth performance between countries are related to intercountry differences in the structure of production which comes from evolution of

consumption testes and preferences. As the structure of demand changes, the structure of production changes, also matters for growth performance. Araujo and Lima (2007) shed light on uneven development between advanced and underdeveloped countries by deriving the Thirlwall's (1979) BPCG model within a Pasinettian multi-sector macrodynamic framework: Multi-Sectoral Thirlwall's law. The model regards that a country's growth rate per capita income is directly proportional to the growth rate of its exports. Likewise, Gouvea and Lima (2010) examined how structural change, identified with change in the sectoral composition of exports and/or imports, affects extent of the external constraint by testing the original Thirlwall's Law and Multi-Sectoral Thirlwall's Law for a sample of Latin America and Asian. Both Araujo and Lima (2007) and Gouvea and Lima (2010) showed that, for any given country, growth rates which are estimated by using the extended model are closer to actual growth rates than those estimated by using the original Thirlwall's model, and it seems that Multi-Sectoral Thirlwall's law is valid for all sample countries. Unlike the previous ones, Blecker and Ibarra (2013) developed an extended model of the BPCG with two types of exports (manufactured and other) and two types of imports (intermediate and final goods) to clarify the slowdown in Mexico's growth. The extended version of BPCG closely fits the real growth of Mexico's GDP throughout the period from 1960 to 2006. However, looking at two sub-periods (pre- and post-liberalization), BPCG is valid in the first of those periods, and it is seen that Mexico did better its BP-equilibrium growth throughout the pre-liberalization period. In contrast, Mexican economy has been underperforming relative to its BP-equilibrium growth rates during post-liberalization period. This shows that the BP constraint is not binding and extension of BPCG model is not enough to explain the post-liberalization growth slowdown in Mexico. A structural model of the balance of payments with disaggregated exports and imports,

and a reduced-form model of the trade balance for the Mexican economy are estimated by Ibarra and Blecker (2015) regarding the structural changes in the composition of Mexico's trade in five subperiods. The outcomes indicated that a strengthening of the balance of payments constraint may account for the post-liberalization slowdown in Mexico's growth only throughout certain subperiods and that the effect of real exchange rate variations on the trade balance lessened, most likely because of the increasing addition of export industries into worldwide supply chains. The outcomes also suggested that a country cannot sustain growth above the rate consistent with balance of payments equilibrium, as predictable, but it can grow insistently under that rate when other limitations are more binding.

3. THE DESCRIPTIVE ANALYSES OF CHANGES IN TURKEY'S ECONOMIC CONDITIONS AND IN COMPOSITION OF EXPORTS AND IMPORTS FOR THE PERIOD FROM 1998 TO 2019

3.1. Changes in Economic Conditions for the Period from 1998 to 2019

In this section, we descriptively analyze the Turkish economy considering the 2001 and 2008 recessions which corresponded to changes in Turkey's economic conditions, and therefore we divided the 22-year data set into three periods: Collapse of the exchange rate-based stabilization program (1998-2001) and 2001 crisis; Recovery from the 2001 crisis, 2008 global crisis (2002-2008) and Recovery from the 2008 global crisis (2009-2019)[7]. Table 1 below shows the percentage changes in real GDP, in trade aggregates (manufactured exports and three types of imports), the shares of these trade

[7] We paid attention to possible structural breaks in the estimated equations in Section-5 below using the Chow test. This test showed statistically significant breaks in 2001 using the bounds testing estimation method and in 2009 using the first difference estimation method.

aggregates in total exports or imports, the terms of trade and the balance of payments (percentage of GDP) over time. The average share of manufactured exports as a proportion of total exports is 93% per annum and the average shares of intermediate, consumption and capital imports as a proportion of total imports are 72%, 12% and 16% per year, respectively. In 22 years, the shares of manufactured exports and intermediate imports in their respective totals did not change much.

Collapse of the Exchange Rate-Based Stabilization Program (1998-2001) and 2001 Crisis: At the conference, the subject of which is the Reflections on the February 2001 Turkish Crisis, Serdengecti (2002) stated that "In an attempt to stabilize the economy plagued by chronic high inflation and high real interest rates as well as deteriorating debt dynamics, Turkey has launched an exchange rate based stabilization program (ERBSP) supported by international financial institutes[8], in December 1999" and that "In spite of its effectiveness as a nominal anchor in reducing inflation, the adoption of an ERBSP entails vulnerabilities that, depending on the country's fundamentals, usually end with the collapse of the peg. Evidence to date points to at least four main factors that often paved the path for the collapse of the program: such as inconsistent fiscal policy, weak banking system, lack of a pre-announced exit date or strategy, and adverse shocks - such as an adverse terms of trade shocks - under which adjustment of the exchange rate can in fact be welfare improving".

According to Serdengecti (2002), the main contributing factors to the failure of the Turkey's ERBSP can be listed as follows:

First, Turkey enjoyed large capital inflows following the introduction of the program. The sharp rise in capital inflows (in 2000, Figure 1), in turn, enlarged the

[8] International Monetary Fund, IMF.

supply of loanable funds at banks' disposal, thereby allowing banks to bring about a lending boom.

Second, "weak and under-supervised banking sectors have been one of the most important contributing factors to collapse of the fixed exchange rate regimes since stabilizing the banks and keeping the exchange rate peg become mutually incompatible objectives" , "the banking supervision was not adequate for various reasons and banks were vulnerable to adverse shocks" and "these vulnerabilities should have been addressed or alleviated prior to the introduction of the Turkey's ERBSP" (Serdengecti, 2002).

Third, another contributing factors of the 2001 (February) crisis is the notable terms of trade shock that the country was subject to. Due to sharp rise in oil prices, among other things, the terms of trade (measured by the exports prices divided by imports prices deteriorated as this index decreased from 120.5 down to 108.8 (Figure 2)) deteriorated in 2000 compared to 1999, so worsening the current account deficit (and the merchandise trade deficit :-8.07%)[9], as a percentage of GDP (Figure 3). "To return to current account equilibrium, the real exchange rate had to depreciate, which in the absence of any adjustment in the nominal exchange rate, would call for decline in the domestic price level. Since neither the latter more painful adjustment nor the former adjustment of the exchange rate took place, the terms of trade shock further contributed to the concerns over the sustainability of the peg" (Serdengecti, 2002).

Fourth, "the absence of a contingent funding facility at the outset of the stabilization program proved to be detrimental for the sustainability of the program, when we

[9] It is interesting that the merchandise trade deficit became larger in a period when the imports prices were relatively more expensive compared to exports prices. However, in Section 5 below, in our econometric estimation we will find that the relative prices are not so important for the demand for imports: a view that is supported by the basic Thirlwall law.

consider the fact that the possibility of a liquidity crisis could be lessened with the existence of such a funding facility" (Serdengecti, 2002).

Lastly, "unfavorable external developments - particularly concerning the economy of Argentina - were not helpful for us as international investors had a tendency to associate the two emerging economies with each other, in spite of their distinct features. This, in turn, contributed to capital outflows that undermined the sustainability of the peg" (Serdengecti, 2002).

Recovery from the 2001 Crisis, 2008 Global Crisis (2002-2008): To overcome the 2001 crisis, the 'strong economy transition program' was supported by the stand-by arrangement signed with the IMF and by the World Bank (WB) loans. Later, the independence of the Central Bank of the Republic of Turkey (CBRT) was ensured, and many structural problems began to be solved. As stated by Serdengecti (2002), "the Central Bank's main purpose was to restore the financial stability and prevent hyperinflation. In the face of the exorbitant interest rates during the early days of the collapse of the peg, which arose from the liquidity needs of the public banks and intervened banks coupled with the surge in demand for the foreign exchange, the Central Bank entered the money markets through quoting buying and selling rates with a view to restore the integrity of the payment system and bring stability back to the financial markets. The collapse of the peg and move to the float obviously made it possible for the Central Bank to lift the ban on its domestic credit. As a result, interest rates fell to more reasonable levels" (Serdengecti, 2002).

As of 2002, the Turkish Lira (TL) appreciated in nominal terms due to the capital inflows into Turkey starting to increase again (Figure 3.1) and also the U.S. Central Bank's (Federal Reserve System, FED) lowering the U.S. rate of interest. Therefore,

imports began to increase in Turkey while the terms of trade were about constant at the level of 108 between the years 2001-2005 in the meantime.

Since the mid-2000's, there has been an annual growth of 5% per year in the world output and high growth rates exceeding 8% per year in developing countries. However, this expansion process in the world economy was affected by the financial crisis originating from the U.S. housing market in mid-2007, and an economic crisis was experienced throughout the world in the year of 2008. The growing unease in the financial markets caused a slowdown in capital inflows to Turkey (Figure 1). Imports and manufactured exports, which increased after the year of 2001, started to decline in early 2008. The percentage of the merchandise trade deficit in GDP, started to decrease in 2009 mainly due to the 2008 global crisis (Figure 3).

Recovery from the 2008 global crisis (2009-2019): Turkey's major trading partner countries (mainly the Euro area) experienced an economic contraction and there were serious contractions in the demands for consumption and investment in almost all countries during the 2008 global economic crisis. Moreover, the 2008 global economic crisis led to a sharp decline in the amount of capital inflows into Turkey in the year of 2009. (Figure 1). FED decided to implement an expansionary monetary policy to reduce the negative effects of the 2008 global economic crisis allowing plentiful of liquidity to flow to developing countries like Turkey.

After 2009, increased capital inflows led to an increase in Turkish imports, raising the percentage of current account deficit in GDP (Figure 3). However, as of 2014, the end of the FED's expansionary monetary policy negatively affected Turkey's growth performance. Turkey's foreign trade deficit began to improve again due to the capital outflow from the country causing the Turkish Lira (TL) to depreciate and the sharp

decline in oil prices (Figures 1 and 3). The latter effect helped the Turkish terms of trade to develop favorably (Figure 2). As of 2016, Turkey's economy slowed down due to contraction of its domestic demand and external reasons such as the withdrawal of the United Kingdom (UK) from the European Union (EU), (Brexit), FED's initiation to increase interest rates, and continuation of low growth rates in European Union countries. In Figure 3, when we observe that during the years of 2018 and 2019, the percentage of the merchandise trade deficit in GDP decreased from -5.17% to -2.21% because of Turkey's slow growth performance.

Table 1

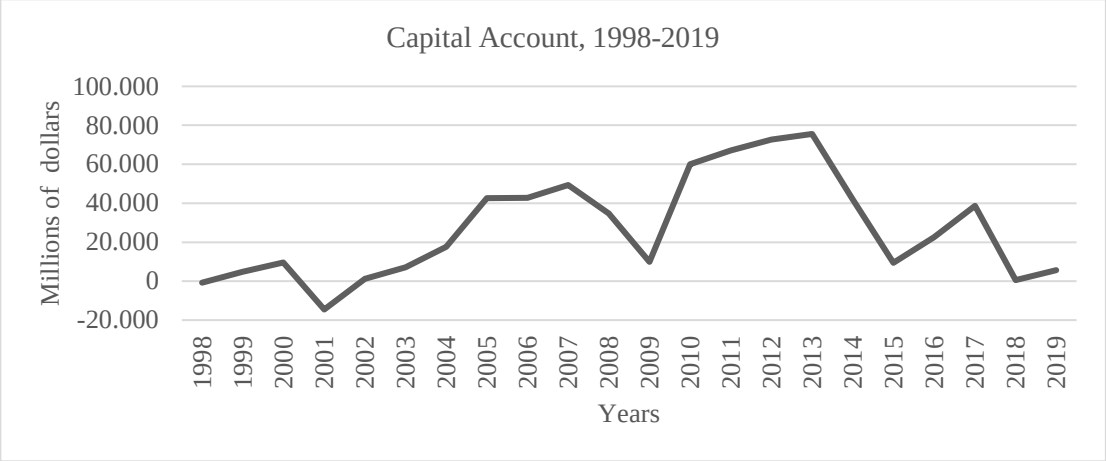
Descriptive Statistics by Time Period, Turkey

Period (phase) and years	1998-2019	1998-2001	2002-2008	2009-2019
Average annual growth rates (%)				
Real GDP, y	4.37	-0.89	6.22	4.62
Trade aggregates				
Manufactured exports (x_n)	8.90	12.55	12.61	5.22
Imports of intermediate goods (m_i)	6.21	2.95	12.16	3.62
Imports of consumption goods (m_c)	5.72	-2.28	18.59	0.43
Imports of capital goods (m_k)	6.37	-2.7	22.97	-0.90
Shares of exports and imports (%)				
Share of manufactures in total exports	92.86	89.75	93.86	93.36
Share of intermediate goods in total imports (θ_1)	71.64	67.50	71.86	73.00
Share of consumption goods in total imports (θ_2)	0.12	0.11	0.11	0.12
Share of capital goods in total imports (θ_3)	0.16	0.20	0.16	0.15
Terms of trade (TOT)				
Average level (index, 2010 = 100)	105.42	114.18	104.69	102.71
Average rate of change (TOT) (%)	-0.74	-3.46	-1.01	0.18
BOP (percentage of GDP)				
Current account balance	-3.30	-0.35	-3.80	-4.05
Trade balance (goods and services)	-2.59	-0.53	-2.90	-3.14
Merchandise trade balance	-5.84	-4.63	-5.76	-6.33
Capital account balance	-3.65	0.53	-5.04	-4.29

Note. Source: Turkish Statistical Institute (TurkStat).

Figure 1

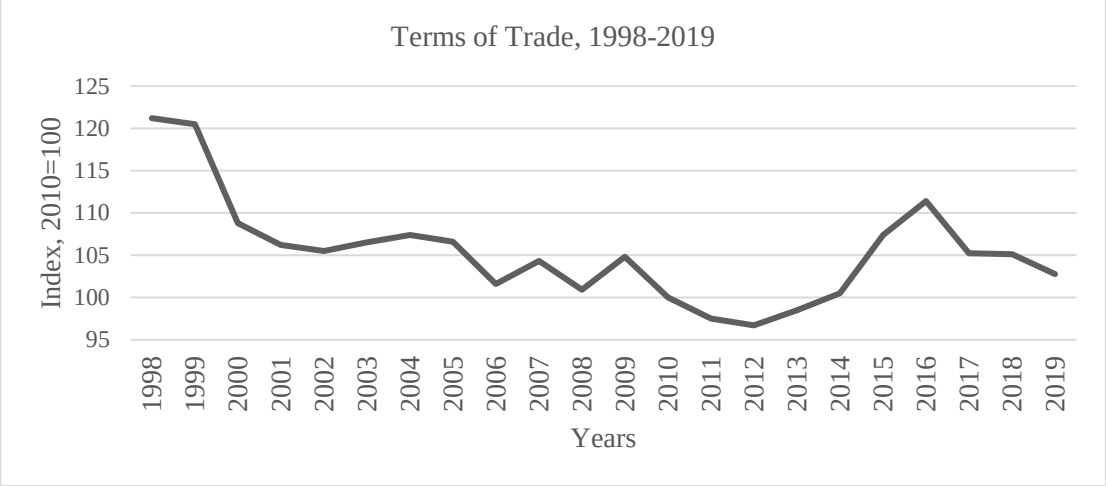
Capital Account, 1998-2019



Note. Source: Turkish Statistical Institute (TurkStat).

Figure 2

Terms of Trade, 1998-2019



Note. Source: Turkish Statistical Institute (TurkStat).

Figure 3

Current Account, Goods and Services and Merchandise Trade Balances for Turkey, as a Percentage of GDP, 1998-2019

Note. Source: Turkish Statistical Institute (TurkStat).

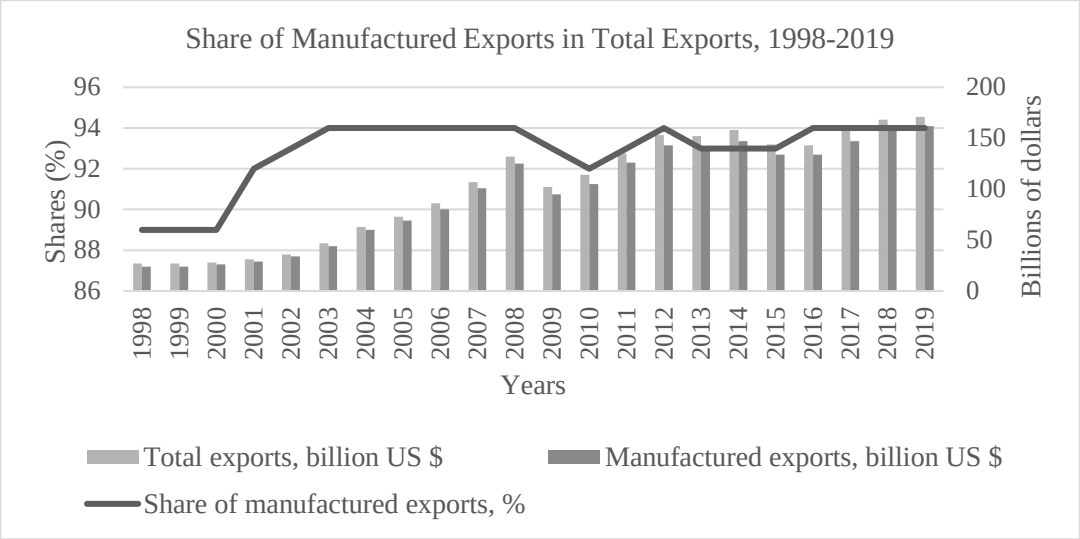
3.2. The Composition of Exports

An important part of the value (in U.S. dollar) of Turkey's total exports[10] consists of exports of manufacturing industry. Figure 4 below shows that, on average, the share of manufactured exports in the value of total exports is 93% (structural change is reflected in the composition of exports) for the period 1998-2019.

[10] Exports (value) by ISIC (International Standard Industry Classification (UN)), Rev.3 from Turkish Statistical Institute (TurkStat).

Figure 4

Share of Manufactured Exports in Total Exports, 1998-2019



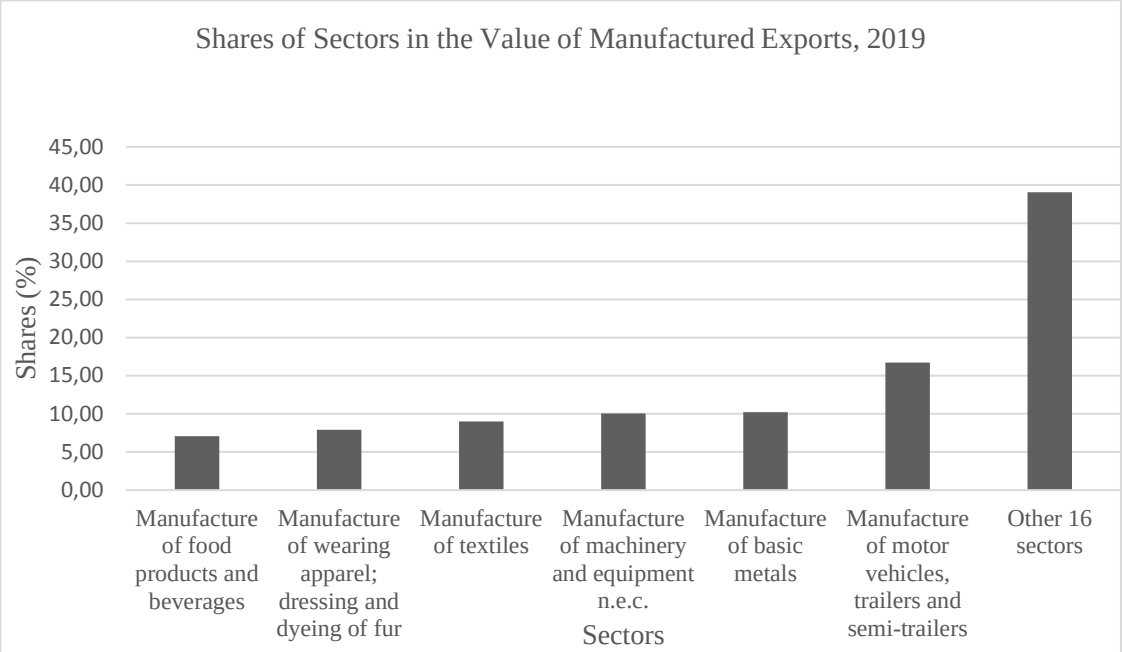
Note. Source: Turkish Statistical Institute (TurkStat).

During the 22-year period, the share of manufactured exports in the value of total exports increased from 89% to 94% and the value of exports of the manufacturing industry grew by an average of 10% per year from $ 24 billion to $ 162 billion. Figure 5 shows that as of 2019, in Turkey, the manufactured exports consist of motor vehicles which represent 16.72%, basic metal industry which represents 10.20%, machinery and equipment which represent 10.05%, textile products which represent 9.01%, clothing which represents 7.92%, and of food and beverage products which represent 7.07%. The share of these six sectors in the value of manufactured exports is 60.97%. According to Eurostat Technology Classification (Eurostat, 2020), as of 2019, a significant proportion of Turkey's manufactured exports consists of medium high-tech and low-tech products. The shares of medium high-tech (motor vehicles and machinery and equipment), medium low-tech (basic metal industry) and low-tech exports (textile

products, clothing and food and beverage products) in total manufactured exports are 26.77%, 10.20%, and 24%, respectively. Turkey, here, needs to move from the production of low-tech goods to production of goods with high-tech content. From the view of export-led growth, it can be understood that the manufactured exports which consists of high-tech goods are a key factor to drive economic growth, relaxing the balance of payments.

Figure 5

Shares of Sectors in the Value of Manufactured Exports, 2019

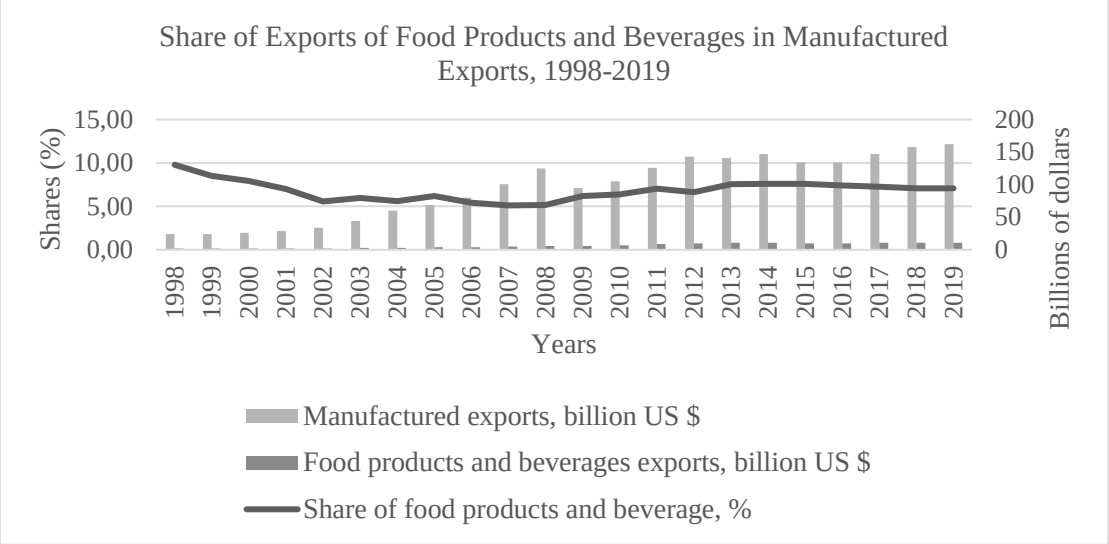


Note. Source: Turkish Statistical Institute (TurkStat).

Structural changes of six sectors that have a large share in the manufactured exports (shown in Figure 5 above) are examined in detail below (from Figure 6 to Figure 11). In Figure 6, during the 22-year period, the share of food products and beverages which are defined as low-tech products according to Eurostat, in the value of manufactured exports decreased from 9.79% down to 7.07%.

Figure 6

Share of Exports of Food Products and Beverages in Manufactured Exports, 1998-2019



Note. Source: Turkish Statistical Institute (TurkStat).

In Figure 7 below, during the 22-year period, the share of clothing products which are defined as low-tech products according to Eurostat, in the value of manufactured exports decreased steadily from 23.75% down to 7.92%.

Figure 7

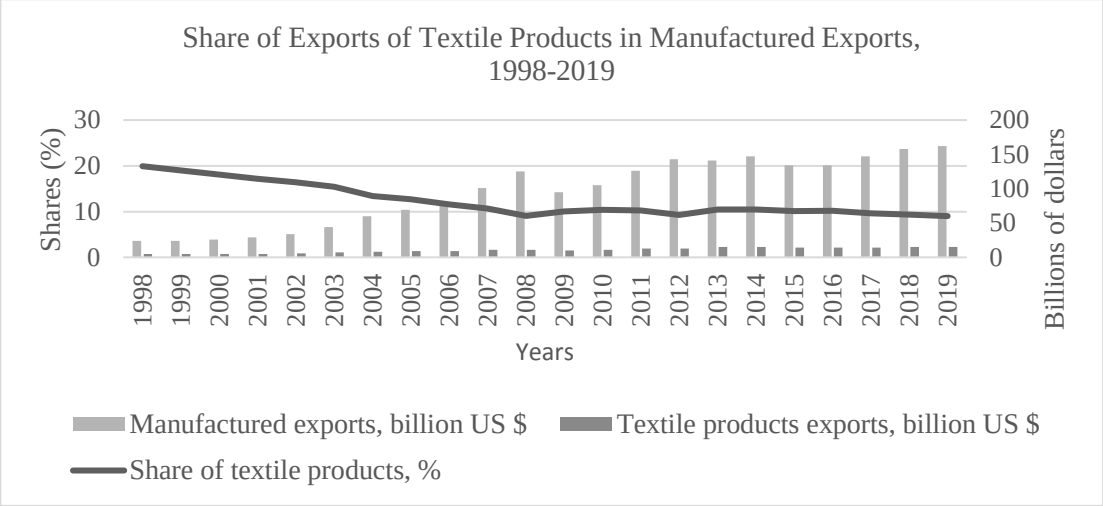
Share of Exports of Clothing Products in Manufactured Exports, 1998-2019

Note. Source: Turkish Statistical Institute (TurkStat).

In Figure 8 below, during the 22-year period, the share of textile products, which are defined as low-tech products according to Eurostat, in the value of manufactured exports decreased steadily from 19.92% down to 9.01%.

Figure 8

Share of Exports of Textile Products in Manufactured Exports, 1998-2019

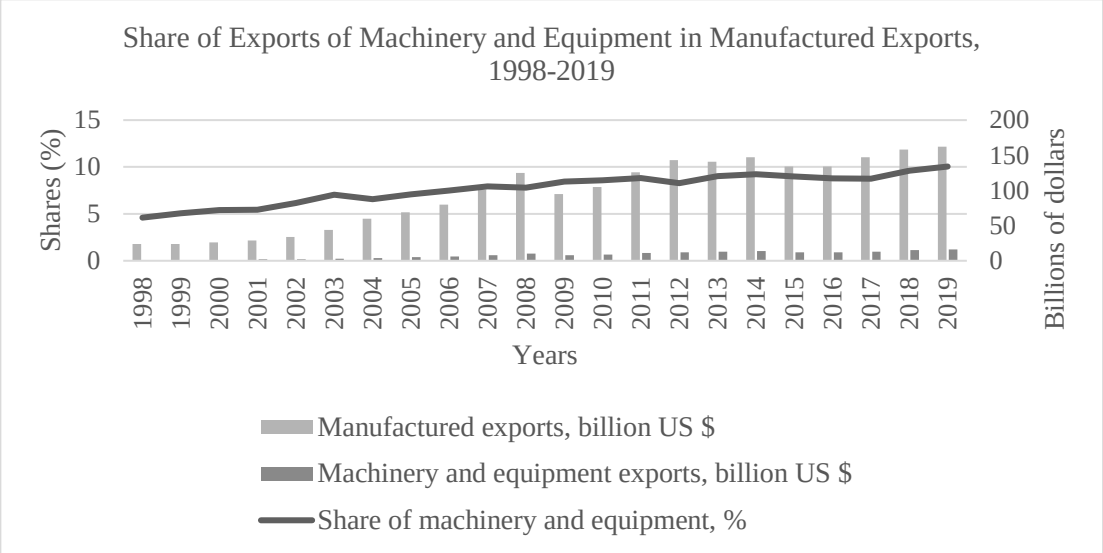


Note. Source: Turkish Statistical Institute (TurkStat).

In Figure 9 below, during the 22-year period, the share of machinery and equipment products which are defined as medium high-tech products according to Eurostat, in the value of manufactured exports increased steadily from 4.60% up to 10.05%.

Figure 9

Share of Exports of Machinery and Equipment in Manufactured Exports, 1998-2019

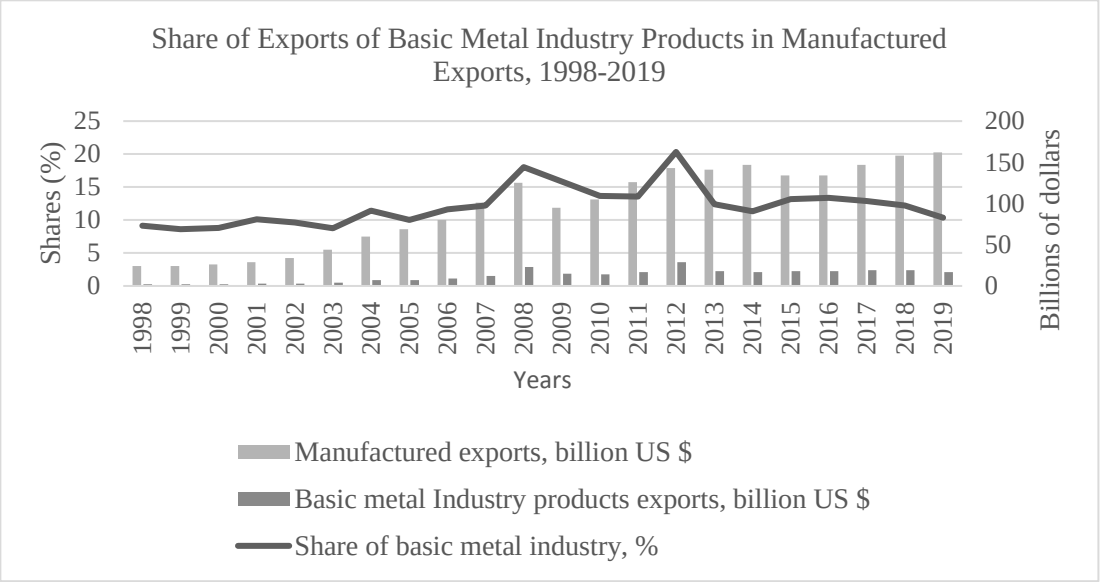


Note. Source: Turkish Statistical Institute (TurkStat).

In Figure 10 below, during the 22-year period, the share of basic metal industry products, which are defined as medium low-tech products according to Eurostat, in the value of manufactured exports increased from 9.13% up to 10.37%.

Figure 10

Share of Exports of Basic Metal Industry Products in Manufactured Exports, 1998-2019

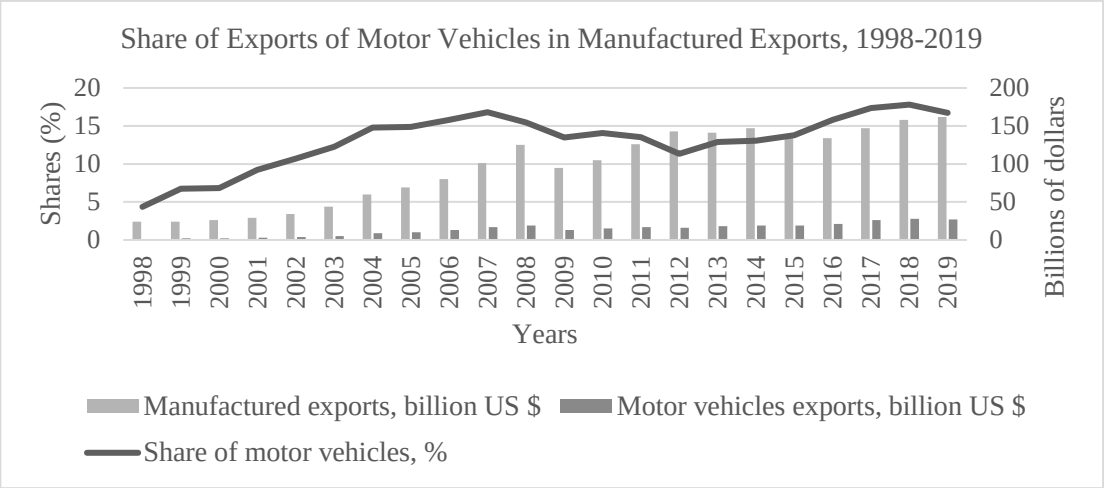


Note. Source: Turkish Statistical Institute (TurkStat).

In Figure 11 below, during the 22-year period, the share of motor vehicles, which are defined as medium high-tech products according to Eurostat, in the value of manufactured exports increased steadily from 4.36% up to 16.72%.

Figure 11

Share of Exports of Motor Vehicles in Manufactured Exports, 1998-2019



Note. Source: Turkish Statistical Institute (TurkStat)

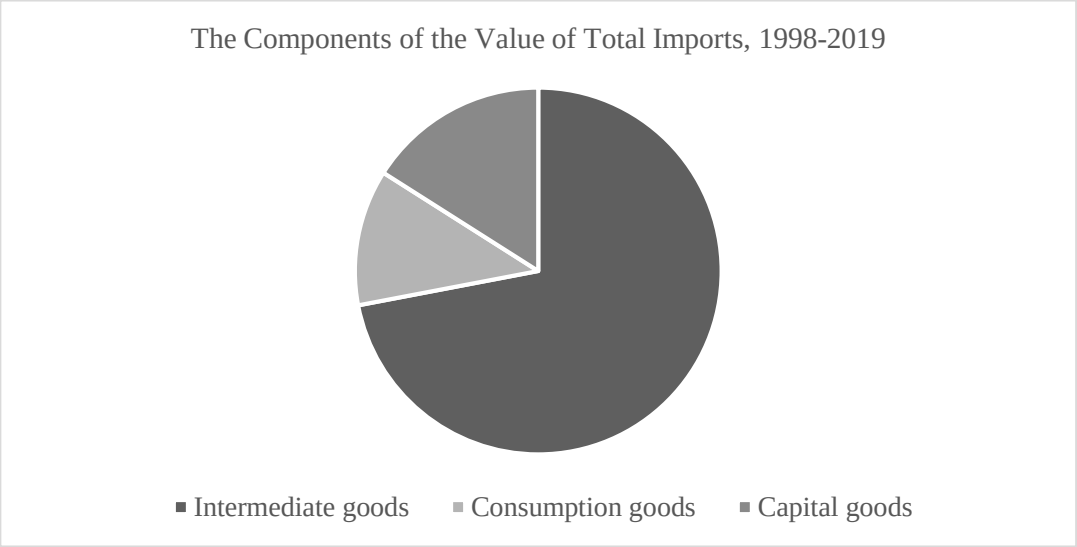
3.3. The Composition of Imports

The value of Turkey's total imports[11] in U.S dollars consists of intermediate, consumption and capital goods. Figure 12 below shows the value of total imports in three parts.

[11] Imports (value) by BEC (Classification by Broad Economic Categories (UN)), from TurkStat.

Figure 12

The Components of the Value of Total Imports, 1998-2019

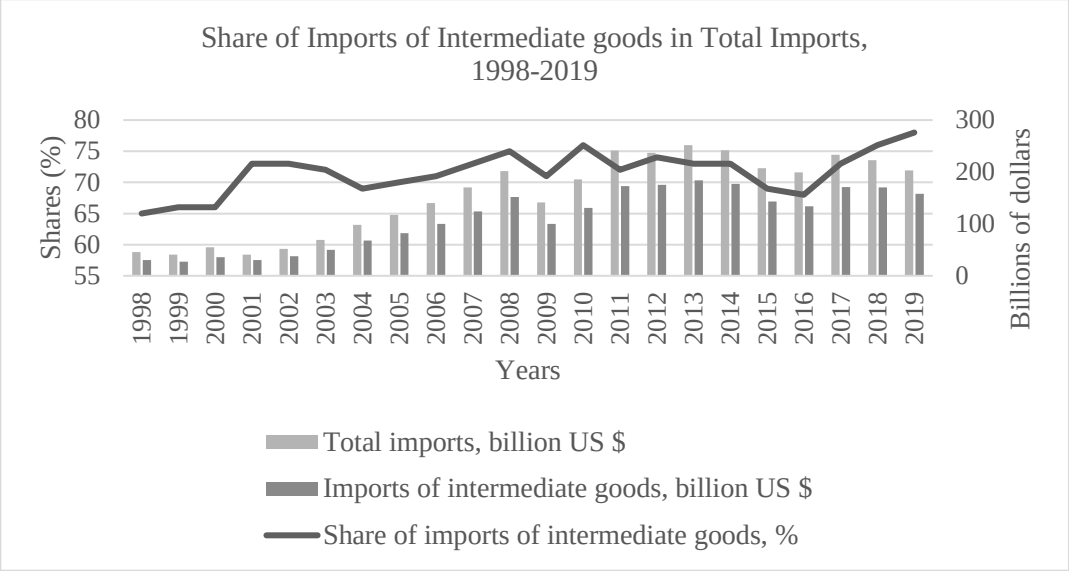


Note. Source: Turkish Statistical Institute (TurkStat). On average, the shares of intermediate, consumption and capital goods in the value of total imports are 72%, 12%, 16% per year, respectively.

In Figure 13 below on average, the share of intermediate goods in the value of total imports is 72% (structural change is reflected in the composition of imports) for the period 1998-2019. During the 22-year period, the share of imports of intermediate goods in the value of total imports increased from 65% to 78%. The intensive use of imported inputs at certain sectors of the manufacturing industry causes the intermediate goods to be the largest components of total imports. When the value of import of intermediate goods is examined, it is seen that it grew by an average of 10% per year from $ 30 billion to $ 158 billion.

Figure 13

Share of Imports of Intermediate goods in Total Imports, 1998-2019

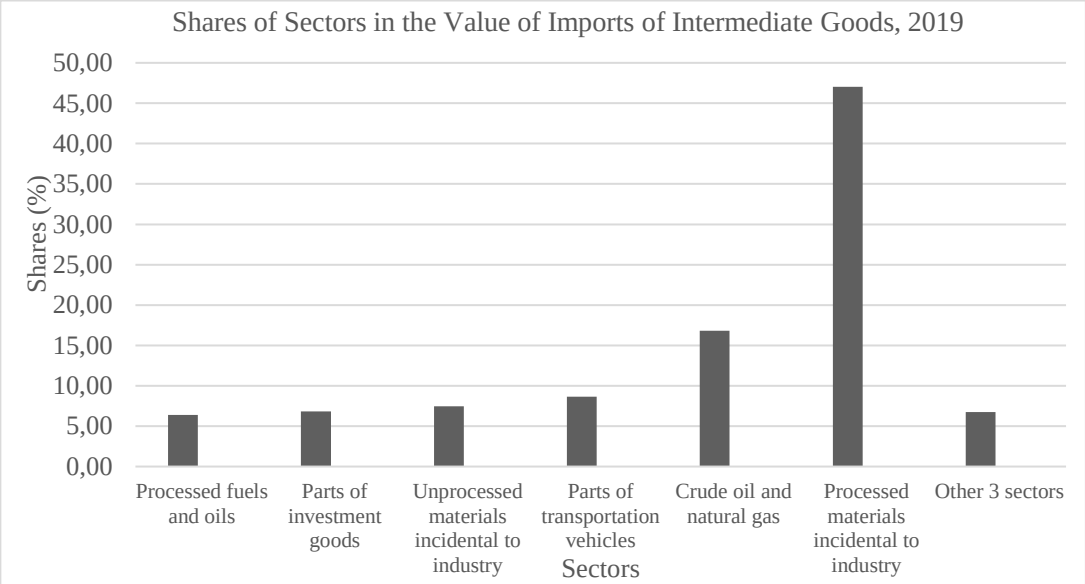


Note. Source: Turkish Statistical Institute (TurkStat).

Figure 14 below shows that as of 2019, in Turkey, the imports of intermediate goods consist of processed materials incidental to industry which represent 47.03%, crude oil and natural gas which represent 16.84%, parts of transportation vehicles which represent 8.65%, unprocessed materials incidental to industry which represent 7.48%, parts of investment goods which represent 6.84%, and of processed fuels and oils which represent 6.41%. Almost half of the intermediate imports consist of processed materials which are important for the Turkey's industrial production indicating that Turkey has limited domestic capacity to produce certain key goods.

Figure 14

Shares of Sectors in the Value of Imports of Intermediate Goods, 2019

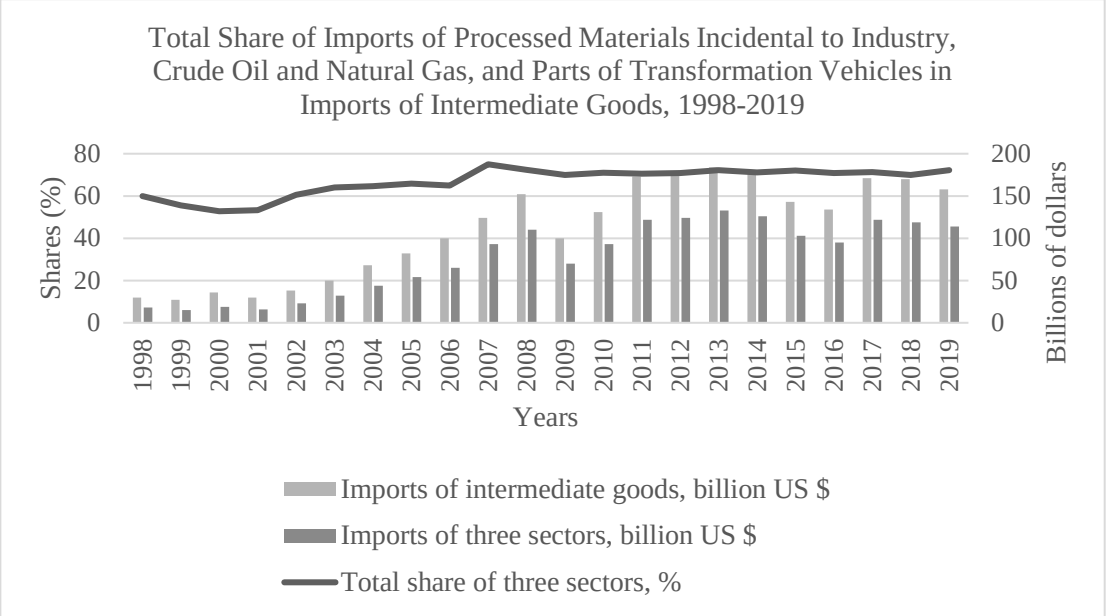


Note. Source: Turkish Statistical Institute (TurkStat).

Structural change in three sectors that have a large share in the value of imports of intermediate goods is shown in Figure 15 below. During the 22-year period, total share of processed materials incidental to industry, crude oil and natural gas, and parts of transportation vehicles in the value of imports of intermediate goods increased from 60% up to 72.15%.

Figure 15

Total Share of Imports of Processed Materials Incidental to Industry, Crude Oil and Natural Gas, and Parts of Transformation Vehicles in Imports of Intermediate Goods, 1998-2019



Note. Source: Turkish Statistical Institute (TurkStat).

4. OUR EXTENDED BALANCE OF PAYMENTS CONSTRAINT GROWTH MODEL WITH CAPITAL FLOWS AND INTERMEDIATE, CONSUMPTION AND CAPITAL GOODS IMPORTS

In this section, we extend the BPCG model (Thirlwall, 1979) and present our extended BPCG model for the Turkish economy. Our extended BPCG model involves both the capital inflows as the proportions of imports bill and the disaggregated imports demand functions into intermediate, consumption and capital goods. In our model, the analysis for the balance of payments equilibrium growth rate considers the composition of imports and exports as well as the income elasticities and other estimated coefficients. All variables are stated in levels of usual logarithms so that their estimated coefficients can be understood as elasticities.

The basic BPCG model is highly simplified, but the empirical studies support the Thirlwall law in the long run. Although its bareness is part of its power, it also seems to be important to evaluate its predictions as a guiding tool for governmental policy, where perhaps short run decisions may take precedence. Therefore, in this section, we will incorporate the two extensions mentioned in the Introduction section above to the Thirlwall's basic model of BPCG. Namely, we allow for capital inflows and apportion the total imports between various sectors (intermediate, consumption and capital imports).

The merchandise trade balance (TB) of the country expressed in foreign currency (in US dollars) is in an initial disequilibrium and financed by capital inflows/outflows[12],

$$P_{xt} X_t + C_t = (M_{it} * P_{it} + M_{ct} * P_{ct} + M_{kt} + P_{kt}) \quad (57)$$

where X_t and P_{xt} are the volume and price of exports, C_t is the value of capital flows measured in foreign currency, M_{it}, M_{ct} and M_{kt} are the volumes of intermediate, consumption and capital goods, P_{it}, P_{ct} and P_{kt} are their prices in foreign currency respectively (multi-sectoral imports) and t is a time index. We explain $M_t = (M_{it} * P_{it} + M_{ct} * P_{ct} + M_{kt} + P_{kt})$ as the nominal value of total imports in foreign currency. Taking the continuous rates of change of the variables in Eq. (57) and denoting them by lower case letters[13],

$$\alpha_t (p_{xt} + x_t) + (1 - \alpha_t) c_t = [\theta_{1t} (m_{it} + p_{it}) + \theta_{2t} (m_{ct} + p_{ct}) + \theta_{3t} (m_{kt} + p_{kt}) \quad (58)$$

where $\alpha_t = (P_{xt} X_t) / M_t$ and $(1 - \alpha_t) = C_t / M_t$ are the time varying shares of exports earnings and capital flows as a proportion of the imports bill respectively. $\theta_{jt} = (M_{jt} *$

[12] We abstain from the services imports and exports, incomes earned/paid on investments at home/abroad and unilateral transfers so that the current account reduces to the trade balance of goods only.

[13] In Eq. (58), we used the fact that the instantaneous rate of growth of product is the sum of the instantaneous rate of growth of its components whereas the instantaneous rate of growth of a sum is a weighted average of the instantaneous rates of growth of its components.

P_{jt}) / M_t for j = 1, 2 and 3, are the time varying shares of intermediate, consumption and capital goods imports as a proportion of total imports respectively[14].

Assuming a multiplicative intermediate, consumption and capital imports demand functions with constant elasticities,

$$M_{it} = \left(\frac{Pxt}{Pit}\right)^{\varepsilon i} Y_t^{\pi i} X_{nt}^{\beta}$$

$$M_{ct} = \left(\frac{Pxt}{Pct}\right)^{\varepsilon c} Y_t^{\pi c}$$

$$M_{kt} = \left(\frac{Pxt}{Pkt}\right)^{\varepsilon k} Y_t^{\pi k} \qquad (59)$$

where ε_i, ε_c, ε_k and π_i, π_c, π_k are the price and income elasticities of demand for intermediate, consumption and capital imports respectively, Y_t is the domestic income, X_{nt} is the manufactured exports and β is the elasticity of demand for intermediate imports with respect to manufactured exports. All elasticities are defined to be positive. We assumed that the demands for consumption and capital imports are not functions of exports and these types of imports are consumed for domestic purposes. Our econometric estimations in Section 5 below support this assumption. We differentiated the prices by the types of imports: P_{it}, P_{ct} and P_{kt}. Finally, P_{xt} is the foreign prices of exports.

The rates of growth of demand for imports in Eq. (59) can be written (in lower-case letters)

$$m_{it} = \varepsilon_i (p_{xt} - p_{it}) + \pi_i y_t + \beta x_{nt}$$

$$m_{ct} = \varepsilon_c (p_{xt} - p_{ct}) + \pi_c y_t$$

[14] In Eq. (58), we preserved the possible time-dependency of shares (α_t, θ_{1t}, θ_{2t}, θ_{3t}) just as the time variability of the growth rates of variables (p_{xt}, x_t, c_t, p_{it}, p_{ct}, p_{kt}, m_{it}, m_{ct} and m_{kt}).

$$m_{kt} = \varepsilon_k (p_{xt} - p_{kt}) + \pi_k y_t \quad (60)$$

where m_{it}, m_{ct}, and m_{kt} are the demand functions for imports of intermediate (LIMPI), consumption (LIMPC) and capital goods (LIMPK) (respectively); y_t is the domestic income (LGDP); $(p_{xt} - p_{it})$, $(p_{xt} - p_{ct})$ and $(p_{xt} - p_{kt})$ are the terms of trade (or the relative prices) of imports of intermediate (LTOTI), consumption (LTOTC) and capital goods (LTOTK), (respectively); x_{nt} is the manufactured exports (LMANEX). See Appendix A for more details on data sources and definitions.

Substituting the Eqs. in (60) into (58), we can solve for the rate of income, y_{Bt}, consistent with a disequilibrium merchandise trade balance (TB) financed by capital flows while apportioning total imports among intermediate, consumption and capital goods imports.

$$y_{Bt} = [((\alpha_t - \beta\theta_{1t})\, x_{nt} + (1-\alpha_t)(c_t - p_{xt})) + ((p_{xt} - \theta_{1t}\, p_{it} - \theta_{2t}\, p_{ct} - \theta_{3t}\, p_{kt}) - (\theta_{1t}\varepsilon_i (p_{xt} - p_{it}) + \theta_{2t}\varepsilon_c (p_{xt} - p_{ct}) + \theta_{3t}\varepsilon_k (p_{xt} - p_{kt})))] / (\theta_{1t}\, \pi_i + \theta_{2t}\, \pi_c + \theta_{3t}\, \pi_k) \quad (61)$$

Derivation in Eq. (61) corresponds to neither the weak nor the strong version of BPCG. We have not presumed that the relative prices (purchasing power parity) are constant. However, we kept the growth rate of exports of the country, x_{nt}, in this formulation since we have not collected data on the world income. The formulation in Eq. (61) can be named as a weak version of BPCG without presuming that the relative prices (the ratio of exports prices to imports prices) are constant.

If we assume that the imports prices in these three sectors are the same ($p_{it} = p_{ct} = p_{kt}$) and are equal to say, foreign prices, p_{ft}, then Eq. (61) reduces to (dropping the time subscript)

$$y_B = [(\alpha-\beta\theta_1)\, x_n + (1-\alpha)\,(c-p_x) + ((p_x - p_f)\,(1-\theta_1\varepsilon_i - \theta_2\varepsilon_c - \theta_3\varepsilon_k))] \,/\, (\theta_1\,\pi_i + \theta_2\,\pi_c + \theta_3\,\pi_k) \quad (62)$$

In Eq. (62), $(\alpha-\beta\theta_1)\, x_n$ explains the contribution of exports to the BPCG taking into account the fact that intermediate imports increase due to an increase in exports, holding the level of GDP constant (Blecker & Ibarra, 2013). $(1-\alpha)\,(c-p_x)$ shows the effect of real capital flows (nominal capital flows adjusted by the exports prices in foreign currency) on the BPCG. Finally, $((p_x - p_f)\,(1-\theta_1\varepsilon_i - \theta_2\varepsilon_c - \theta_3\varepsilon_k))$ is a version of the Marshall-Lerner (ML) condition of this model. It does not incorporate the price elasticity of demand for exports of the country, since this elasticity is already captured by the exports growth term, x_n. In our econometric estimation in Section 5.2 we will show that the imports sectors shares-weighted price elasticity of demand for imports (ε's) is less than one. Therefore, an appreciation of the domestic currency ($p_x - p_f > 0$) will lead to an increase of the BPCG (given an exports growth rate), since the volume of imports will increase less than in proportion to the decrease in the foreign prices of imports relative to the prices of exports in foreign currency. Thus, the imports bill will decrease relaxing the trade balance and allowing faster income growth. However, this effect turns out not to be so important in the case of Turkey whose periods of economic growth have always been accompanied with heavy capital inflows. In these periods, the Turkish Lira (TL) necessarily appreciated. As we will discuss further in Section 5.2.6 below, the relative price effects are not important as also reinforced by the Thirlwall hypothesis, but the capital inflows remain an important driving force for the Turkish economic growth.

To calculate y_B in Eq. (62), we need to estimate the equations of the structural model (i.e. equations in Eq. (60)) to obtain estimates of the parameters β, π's and ε's. All other

variables and parameters that go into the calculation of Eq. (62) can be obtain from the descriptive statistics using the Table 10 in Section 5.2.6. See Appendix A for data measurement.

5. ECONOMETRIC METHODOLOGY AND ESTIMATION RESULTS

In this section, we will define the estimation methods applied in this thesis (the bounds testing and the first differences estimation methods) and show the estimation results of the regression equations (imports of intermediate, consumption, capital and final (sum of the consumption and capital goods)goods) where we paid attention to possible structural breaks. In this section, we will also compare the calculated rates of growth of income for the Turkish economy from our extended BPCG model, y_B, as given by Eq. (62) above, and that obtained from the basic Thirlwall Law, against the rate of growth of actual income of Turkey. We will also investigate the relationship between the rates of growth of the Turkish GDP and the nominal capital flows.

5.1. Econometric Methodology

We implemented two different kinds of estimation methods: Bounds testing method (an autoregressive distributed lag, ARDL model in error correction form) to the analysis of level relationships (Pesaran, Shin & Smith, 2001) for the period from 1998Q1 to 2019Q3 for a total of 87 quarterly observations and the first differences method for the period from 1998 to 2019 for a total of 22 yearly observations. We paid attention to possible structural breaks in the regression equations. We tested the import demand functions for structural breaks by using Chow test. Despite some variation in the results, this test showed statistically significant breaks in 2001 using the bounds testing estimation method and in 2009 using the first difference estimation method.

All the variables we used in the regression equations were subjected to unit root test separately to test whether they are stationary or not. We carried out Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt, and Shinn (KPSS) tests to test the time properties of the variables. All the tests and the estimations were carried out, by using EViews 10 package program (See Appendix A for data sources).

5.1.1. Unit Root Test for Examining Stationarity

Stationary process plays important role in the analysis of time series and the probability distributions of a stationary time series are stable over time in the following sense: if we take any collection of random variables in the sequence and then move that sequence ahead h time periods, the joint probability distribution must remain unchanged. A formal definition of stationary as follows:

Stationary stochastic process: The stochastic process $\{x_t : t = 1,2,\ldots\}$is stationary if for every collection of time indices $1 \leq t_1 < t_2 <\ldots< t_m$, the joint distribution of $(x_{t1},x_{t2},\ldots,x_{tm})$ is the same as the joint distribution of $(x_{t1+h} + x_{t2+h},\ldots,x_{tm+h})$ for all integers $h \geq 1$. Stationarity requires that the joint distribution of (x_1, x_2) (the first two terms of in the sequence) must be the same as the joint distribution of (x_t, x_{t+1}) for any $t \geq 1$. This places no limitation on how x_t and x_{t+1} are related to each other; in fact, they may be highly correlated. Stationarity needs that the nature of any correlation between adjacent terms is the same across all time periods. A stochastic process that is not stationary is called to be a nonstationary process. Many economic time series have a common tendency of growing over time. It should be noted that some series contain a time trend to draw casual inference using time series data. If we ignore the fact that two sequence are trending in the same or opposite directions, this can lead us to falsely infer that changes in one variable are caused by changes in another variable. In many cases,

two time series processes seem to be correlated only since they are both trending over time for reasons related to other unobserved factors.

Covariance stationary process: If (i) $E(x_t)$ is constant; (ii) $Var(x_t)$ is constant; (iii) for any t, $h \geq 1$, $Cov(x_t,x_{t+h})$ depends only on h and not on t, a stochastic process $\{x_t: t=1,2\ldots\}$ with finite moment $[E(x_t^2) < \infty]$ is covariance stationary. Covariance stationarity undertake only the first two moments of a stochastic process: the mean and variance of the process are constant across time, and the covariance between x_t and x_{t+h} depends only on the distance between the two terms, h, and not on the location of the initial time period, t. It follows that the correlation between x_t and x_{t+h} also relies only on h.

A stationary time series process $\{x_t: t = 1, 2, \ldots\}$is said to be weakly dependent if x_t and x_{t+h} is almost independent as h increases without limit. A covariance stationary time series is weakly dependent if the correlation between x_t and x_{t+h} goes to zero sufficiently quickly as h goes to ∞ (Wooldridge, 2009).

A simple autoregressive, AR (1) process is

$$y_t = \rho y_{t-1} + \pi_t'\delta + \varepsilon_t \qquad (63)$$

where π_t and δ are the vectors of the optional exogenous regressors which may contain constant, or a constant and trend, ρ is a parameter to be estimated, and the ε_t are assumed to be white noise. If $|\rho| \geq 1$, y is a nonstationary series and the variance of y increases in time and closes to infinity. If $|\rho| < 1$ (stability condition which is crucial assumption for weak dependence of an AR (1) process), y is a (trend) stationary series. The hypothesis of (trend) stationarity can be evaluated by testing whether the absolute value of ρ is less than one. The null hypothesis is H_0: $\rho = 1$, its alternative is H_1: $\rho<1$ (EViews, Basic Unit Root Theory, 2019).

5.1.1.1. Augmented Dickey Fuller (ADF) Test

The standard Dickey-Fuller test is carried out by estimating Eq. (63) after subtracting y_{t-1} from both sides of the equation:

$$\Delta y_t = \alpha y_{t-1} + \pi_t' \delta + \varepsilon_t \quad (64)$$

Where $\alpha = \rho - 1$, the null of unit root and alternative hypotheses are H_0: $\alpha = 0$, H_1: $\alpha < 0$.

The simple Dickey-Fuller unit root test described above is valid only if the series is an AR (1) process. If the series is correlated at higher order lags, the assumption of white noise disturbances ε is violated. The Augmented Dickey Fuller (ADF) test (Dickey & Fuller, 1981) generates a parametric correction for higher-order correlation by assuming that the y series follows an AR (p) process and adding p lagged difference terms of the dependent variable y to the right-hand side of the test regression:

$$\Delta y = \alpha y_{t-1} + \pi_t' \delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \ldots + \beta_p \Delta y_{t-p} + \upsilon_t \quad (65)$$

"An important result obtained by Fuller is that the asymptotic distribution of the t-ratio for α is independent of the number of lagged first differences included in the ADF regression. Moreover, while the assumption that y follows an autoregressive (AR) process may seem restrictive, Said and Dickey (1984) demonstrate that the ADF test is asymptotically valid in the presence of a moving average (MA) component, provided that sufficient lagged difference terms are included in the test regression" and in performing an ADF test, "you must choose whether to include exogenous variables in the test regression. You have the choice of including a constant, a constant and a linear time trend, or neither in the test regression" (The Augmented Dickey-Fuller (ADF) test, 2019).

5.1.1.2 Phillips-Perron (PP) Test

This is an alternative (nonparametric) method of controlling for serial correlation when testing for a unit root (Phillips & Perron, 1988). The PP method estimates the non-augmented DF test Eq. (64) and modifies the ţ-ratio of the α coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic. The PP test depends on the statistic:

$$ŧ_\alpha = ţ_\alpha \left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0-\gamma_0)(se(\check{\alpha}))}{2f_0^{1/2}s} \quad (66)$$

where ă is the estimate, $ţ_\alpha$ is the ţ-ratio of α, and se(ă) is coefficient standard error, s is the standard error of the test regression, and γ_0 is a consistent estimate of the error variance in Eq. (64) (computed as (T-k) s^2 / T, where k is the number of regressors). The remaining term, f_0, is an estimator of the residual spectrum at frequency zero. When performing the PP test, first, one must choose whether to include a constant, a constant and a linear time trend, or neither, in the test regression. Second, one must choose a method for estimating f_0. EViews supports estimators for f_0 based on kernel-based sum-of-covariances, or on autoregressive spectral density estimation (EViews, Frecuency Zero Spectrum Estimation, 2020). The asymptotic distribution of the PP modified ţ-ratio is the same as that of the ADF statistic. The null hypothesis of a unit root is tested by using MacKinnon lower-tail critical and *p*-values. (EViews, The Phillips-Perron Test, 2020).

5.1.1.3. Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) Test

The KPSS test (Kwiatkowski, Phillips, Schmidt, & Shin, 1992) differs from other unit root tests described above in that the series y_t is assumed to be (trend-)

stationary under the null hypothesis, and the KPSS statistic is based on the residuals from the OLS regression of y_t on the exogenous variables π_t :

$$y_t = \pi_t'\delta + u_t. \quad (67)$$

The LM statistic is defined as:

$$LM = \sum_t S(t)^2/(T^2 f_0) \quad (68)$$

Where f_0 refers to an estimator of the residual spectrum at frequency zero (EViews, Frecuency Zero Spectrum Estimation, 2020) and S(t) refers to cumulative residual function:

$$S(t) = \sum_{r=1}^{t} u_r \quad (69)$$

Based on residuals $u_t = y_t - \pi_t'\delta$ (0).

To specify the KPSS test, one must specify the set of exogenous regressors π_t and a method for estimating f_0 (EViews, KPSS Test, 2020). The reported critical values are obtained from Kwiatkowski et al. (1992), Table 1.

5.1.2. Analyzing the Estimation Methods Conducted in this Research

5.1.2.1. Bounds Testing Estimation Method

Since our variables are not all integrated of the same order, in our estimations, we preferred the bounds testing method developed by Pesaran et al. (2001). This approach is suitable because the variables used in the estimation can be combined with different orders of integration, *I*(0) or *I*(1), it has good small sample properties and

provides unbiased estimators in the long run even if some variables are endogenous within an autoregressive distributed lag (ARDL) framework.

First, we estimate an autoregressive distributed lag (ARDL) model as Pesaran et al. (2001) suggested. In this model, long-term and short-term variables can be showed simultaneously in error correction form as follows:

$$\Delta \text{Trade}_t = d_0 + \sum_{j=1}^{n} a_j \Delta Trade_{t-j} + \sum_{i=1}^{k} \sum_{j=0}^{n} b_{i,j} \Delta Z_{i,t-j} + \sigma \text{Trade}_{t-1} + \sum_{i=1}^{k} d_i Z_{i,t-1} \quad (70)$$

where Δ refers to first difference of the variable, -σ measures the speed of adjustment (or error-correction coefficient) of imports toward the long run equilibrium specified by Eq. (71) below. Trade can be imports of intermediate, LIMPI, or final goods (the sum of consumption and capital goods), LIMPF. The regressors Z consists of three potential determinants: Turkey's real output, LGDP; The real exchange rate, LRER; Manufactured exports, LMANEX. See Appendix A for more details on data sources and definitions.

Second, Pesaran at al. (2001) suggested that one should perform two bounds tests for the existence of a long run association: a t-test should be performed for the significance of the speed of adjustment coefficient, σ, and an F-test should be performed for the joint significance of σ and d_i coefficients. Every test has higher and lower bounds for each significance level, where the critical values depend on the number of independent variables. If the estimated statistic (t or F) lies above the upper bound for a given significance level, the null of no long run relation can be rejected even if all variables are *I*(1); if the statistics lie between the higher and lower bounds,

the null can be rejected only if all variables are *I*(0) but if the statistics are below the lower bound *I*(0), the null cannot be rejected regardless of the order of integration.

Third, the lag structure of Eq. (70) above is simplified by eliminating stepwise the longest statistically insignificant lags of the first differences for each variable. Then, the long run coefficients in Eq. (70) can be retrieved as $\square_i = -d_i / \sigma$ for each regressor i, leading to the long run equation:

$$Trade_{LR} = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \ldots + \delta_k Z_k \quad (71)$$

When we estimated the equations of the structural model (in Eq. (60)), we apportioned the total imports among two sectors rather than three sectors: Imports of intermediate (LIMPI) and final goods (the sum of consumption and capital goods, LIMPF) equations, for a total of 87 quarterly observations (1998-2019). Only these regression equations yielded statistically more adequate estimates compared to three-sector imports equations. LIMPI and LIMPF equations passed all the battery of diagnostic tests and bounds tests (especially when we allow for structural breaks), thus indicating the success of this method to cover a long run relationship in those equations. In addition, we used real exchange rate, LRER variable rather than the terms of trade variables (in Eq. (60)). This was because in the bounds testing method, using three different types of terms of trade variables with respect to three regression equations (LIMPI, LIMPC and LIMPK) yielded either high or negative GDP coefficient or positive or statistically insignificant error-correction terms, especially when we allow for structural breaks.

5.1.2.2. First Differences Estimation Method

In first differences method, lagging Eq. (60) by one period and taking the first differences yield

$$\Delta \text{Trade}_t = \beta_0 + \sum_{i=1}^{k} \beta_i \Delta Z_{i,t} \quad (72)$$

where Δ denotes the first difference of the variable, Trade can be imports of intermediate, LIMPI, consumption, LIMPC or, capital goods, LIMPK. The regressors Z consists of three potential determinants: Turkey's real output, LGDP; Terms of trade (or relative price) of intermediate imports, LTOTI, consumption goods imports, LTOTC, or capital goods imports, LTOTK; Manufactured exports, LMANEX. We estimated the equations of the structural model in Eq. (60) for a total of 22 yearly observations (1998-2019). Note that more details on data sources and definitions are in Appendix A.

5.1.2.3 Standard Diagnostic Tests

When implementing both estimation methods explained above, statistical adequacy of each regression equation needs to be ensured. This incorporates determining the number of lags to be included (only for ARDL models) and certifying that the standard diagnostic tests are satisfied. ARDL Model identification is important in time series analysis. It is necessary to identify the model that represents only the main futures of a time series. A selection criterion must be used to select model order and to balance model fit (Koehler & Murphree, 1988). The optimal lag length is determined according to the lowest Akaike Information Criteria (AIC) (Akaike, 1974) and/or Schwarz Information Criteria (SIC) (Schwarz, 1978) allowing the selected optimum model to pass the standard diagnostic tests (EViews, User's Guide, 2019) as follows:

- Breusch-Godfrey serial correlation LM test belongs to the class of asymptotic (large sample) tests known as Lagrange Multiplier (LM) tests. Unlike the Durbin-Watson static for AR (1) errors, the LM test may be utilized to test for higher order ARMA errors and may be applicable whether there are lagged dependent variables

or not. With the possibility that your errors exhibit autocorrelation, LM test is carried out under the null hypothesis of no serial correlation. If the test indicates serial correlation in the residuals, Least Squares standard errors are infirmed and should not be used for inference.

• ARCH test is a Lagrange multiplier (LM) test for autoregressive conditional heteroskedasticity (ARCH) in the residuals (Engle, 1982) to test for a range of specifications of heteroscedasticity in the residuals of an equation, and the null hypothesis is that there is no heteroscedasticity. OLS estimates are consistent in the presence of heteroscedasticity, but the computed standard errors are no longer valid.

• RESET stands for Regression Specification Error Test (Ramsey, 1969). The classical normal linear regression model is $y = \beta X + \upsilon$, where y is dependent variable, X is independent variable, β is the coefficient of independent variable, and υ is the error term. RESET is a general test for the following types of specification errors: Omitted variables; X may not include all relevant variables. Incorrect functional form: some or all the variables in y and X need to be converted to logs, powers, reciprocals or in some other way. Correlation between X and υ, which may be caused, among other things, by measurement error in X, simultaneity, or the presence of lagged y values and serially correlated error terms. Reset test detects whether there is no specification error (the null hypothesis) in an equation.

• The purpose of the breakpoint CHOW test is to fit the equation separately for each subsample and to grasp whether there are significant differences in the estimated equations. A significant difference shows a structural change in the relationship. By default, the Chow breakpoint test tests whether there is a structural change in all the equation parameters.

5.2. Estimation Results

In this section, we will show the results of unit root tests (ADF, PP and KPSS tests) and the estimated equations for imports (including the results of AIC and SIC information criterions (in bounds testing) and diagnostic tests). In the bounds testing and the first differences methods, our estimation period runs from 1998Q1 to 2019Q3 for a total of 87 quarterly observations and from 1998 to 2019 for a total of 22 yearly observations, respectively. All the variables (See Appendix A for data sources) in the regression equations are stated in levels of natural logarithms so that their estimated coefficients can be understood as elasticities. Since using variables in first differences in differenced form loses data about long-run relations, we express the variables in (log) levels while using an econometric procedure that controls for potential unit roots in the variables.

5.2.1. Results of Unit Root Tests

The whole time series data in our regression equations were subjected to unit root test separately. Tables 2 and 3 below report the results of the Augmented Dickey Fuller (ADF) unit root test for the 87 quarterly and for the 22 yearly observations, respectively. The variables are stationary either in their level with trend or in their first differences.

The null hypothesis and its alternative of ADF test are,

H_0: There is a unit root for the series,

H_1: There is no unit root for the series.

Since the computed ADF statistics are lower than the critical values in their first differences, the null hypothesis of a unit root of the ADF test is rejected, and its alternative of non-unit root is accepted.

Table 2

Unit Root Test (sample period: 1998Q1-2019Q3; 87 observations) Augmented Dickey Fuller (ADF) Test.

Null: unit root $I(1)$[a]	Level	Level with trend	First difference
Imports of final goods, LIMPF	-1.81	-2.20	-13.50*
Imports of intermediate goods, LIMPI	-1.75	-3.35	-9.60*
Gross Domestic Products, LGDP	-1.50	-7.18	-10.31*
Real exchange rate, LRER	-2.36	-2.61	-10.55*
Manufactured exports, LMANEX	-1.65	-3.21	-15.30*
1%	-3.50	-4.06	-3.50
5%	-2.89	-3.46	-2.89
10%	-2.58	-3.15	-2.58

Note. All tests assume an intercept.
[a] *: The null hypothesis of a unit root is rejected at the 1%, 5%, 10% significance levels, using McKinnon one-sided p-values for ADF.

Table 3

Unit Root Test (sample period: 1998-2019; 22 observations)

Augmented Dickey Fuller (ADF)Test.

Null: unit root $I(1)$[a]	Level	Level with trend	First difference
Imports of intermediate goods, LIMPI	-1.65	-2.05	-5.61*
Imports of consumption goods, LIMPC	-1.43	-1.29	-5.22*
Imports of capital goods, LIMPK	-1.65	-0.88	-4.07*
Gross Domestic Products, LGDP	0.03	-3.10	-4.22*
Terms of trade of intermediate imports, LTOTI	-2.27	-1.78	-4.31*
Terms of trade of consumption imports, LTOTC	-1.47	-1.79	-3.90*
Terms of trade of capital imports, LTOTK	-1.46	-1.05	-4.31*
Manufactured exports, LMANEX	-2.58	-1.25	-3.52**
1%	-3.78	-4.46	-3.80
5%	-3.01	-3.64	-3.02
10%	-2.64	-3.26	-2.65

Notes. All tests assume an intercept.
[a] *, **: For first difference the null hypothesis of a unit root is rejected at the 1%, 5%, 10% significance levels, using McKinnon one-sided p-values for ADF.

Tables 4 and 5 below report the Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) unit root tests, for the 87 quarterly and for the 22 yearly observations, respectively. The variables are stationary either in their level with trend or in their first differences.

The null hypothesis and its alternative of PP test are,

H_0: There is a unit root for the series.

H_1: There is no unit root for the series.

Since the computed PP statistics are lower than the critical values, the null hypothesis of a unit root of the PP test is rejected, and its alternative of non-unit root is accepted. The null hypothesis and its alternative of KPSS test are,

H_0: The series are stationary.

H_1: The series are not stationary.

Since the computed KPSS statistics are lower than the critical values, the null hypothesis of a stationarity of the KPPS test is accepted, and its alternative of non-stationarity is rejected.

Table 4

Unit Root Tests (sample period: 1998Q1-2019Q3; 87 observations). Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt, and Shinn (KPSS) Tests

	Phillips-Perron (PP) Null: unit root *I* (1)[a]			Kwiatkowski, Phillips, Schmidt, and Shinn (KPSS) Null: stationarity *I* (0)[b]		
	Level	Level with trend	First difference	Level	Level with trend	First difference
Imports of final goods, LIMPF	-1.61	-2.12	-12.98*	0.95	0.24	0.50^{+++}
Imports of intermediate	-1.86	-3.23	-16.64*	1.11	0.22	0.37^{++}

goods, LIMPI						
Gross Domestic Products, LGDP	-0.94	-7.14	-15.90*	1.16	0.11	0.05+
Real exchange rate, LRER	-2.19	-2.52	-11.29*	0.33	0.29	0.25+
Manufactured exports, LMANEX	-2.46	-3.41	-17.54*	1.13	0.29	0.39++
1%	-3.50	-4.06	-3.50	0.73	0.21	0.73
5%	-2.89	-3.46	-2.89	0.46	0.14	0.46
10%	-2.58	-3.15	-2.58	0.34	0.11	0.34

Notes. See Appendix A for data sources. All tests assume an intercept and use the Bartlett kernel and Newey-West Bandwidth.
[a] *: The null hypothesis of a unit root is rejected at the 1%, 5%, 10% significance levels, using McKinnon one-sided p-values for PP.
[b] +++ , ++, +: The null hypothesis of stationarity is accepted at the 1%, 5%, 10% significance levels. Critical values from Kwiatkowski et al. (1992, Table 1).

Table 5

Unit Root Tests (sample period: 1998-2019; 22 observations). Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt, and Shinn (KPSS) Tests

	Phillips-Perron (PP) Null: unit root *I* (1)[a]			Kwiatkowski, Phillips, Schmidt, and Shinn (KPSS) Null: stationarity *I* (0)[b]		
	Level	Level with trend	First difference	Level	Level with trend	First difference
Imports of intermediate goods, LIMPI	-2.64	-1.91	-5.74*	0.62	0.17	0.29+

Imports of consumption goods, LIMPC	-1.39	-1.18	-5.22*	0.54	0.16	0.17+
Imports of capital goods, LIMPK	-1.65	-0.90	-4.05*	0.51	0.15	0.26+
Gross Domestic Products, LGDP	-0.02	-3.10	-4.23*	0.64	0.07	0.11+
Terms of trade of intermediate imports, LTOTI	-2.27	-1.78	-4.31*	0.42	0.15	0.23+
Terms of trade of consumption goods, LTOTC	-1.47	-1.93	-3.88*	0.28	0.11	0.09+
Terms of trade of capital goods, LTOTK	-1.46	-1.05	-4.31*	0.35	0.14	0.21+
Manufactured exports, LMANEX	-2.79	-1.22	-3.60**	0.63	0.16	0.39++
1%	-3.78	-4.46	-3.80	0.73	0.21	0.73
5%	-3.01	-3.64	-3.02	0.46	0.14	0.46
10%	-2.64	-3.26	-2.65	0.34	0.11	0.34

Notes. See Appendix A for data sources. All tests assume an intercept and use the Bartlett kernel and Newey-West Bandwidth.

[a] *,**: The null hypothesis of a unit root is rejected at the 1%, 5%, 10% significance levels, using McKinnon one-sided p-values for PP.

[b] ++, +: The null hypothesis of stationarity is accepted at the 1%, 5%, 10% significance levels. Critical values from Kwiatkowski et al. (1992, Table 1).

The tests reveal a mixture of stationary and nonstationary variables either in their levels or in their levels with trend, but all variables are stationary in their first differences.

5.2.2. Estimations of Imports of intermediate Goods Equations

The results of the estimated equations for the demand for imports of intermediate goods using the bounds testing and the first differences (respectively) methods are reported in Table 6 below. In the bounds testing method, we included the gross domestic product, LGDP, real exchange rate, LRER, and manufactured exports, LMANEX as regressors using quarterly data for the period of 1998-2019. Both the estimated equation without structural break (column 1) and the estimated equation with structural break (column 2) passed the bounds F-test but did not pass the bounds t-test. An increase in LGDP, an increase in LRER (a real appreciation of Turkish Lira), and an increase in LMANEX tend to raise the demand for imports of intermediate goods as expected. Using the Chow test and allowing for a structural break for the year of 2001 in column 2, we observe that the elasticity of LGDP is 0.72 before 2001 and 0.75 after 2001 suggesting that a 1% increase in domestic income would raise Turkey's imports of intermediate goods by about 0.75% after 2001. LRER is significant and implies that a 1% appreciation (depreciation) of Turkish Lira would raise (decrease) Turkey's demand for imports of intermediate goods by about 0.26-0.30%. LMANEX is also significant, and we find that a 1% increase in manufactured exports would raise Turkey's demand for imports of intermediate goods by about 0.25-0.29%. The speed of adjustment, σ is -0.50 indicating that the imports of intermediate goods approach the equilibrium state in the long run at a speed of 50% each quarter.

In the first differences method (columns 3 and 4) we included the gross domestic product, LGDP, the terms of trade in the intermediate goods sector, LTOTI, and LMANEX as regressors and were unable to identify any statistically significant structural break for the year of 2001 in the coefficient of LGDP using yearly data. The elasticities with respect to LGDP (range of 1.03 to 1.05) and to LMANEX (range of 0.67 to 0.74) were found to be higher compared to the estimated elasticities of LGDP (range of 0.69 to 0.72) and of LMANEX (range of 0.25 to 0.29) from the bounds testing approach above respectively. However, we found that the estimated price elasticity with respect to LTOTI (0.16) from the first differences method (column 3) is insignificant and somehow lower than the estimated price elasticity of LRER (range of 0.26 to 0.30) from the bounds testing approach above.

Table 6

Estimated Equations for Imports of Intermediate Goods

Estimation method	Bounds testing estimates in log levels		OLS estimates in log first differences	
Estimated equation	(1)	(2)	(3)	(4)
Sample period	1998Q1-2019Q3	1998Q1-2019Q3	1998-2019	1998-2019
Speed of adjustment, σ	-0.49	-0.50		
Gross domestic product, LGDP	0.69(0.00)	0.72(0.00)	1.03(0.00)	1.05(0.00)
Real exchange rate, LRER	0.26(0.04)	0.30(0.01)		
Terms of trade, LTOTI			0.16(0.22)	
Manufactured exports, LMANEX	0.29(0.00)	0.25(0.02)	0.74(0.00)	0.67(0.00)
Dummy for 2001*LGDP		0.03(0.04)		
Adjusted R^2	0.76	0.78	0.87	0.86
Bounds tests				

t-test	-3.74*	-3.76*		
F-test	4.48**	6.35**		
Diagnostics (p-values, for F-statistics, where relevant)				
Serial correlation (Breusch-Godfrey 2 lags)	0.054	0.127	0.714	0.680
RESET (squared fitted values)	0.695	0.377	0.070	0.263
ARCH(1 lag)	0.885	0.465	0.797	0.516

Notes. Numbers in parentheses are p-values.
Coefficients for the bounds testing estimates are long run coefficients after model simplification.
The regression equation in column 1 was estimated with four lags as suggested by the Akaike (AIC) and Schwarz (SIC) criteria (-3.07 and -2.37, respectively). The inclusion of four lags is sufficient to pass the standard diagnostic tests. Increasing or reducing the number of lags caused problems with diagnostic tests or increased AIC or SIC criteria.
Diagnostic tests for the first differences and for the bounds testing (after model simplification) show the p-values. The nulls of no serial correlation (Breusch-Godfrey), no misspecification in model (Ramsey's RESET test), and no heteroskedasticity (no ARCH errors) are accepted.
*: We cannot reject the null of no cointegration under the condition that all variables are *I*(0), at 1%, 5%, and 10% using asymptotical critical values (Pesaran et al., 2001), table CII(i): Case I for t-test.
**: We can reject the null of no cointegration under the condition that all variables are *I*(0), at 1%, 5%, and 10% using asymptotical critical values (Pesaran et al., 2001), table CI(i): Case I for F-test.

5.2.3. Estimations of Imports of Consumption Goods Equations

The results of the estimated equations for the demand for imports of consumption goods using the first differences method are reported in Table 7 below. We included gross domestic product, LGDP and manufactured exports, LMANEX as the only regressors since the terms of trade variable was found to be statistically insignificant. The elasticity of LGDP is 2.52 and significant for 1998-2019 (the whole period) in column 1. This elasticity is estimated to be 3.75 before 2009 and 1.11 (3.75-2.64) after 2009 using a structural break (Chow test) and thus having an average of 2.43 for the whole period (column 2). This average elasticity of 2.43 of LGDP is quite close to 2.52, which was that found without a structural break. Therefore, we concluded that a 1% increase in domestic income would raise Turkey's demand for imports of

consumption goods by about 2.43 to 2.52 for the whole sample period. However, a significant downward shift (-2.64) in the elasticity of the demand for consumption goods with respect to LGDP is found after the Global Crisis of 2009. The elasticity of LMANEX is not significant in column 1 whereas it is significant only at 10% significance level in column 2. Therefore, we conclude that a change in the manufactured exports (LMANEX) does not affect the demand for the imported consumption goods holding GDP constant.

Table 7

Estimated Equations for Imports of Consumption Goods

Estimation method	OLS estimates in log first differences	
Estimated equation	(1)	(2)
Sample period, yearly	1998-2019	1998-2019
Gross domestic product, LGDP	2.52(0.00)	3.75(0.00)
Manufactured exports, LMANEX	0.19(0.67)	-0.71(0.08)
Dummy for 2009*LGDP		-2.64(0.00)
Adjusted R^2	0.35	0.66
Diagnostics (p-values, for F-statistics, where relevant)		
Serial correlation (Breusch-Godfrey 2 lags)	0.051	0.227
RESET (squared fitted values)	0.094	0.991
ARCH (1 lag)	0.171	0.357

Notes. Numbers in parentheses are p-values.
Diagnostic tests for the first differences show the p-values. The nulls of no serial correlation (Breusch-Godfrey), no misspecification in model (Ramsey's RESET test), and no heteroskedasticity (no ARCH errors) are accepted.

5.2.4. Estimations of Imports of Capital Goods Equations

The results of the estimated equations for the demand for imports of capital goods the using first differences method are reported in Table 8 below. We included the gross domestic product LGDP, the terms of trade in capital goods sector, LTOTK, and manufactured exports, LMANEX as regressors. The elasticity of LGDP is 2.14 and significant for 1998-2019 (the whole period) in column 1. This elasticity is estimated to be 3.88 before 2009 and 1.25 (3.88-2.63) after 2009 using a structural break (Chow test) and thus having an average of 2.56 for the whole period (column 2). This average elasticity of 2.56 of LGDP is close to 2.14 which was found without a structural break. Therefore, we conclude that a 1% increase in domestic income would raise Turkey's demand for imports of capital goods by about 2.14 to 2.56 for the whole sample period. However, a significant downward shift (-2.63) in the elasticity of the demand for capital goods with respect to GDP is found after the Global Crisis of 2009.

The elasticity of LMANEX is significant in column 1 whereas it is not significant in column 2. Since the Dummy variable for LGDP is significant in column 2 and therefore the structural break in 2009 must be considered, we conclude that the changes in manufactured exports do not affect the demand for imports of capital goods. Similarly, LTOTK is significant in column 1 whereas it is not significant in column 2. For the same reason we assert that the changes in the terms of trade of the capital goods sector do not affect the demand for imports of capital goods.

Table 8

Estimated Equations for Imports of Capital Goods

Estimation method	OLS estimates in log first differences	
Estimated equation	(1)	(2)

Sample period, yearly	1998-2019	1998-2019
Gross domestic product, LGDP	2.14(0.00)	3.88(0.00)
Terms of trade, LTOTK	1.04(0.07)	-0.20(0.74)
Manufactured exports, LMANEX	0.86(0.04)	0.29(0.44)
Dummy for 2009*LGDP		-2.63(0.01)
Adjusted R^2	0.62	0.74
Diagnostics (p-values, for F-statistics, where relevant)		
Serial correlation (Breusch-Godfrey 2 lags)	0.052	0.091**
RESET (squared fitted values)	0.041*	0.292
ARCH (1 lag)	0.439	0.967

Notes. Numbers in parentheses are p-values.
Diagnostic tests for the first differences show the p-values. The nulls of no serial correlation (Breusch-Godfrey), no misspecification in model (Ramsey's RESET test), and no heteroskedasticity (no ARCH errors) are accepted.
*: The null of no misspecification in model (Ramsey's RESET test) is rejected.
**: The null of no serial correlation (Breusch-Godfrey, 1 lag) is accepted.

5.2.5. Estimations of Imports of Final Goods Equations

The results of the estimated equations for imports of final goods using bounds testing are reported in Table 9 below. We included gross domestic product, LGDP and the real exchange rate, LRER as regressors. For imports of final goods, both the estimated equation without structural break (column 1) and the one with structural break (column 2) passed both bounds tests (t-test and F-test) and the estimated equation (column 2) with structural break clearly passed both bounds (t- test and F-test). The elasticity of LGDP is 1.46 and significant for 1998-2019 (the whole period) in column 1. This elasticity is estimated to be 1.47 before 2009 and 1.51 (1.47+0.04) after 2009

using a structural break (Chow test) and thus having an average of 1.49 for the whole period (column 2). This average elasticity of 1.49 of LGDP is approximately the same as 1.46, which was that found without a structural break. Therefore, we conclude that a 1% increase in domestic income would raise Turkey's demand for imports of final goods by about 1.46 to 1.49 for the whole sample period. Moreover, no significant shift (0.04) in the elasticity of the demand for final goods with respect to GDP was found after the Global Crisis of 2009.

The elasticity of LRER is significant in both column 1 and column 2. A 1% appreciation (depreciation) of Turkish Lira would raise (decrease) Turkey's demand for imports of final goods by about 1.92-1.98%. The speed of adjustment, σ is -0.30 and the whole system can get back to long run equilibrium in about three quarters.

Table 9

Estimated Equations for Imports of Final Goods

Estimation method	Bounds testing estimates in log levels	
Estimated equation	(1)	(2)
Sample period	1998Q1-2019Q3	1998Q1-2019Q3
Speed of adjustment, σ	-0.30	-0.30
Gross domestic product, LGDP	1.46(0.00)	1.47(0.00)
Real exchange rate, LRER	1.98(0.00)	1.92(0.00)
Dummy for 2009*LGDP		0.04(0.08)
Adjusted R^2	0.84	0.84
Bounds tests		

t-test	-4.49**	-6.69*
F-test	7.11*	14.31*
Diagnostics (p-values, for F-statistics, where relevant)		
Serial correlation (Breusch-Godfrey 2 lags)	0.571	0.390
RESET (squared fitted values)	0.359	0.572
ARCH (1 lag)	0.553	0.728

Notes. Numbers in parentheses are p-values.
Coefficients for the bounds testing estimates are long run coefficients after model simplification.
The regression equation in column 1 was estimated with two lags based on the smallest Akaike (AIC) and Schwarz (SIC) criteria (-2.48 and -2.14, respectively). The inclusion of two lags is sufficient to pass the standard diagnostic tests. Increasing or reducing the number of lags caused problems with diagnostic tests or increased AIC or SIC criteria.
Diagnostic tests for the bounds testing (after model simplification) show the p-values. The null of no serial correlation (Breusch-Godfrey), no misspecification in model (Ramsey's RESET test), and no heteroskedasticity (no ARCH errors) are accepted.
*: We can reject the null of no cointegration under the condition that all variables are $I(0)$, at 1%, 5%, and 10% using asymptotical critical values (Pesaran et al., 2001), table CII(i): Case I for t-test and table CI(i): Case I for F-test.
**: We can reject the null of no cointegration under the condition that all variables are $I(0)$, at 10% using asymptotical critical values (Pesaran et al., 2001), table CII(i): Case I for t-test.

5.2.6. Determination of the Rate of Growth of Income from BPCG Model and the Rate of Growth of Income from Basic Thirlwall Law

In this section we will compare the calculated rates of growth of income for the Turkish economy from our extended BPCG model, y_B, as given by Eq. (62) above, and that obtained from the basic Thirlwall Law, against the rate of growth of actual income of Turkey. The rate of growth of income for the extended BPCG model is calculated using the average annual growth rates (exports, terms of trade and capital flows), the relative shares of intermediate, consumption and capital imports sectors, the estimated price and income elasticities of demands for three types of imports and the

time-varying share of exports earnings in total imports expenditures. Later, we will display the contributions of the three components of the extended BPCG model to the rate of growth of income: exports growth, relative prices effect and capital inflows growth. In this section, we will also investigate the relationship between the rates of growth of the Turkish GDP and the nominal capital flows.

When calculating the extended BP- equilibrium growth rate (See Appendix A for data measurement), we used the estimated elasticities of demand for imports of intermediate, consumption and capital goods with respect to the income, from Table 6 (column 4), Table 7 (column 1) and Table 8 (column 1), respectively. Since the price elasticities for the consumption and capital goods were found not to be significant, we used the estimated elasticity of demand for imports of intermediate goods with respect to the price, from Table 6 (column 1). Lastly, we used the estimated elasticity of demand for imports of intermediate goods with respect to manufactured exports, from Table 6 (column 4). We also used the shares of intermediate, consumption and capital goods out of total imports. The estimate of the growth rate of income for the basic Thirlwall Law is calculated by dividing the average growth rate of real exports by the imports sectors' shares-weighted income elasticity of demands for imports for these three industries: intermediate, consumption and capital goods.

The results are reported in Table 10 for the yearly period from 1998 to 2019. It is seen that both the extended BPCG model and the basic Thirlwall Law provide quite close yearly average predictions, 4.33% and 4.29% respectively, compared to the average growth rate of actual income of Turkey, 4.37% for the 1998-2019 period.

Table 10

Actual GDP Growth Rate, GDP Growth Rate from the Extended Model, GDP Growth Rate from the Basic Thirlwall Model, and their Determinants (averages for the period shown)

	1998-2019
Actual GDP growth rate, y	4.37
Extended BP-equilibrium growth rate, y_B[a]	4.33
GDP growth rate from the basic Thirlwall model	4.29
Average annual growth rates:	
Exports, x_n	6.01
Terms of trade, (p_x-p_m)	-0.74
Capital flows, c[b]	11.04
Time varying shares	
Share of intermediate goods in total imports, θ_1	72%
Share of consumption goods in total imports, θ_2	12%
Share of capital goods in total imports, θ_3	16%
Exports earnings as a proportion of the total imports bill, α	66%
Capital flows as a proportion of the total imports bill, (1-α)	34%
Elasticities:	
LGDP-elasticity of intermediate goods imports, π_i	1.05
LGDP-elasticity of consumption goods imports, π_c	2.52

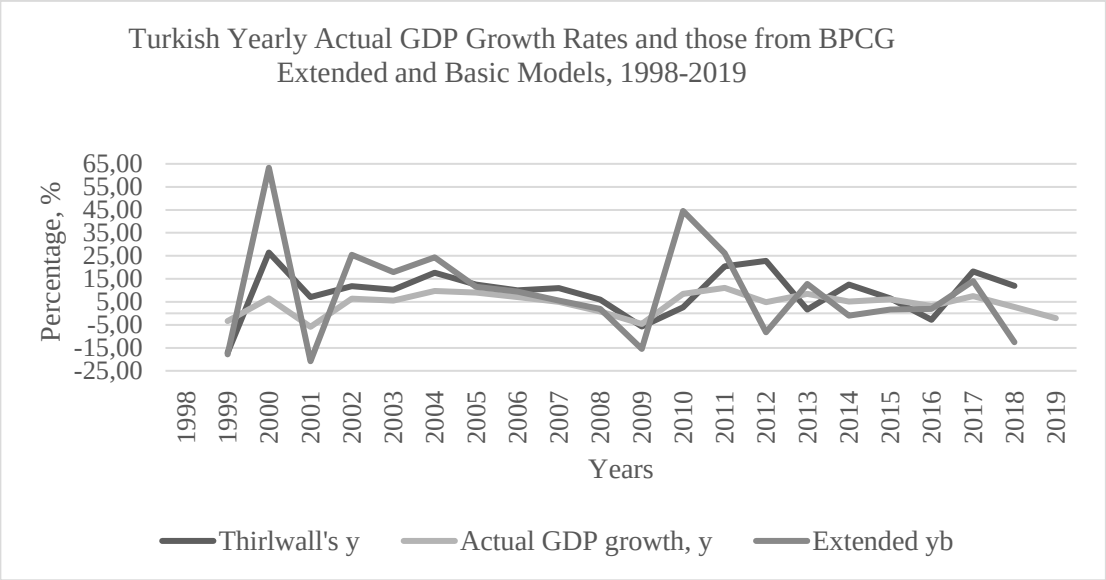
LGDP-elasticity of capital goods imports, π_k	2.14
Price elasticity of intermediate imports, LRER	0.26
LMANEX-elasticity of intermediate imports, β	0.67

Notes. All growth rates are calculated as log difference in real series and showed at annual average percentage rates. The arithmetic average of annual growth rates and the time variability of shares were calculated for 22 years.
[a]: Calculated using Eq. (62).
[b]: The growth rate of nominal capital flows.

Figure 16 below shows that the growth rates of income of the extended model, that of the basic Thirlwall rule and the actual growth rate of income in the 1998-2019 period in Turkey on yearly basis. The averages of these three growth rates were found to be quite close to each other for the 22-year period. However, the predictions of the extended BPCG model have a much higher variability due to its additional considerations of especially capital flows and the relative price changes compared to the basic Thirlwall law. The variations in the predicted growth rate of income from the extended model are seen to be more in line with the actual growth rate of income compared to the basic Thirlwall law: especially between 2011-2015 when the actual growth of income and the growth of extended model moved in the same direction together whereas that from the basic Thirlwall rule moved in the opposite direction throughout this period. This observation is confirmed by the fact that the sample correlation between the actual growth rate of income and that of the extended BPCG model is 0.70 whereas the one between the actual growth rate of income and that of the Thirlwall rule is only 0.59, indicating that the Thirlwall rule is a very useful tool for the long run, but the extended model seems to represent the short-run variations better.

Figure 16

Turkish Yearly Actual GDP Growth Rates and those from BPCG Extended and Basic Models, 1998-2019



Note. Source: Turkish Statistical Institute (TurkStat).

Table 11 below shows the contributions of the three components of the extended BPCG model to the growth rate of GDP in Turkey. Notice that the average share of exports in total imports bill is 66% ($\alpha = 0.66$) and that of the capital inflows is simply 34% ($1 - \alpha = 0.34$), (column 3). It must be recalled that we defined the *capital flows* as all items besides the merchandise trade balance in the Balance of Payments statement. Therefore, the services imports and exports, incomes earned/paid on investments at home/abroad and unilateral transfers included in the current account as well as the capital account, statistical discrepancy and official reserves are all part of our definition of capital flows so that the latter is simply equal to the difference between merchandise imports and exports. For example, tourism earnings are an important item in services exports in Turkey, and they are considered to be a part of capital flows in our definition.

Even though the share of exports (66%) is much higher than that of the capital flows (34%), the average contribution of real exports to the growth of income has only been 0.65% compared to a sizeable contribution of real capital flows of 3.75%. Even though the real exports increased by an average of 6.01% during 1998-2019 period, its relatively small contribution to the rate of growth of income is due to the fact that we took into account the rise in intermediate imports due to an increase in manufactured exports holding the GDP constant as given in Eq. (62) above. This additional channel which gives rise to higher intermediate imports is an additional factor confining the BPCG model. In other words, the income can only grow to the extent that value-added component of manufactured exports is high compared to its imports component. Moreover, even though the share of capital flows is only 34% in the total imports bill, the growth of real capital inflows was 9.68% on the average during 1998-2019.

Table 11

Contributions of the Components of the Extended BPCG Model to the Growth Rate of Income

	Average yearly growth rate	Average shares in total imports bill	Average yearly contributions the components to the growth rate of GDP
Exports growth rates	6.01%	66%	0.65%
Relative price effect	-0.74%	n.a.	-0.43%
Capital inflows growth rate	9.68%	34%	3.75%

Note. n.a.: Not applicable.

The rate of growth of real capital flows, 9.68%, is calculated as the difference between the rate of growth of flows of nominal capital, c_t , 11.04% and that of exports prices index, p_{xt}, 1.36%. The nominal capital flows are simply nominal exports subtracted from nominal imports. Weighted by the average share of nominal capital flows (34%), the real capital flows contributed a sizeable amount, 3.75% to the rate of growth of Turkish income. This shows that the capital inflows, in the way of direct investments, portfolio investment, sale of real estate to foreigners and tourism revenues are very important for the rate of growth of Turkish GDP by relaxing the balance of payment constraint and financing the total imports bill.

We also find that an average of 0.74% decrease (deterioration) in the terms of trade (measured by the exports prices divided by the imports prices) had a very small effect on the rate of growth of Turkish income (-0.43%) during the 1998-2019 period. Our finding is also consistent with the basic Thirlwall hypothesis that the relative price changes are not important for the growth rate of income in the long run. We formulated a model in which a weak version of BPCG without assuming that the relative prices are constant, was used. The Marshall Lerner Condition of this model then amounted to considering the imports price elasticities only (not the exports price elasticities). We found a very small imports sectors weighted price elasticity (0,72*0,26% = 0.18%) as estimated in Section 5 above. The price elasticities for the consumption and capital goods were statistically insignificant and only that for the intermediate goods was significant and was equal to 0.26%. As the imports sectors weighted sum of these price elasticities was only 0.18%, a deterioration in the terms of trade (-0.74% which is also small) during 1998-2019 had an expanding value effect (since imports prices were higher) outweighing the contracting volume effect on imports and thus running up the total imports bill and therefore constraining the growth of income by 0.43%.

All three components of the extended BPCG model are of course equally affected by the estimate of the income elasticity of demand for imports. As shown in denominator of the Eq. (62) above, we have calculated an imports sectors weighted average of income elasticity of imports, say π_a. Using the elasticity estimates from Section 5 above, we found $\pi_a = \theta_{1t}\,\pi_i + \theta_{2t}\,\pi_c + \theta_{3t}\,\pi_k$ = 0.72 * 1.05 + 0.12* 2.52 + 0.16 * 2.14 = 1.40. This share-weighted income elasticity is somehow lower than the income elasticities found by other authors who also investigated the BPCG model using Turkish data in different time periods and using different versions of the BPCG model.

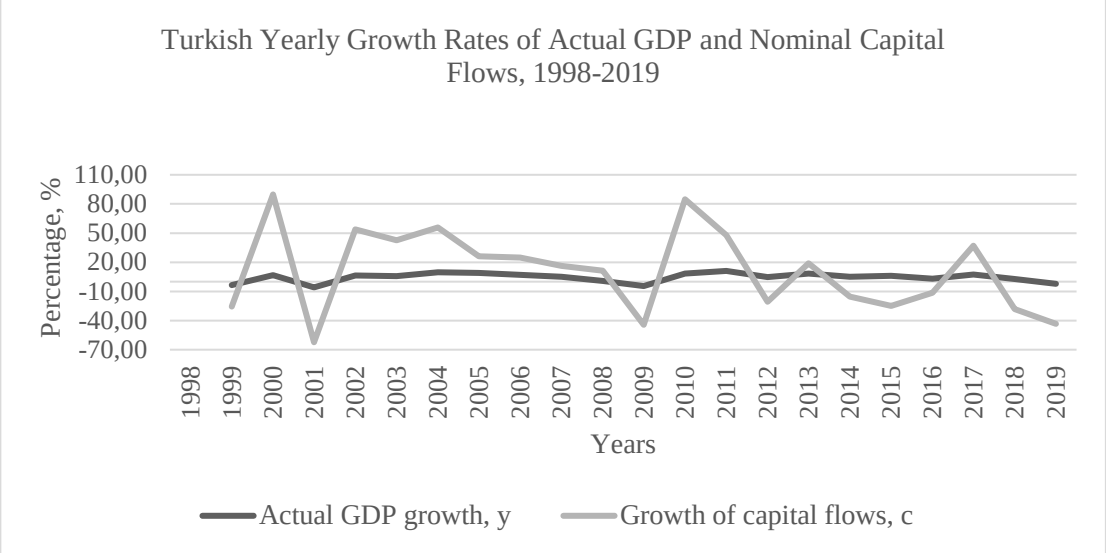
The estimated income elasticities of demand for total imports are 2.07 for the 1960-2004 yearly period (Elitok & Campbell, 2008), 1.82 for the 1980-2008 yearly period (Halicioglu, 2012), 2.60 for the 1968-2011 yearly period (Gokce & Cankal, 2013) and 2.07 for the 1950-2014 yearly period (Tatliyer, 2017) for the Turkish economy.

Figure 17 below shows the yearly rates of growth of Turkish GDP and growth of nominal capital flows. The first stylized fact for the Turkish economy seems to be abrupt decreases in capital flows before/during the recessions. For example, the nominal capital flow decrease of about 60% during the 2001 recession was accompanied by a substantial diminishing of the GDP by 5.87%. Likewise, during the 2009 recession in Turkey where the global crisis's effect was felt about a year later, the GDP diminished by 4.67% while the decrease in capital flows amounted to 44%. The second stylized fact for Turkey seems to be that the periods when the GDP grew rapidly have been associated with heavy increases in capital inflows, generally after the recessions. For example, between 2002-2007 when the capital inflows were quite strong, the GDP grew by 5.04 - 9.69%. Similarly, during 2010-2011 when Turkey again attracted sizeable foreign capital, the Turkish GDP increased by 8.5 – 11%. However, the rates of capital flows have been quite irregular since the year of 2012 up till 2007,

perhaps due to more globalized financial markets. Nevertheless, the Turkish economy kept growing by 3.2 – 8.47% during this period. The August 2018 was the beginning of the last recession Turkish economy experienced as of today and as we could expect from our extended BPCG model, the capital flows decreased by 28% in the year of 2018 and falling again by 43% in the year of 2019.

Figure 17

Turkish Yearly Growth Rates of Actual GDP and Nominal Capital Flows, 1998-2019



Note. Source: Turkish Statistical Institute (TurkStat).

6. JOHANSEN AND ENGLE-GRANGER COINTEGRATION METHODOLOGY APPLIED TO TURKISH DATA BETWEEN 1998 AND 2019 YEARS

In this section, we will test our extended BPCG model using Johansen cointegration test technique (Johansen, 1991, 1995) as a multivariate method based on a Vector Autoregressive (VAR) model. Thanks to the Johansen Cointegration technique, we can capture possible presence of more than one cointegration relationships between disaggregated imports (intermediate, consumption and capital goods imports) and domestic income, terms of trade and manufactured exports which are very important variables for testing our extended BPCG model. Our disaggregated imports demand functions (LIMPI, LIMPC and LIMPK equations are shown in Eq. (60) above) are estimated for the period from 1998 to 2019 for a total of 22 yearly observations for the Turkish economy. In order to clarify whether there is a long run relationship or not between our variables, we also implemented Engle-Granger cointegration test technique based on the residuals from a regression equation (Engle & Granger, 1987). Later, we will calculate the rates of growth of income for the Turkish economy from our extended BPCG and the growth rate of income for the basic Thirlwall Law.

6.1. Johansen Methodology

Johansen Methodology starts from the estimation of VAR model. “The vector autoregression (VAR) is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The reduced form VAR approach sidesteps the need for structural modeling

by treating every endogenous variable in the system as a function of *p*-lagged values of all the endogenous variables in the system" and "we may write the stationary, k-dimensional, VAR(*p*) process as

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + C\varkappa_t + \varepsilon_t \quad (73)$$

where $y_t = (y_{1t}, y_{2t}, \ldots y_{Kt})'$ is a k x 1 vector of endogenous variables, $\varkappa_t = (\varkappa_{1t}, \varkappa_{2t}, \ldots \varkappa_{dt})'$ is a d x 1 vector of exogenous variables, $A_1 \ldots A_p$ are k x k matrices of lag coefficients to be estimated, C is a k x d matrix of exogenous variable coefficients to be estimated, $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \ldots \varepsilon_{Kt})'$ is a k x 1 vector of white noise innovation process, with $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_t') = \Sigma_\varepsilon$, and $E(\varepsilon_t \varepsilon_s') = 0$ for $t \neq s$. The last statement implies that the vector of innovations are contemporaneously correlated with full rank matrix Σ_ε but are uncorrelated with their leads and lags of the innovations and (assuming the usual $\varkappa_t$, orthogonality) uncorrelated with all of the right-hand side variables" (EViws User's Guide: Vector Autoregreesions, VARs, 2020).

The VAR model is estimated with the optimal lag length. We can select the lag length using the multivariate generalizations of the AIC and/or SIC (mentioned in Section 5.1.2.3): The smaller the value of the information criteria the better the VAR model. After the optimal lag length selection, one should examine the properties of the residuals from the estimated VAR model: Breusch-Godfrey LM is performed to test for autocorrelation in residuals, and Jarque-Bera normality test is performed to test whether the residuals are multivariate normal. After that, in order to test the stability condition of the system, AR roots test is performed. The estimated VAR is stable (stationary) if all values of modulus are less than one and lie inside the unit circle (EViews User's Guide: Residual Tests; Diagnostic Views, 2020)

The Johansen cointegration test is implemented to the estimated VAR model to reveal a cointegration relation among the variables. VAR-based cointegration tests

using the methodology developed in Johansen (1991, 1995) performed using a Group object or an estimated VAR object. We may rewrite Eq. (73), VAR as,

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-I} + C_{\varkappa t} + \varepsilon_t \quad (74)$$

$$\Pi = \sum_{i=1}^{p} A_i - I, \quad \Gamma_i = -\sum_{j=i+1}^{p} A \quad (75)$$

If the coefficient matrix Π has reduced rank r < k, then there is k x r matrices α and β each rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is $I(0)$, stationary. r is the number of cointegrating relationships and each column of β is the cointegrating vector. The Johansen methodology uses the trace and maximum eigenvalue statistics (critical values can be found in Johansen & Juselius, 1990) to reveal cointegrating relationships and the number of cointegrating vectors. The trace statistic tests the null hypothesis of r cointegrating relations (vectors) against the alternative of k cointegrating relations (vectors), where k is the number of endogenous variables, for r = 0, 1, …, k-1. The trace statistic for the null hypothesis of r cointegrating relations is calculated as:

$$LR_{tr}(r \mid k) = -T \sum_{i=r+1}^{k} log\,(1-\lambda_i) \quad (76)$$

where λ_i is the i^{th} largest eigenvalue of the Π matrix in Eq. (75). The maximum eigenvalue tests the null hypothesis of r cointegrating relations against the alternative of r+1 cointegrating relations. This test statistic is calculated as:

$$LR_{max}(r \mid r+1) = -T \log (1-\lambda_{r+1})$$
$$= LR_{tr}(r \mid k) - LR_{tr}(r+1 \mid k) \quad (77)$$

for r = 0, 1, …, k-1 and T is the sample size (EViews User's Guide: Johansen Cointegration Test, 2020).

6.2. Engle-Granger Methodology

“Engle and Granger (1987) note that a linear combination of two or more *I*(1) series may be stationary, or *I*(0), in which case we say the series are cointegrated. Such a linear combination defines a cointegrating equation with cointegrating vector of weights characterizing the long run relationship between the variables” (User's Guide: Advanced Single Equation Analysis: Cointegrating Regression: Background, 2021). The Engle-Granger residual-based test for cointegration is unit root test applied to the residuals obtained from the equation like this:

$$y_t = \beta_0 + \beta_1 z_t + e_t \qquad (78)$$

One can test the residuals for stationarity obtained from OLS estimation of a regression equation in the form Eq. (78). If the residuals are stationary in level by using Augmented Dickey Fuller (ADF) unit root test, the null hypothesis of no cointegration against the alternative of cointegration is rejected so, we can say that the variables are cointegrated in the long run.

6.3. Estimation Results

In this section, we will show the estimation results from the disaggregated imports demand functions (imports of intermediate, consumption and capital goods) for the period from 1998 to 2019 for a total of 22 yearly observations. Estimation of the orders of integration are carried out through Augmented Dickey Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski, Phillips, Schmidt, and Shinn (KPSS) unit root tests and results are displayed in Table 3 for ADF test and in Table 5 for PP and KPSS tests. The tests reveal a mixture of stationary and nonstationary variables either in their levels or in their levels with trend, but all variables are stationary in their first differences. This allowed us to test the presence of one or more cointegrating relationship between them.

6.3.1. Imports of Intermediate Goods, LIMPI

The first step of the Johansen cointegration test technique is to estimate the VAR model. Our VAR model includes three endogenous variables: imports of intermediate goods, LIMPI, gross domestic product, LGDP and manufactured exports, LMANEX. According to E-Views lag order selection criteria, the optimal lag length is 1 in this VAR model (Table 12).

Table 12

LIMPI Equation, the Determination of Lag Length of the VAR Model, 1998-2019, 22 Observations

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	46.567	NA	2.05e-06	-4.586	-4.436	-4.560
1	108.931	98.468*	7.58e-09*	-10.203*	-9.606*	-10.102*
2	113.99	6.39	1.26e-08	-9.788	-8.744	-9.611
3	125.651	11.047	1.21e-08	-10.068	-8.577	-9.816

Notes. * indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at the 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SIC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

To test the adequacy of the lag length, we applied the serial correlation LM test to the residual of the estimated VAR (1) model. Table 13 shows that the p-value of lag 1 is higher than 5%, thus we accept the null hypothesis of no serial correlation in the residual at the 5% significance level. Therefore, we determine the lag length to be 1.

Table 13

LIMPI Equation, VAR Residual Serial Correlation LM Test, 1998-2019, 22 Observations

Lag	LM-Stat	Prob.
1	0.587	0.796

Note. Null Hypothesis: No serial correlation at lag h.

Table 14 shows the results of Jarque-Bera normality test of the estimated VAR (1) model. Based on the test results, the variables have normal distributions both individually and jointly. The p-values are higher than 5%, thus we accept the null hypothesis that residuals are multivariate normal.

Table 14

LIMPI Equation, VAR Residuals Normality Tests, 1998-2019, 22 Observations

Component	Jarque-Bera	df	prob.
1	1.627	2	0.443
2	1.049	2	0.591
3	0.189	2	0.909
Joint	2.866	6	0.825

Notes. Null Hypothesis: Residuals are multivariate normal.
Orthogonalization: Cholesky (Lutkepohl).

After that, whether the VAR (1) model is stable or not was tested. Table 15 shows that VAR (1) model has a stable structure because all values of the modulus are less than unity. Therefore, the estimated VAR (1) satisfies the stability condition.

Table 15

LIMPI Equation, Roots of Characteristic Polynomial, 1998-2019, 22 Observations

Root	Modulus
0.893222 - 0.026140i	0.893
0.893222 + 0.026140i	0.893
-0.102019	0.102

Notes. No root lies outside the unit circle. VAR satisfies the stability condition.

After the goodness of fit tests for residuals were carried out following estimated VAR (1) model, the Johansen cointegration test was applied to the estimated VAR (1) model to reveal a cointegration relation among the variables. Table 16 shows that the cointegration trace test statistic is higher than its 5% critical value (is shown bold), so the null hypothesis of no cointegration is rejected and the presence of at least one cointegration vector among variables is accepted (for H_0: r = 0, H_1: r = 1). Since the trace test statistics (are shown bold) are lower than their 5% critical values, the null hypothesis (for H_0: $r \leq 1$, H_1 r =2 and H_0: $r \leq 2$, H_1 r = 3) is accepted, so we reject the presence of two or three cointegration relations. The estimation results also show that since the cointegration max-eigenvalue test statistic is lower than its 5% critical value, we accept the null hypothesis (for H_0: r = 0, H_1: r = 1) of no cointegration relation.

Table 16

LIMPI Equation, Johansen Cointegration Test, 1998-2019, 22 Observations

Number of	Trace statistic	Critical value, 0.05	Prob.	Max-Eigen statistic	Critical value, 0.05	Prob.
H_0: r = 0 H_1: r = 1	**32.29**	**29.797**	0.025	18.881	21.131	0.1
H_0: r ≤1 H_1: r = 2	13.408	15.494	0.1	12.018	14.264	0.109
H_0: r ≤ 2 H_1: r = 3	1.389	3.841	0.238	1.389	3.841	0.238

Notes. Trace test indicates 1 cointegrating eqn(s) at the 5% level and Max-eigenvalue test indicates no cointegration at the 5% level.

The estimated normalized cointegration equation (standard errors in parentheses) is:

$$\text{LIMPI} = 0.44\ \text{LGDP} + 0.34\ \text{LMANEX}$$

$$(0.141) \qquad (0.094) \qquad (79)$$

In Eq. (79), a 1% increase in domestic income and manufactured exports would raise the imports of intermediate goods by about 0.44% and 0.34%, respectively. The estimated coefficients on LGDP and LMANEX have expected signs and are statistically significant to determine the demand for imports of intermediate goods.

To verify the long run relationship between the variables we also carried out the Engle-Granger cointegration test procedure. Table 17 shows the results of ADF unit root test on residuals obtained from the LIMPI equation above. According to the estimation results, we can reject the null hypothesis that residuals have a unit root since the calculated p-value of 0.002 is smaller than all conventional significance levels of 1%, 5% and 10%. So, we can say that there is a cointegration relationship between

LIMPI, LGDP and LMANEX variables, and that this result is consistent with the results obtained from Johansen method (according to the trace test).

Table 17

LIMPI Equation, Engle-Granger Cointegration Test, 1998-2019, 22 Observations

	t-statistic	prob.*
ADF test statistic	-4.495	0.002
Test critical values:1% level	-3.788	
5% level	-3.012	
10% level	-2.646	

Notes. Null Hypothesis: Residuals have a unit root.
*: MacKinnon (1996) one-sided p-values.

6.3.2. Imports of Consumption Goods, LIMPC

Here, our VAR model includes four endogenous variables: imports of consumption goods, LIMPC, gross domestic product, LGDP, terms of trade in the consumption goods sector, LTOTC, and manufactured exports, LMANEX. According to E-Views lag order selection criteria, the optimal lag length is 1 in this VAR model (Table 18).

Table 18

LIMPC Equation, the Determination of Lag Length of the VAR Model, 1998-2019, 22 Observations

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	43.730	NA	2.67e-07	-3.783	-3.584	-3.740
1	139.289	145.613*	1.42e-10*	-11.360*	-10.366*	-11.145*

Notes. * indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at the 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SIC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

In Table 19 the serial correlation LM test shows that the p-value of lag 1 is higher than 5%, thus we accept the null hypothesis of no serial correlation in the residual at the 5% significance level. Therefore, we determine the lag length to be 1.

Table 19

LIMPC Equation, VAR Residual Serial Correlation LM Test, 1998-2019, 22 Observations

Lag	LM-Stat	Prob.
1	1.578	0.140

Note. Null Hypothesis: No serial correlation at lag h.

Table 20 shows the results of Jarque-Bera normality test of the estimated VAR (1) model. Based on the test results, the variables have normal distributions both individually (except component 1: imports of consumption goods, LIMPC variable) and jointly. The joint p-value is higher than 5%, thus we accept the null hypothesis that residuals are multivariate normal.

Table 20

LIMPC Equation, VAR Residuals Normality Tests, 1998-2019, 22 Observations

Component	Jarque-Bera	df	prob.
1	8.124	2	0.017
2	0.773	2	0.679
3	0.434	2	0.804

4	0.073	2	0.963
Joint	9.406	8	0.309

Notes. Null Hypothesis: Residuals are multivariate normal.
Orthogonalization: Cholesky (Lutkepohl).

Table 21 shows that VAR (1) model has a stable structure because all values of the modulus are less than unity. Therefore, the estimated VAR (1) satisfies the stability condition.

Table 21

LIMPC Equation, Roots of Characteristic Polynomial, 1998-2019, 22 Observations

Root	Modulus
0.961257	0.961
0.740973 + 0.081201i	0.745
0.740973 + 0.081201i	0.745
0.304880	0.304

Notes. No root lies outside the unit circle. VAR satisfies the stability condition.

After the goodness of fit tests for residuals were carried out following estimated VAR (1) model, the Johansen cointegration test was applied to the estimated VAR (1) model to reveal a cointegration relation among the variables. Table 22 shows that both cointegration trace test and max-eigenvalue test statistics (are shown in bold) are higher than their 5% critical values (for H_0: r = 0, H_1: r = 1), so the null hypothesis of no cointegration is rejected. Since the trace test statistics are higher than their 5% critical values (for H_0: r ≤1 H_1: r = 2, H_0: r ≤ 2 H_1: r = 3 and H_0: r ≤ 3 H_1: r = 4), we can reject

the null hypothesis and accept the alternative of null hypothesis of the presence of four cointegration relations.

Table 22

LIMPC Equation, Johansen Cointegration Test, 1998-2019, 22 Observations

Number of	Trace statistic	Critical value, 0.05	Prob.	Max-Eigen statistic	Critical value, 0.05	Prob.
H_0: r = 0 H_1: r = 1	**70.209**	**47.856**	0.000	**35.208**	**27.584**	0.004
H_0: r ≤1 H_1: r = 2	35.000	29.797	0.011	19.136	21.131	0.092
H_0: r ≤ 2 H_1: r = 3	15.864	15.494	0.044	11.735	14.264	0.121
H_0: r ≤ 3 H_1: r = 4	4.128	3.841	0.042	4.128	3.841	0.042

Notes. Trace test indicates 4 cointegrating eqn(s) at the 5% level and Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 5% level.

The estimated normalized cointegration equation (standard errors in parentheses) is:

$$LIMPC = 3.49\ LGDP + 5.88\ LTOTC + 0.91\ LMANEX \quad (80)$$

$$(1.143) \quad (1.627) \quad (0.712)$$

In Eq. (80), a 1% increase in domestic income and terms trade variable would raise the imports of consumption goods by about 3.49% and 5.88%, respectively. The estimated coefficients on LGDP and LTOTC have expected signs and are statistically significant to determine the demand for imports of consumption goods. Note that the terms of trade in the consumption goods sector are calculated by dividing the price of manufactured exports by the price of imports of consumption goods. Therefore, a decrease in the

LTOTC variable (a deterioration in the relative prices with respect to those of imports) leads to an increase in the demand for imports of consumption goods. In Eq. (80), the manufactured exports are statistically insignificant to determine the demand for imports of consumption goods.

To verify the long run relationship between the variables we carried out the Engle-Granger cointegration test procedure. Table 23 shows that the results of ADF unit root test on residuals obtained from the LIMPC equation above. According to estimation results, we cannot reject the null hypothesis that residuals have a unit root since the p-value is higher than 5% (i.e. residuals are nonstationary in level), so we can say that there is no cointegration relationship between LIMPC, LGDP, LTOTC and LMANEX variables. This result is not consistent with the results obtained from Johansen methodology. This may be for the following reason: When implementing the Engle-Granger method, one should be very wary of a result indicating that the variables are cointegrated using one variable for the normalization but are not cointegrated using another variable for the normalization. In such situations, it is possible that only a few of the variables are cointegrated. Assume that x_{1t}, x_{2t}, and x_{3t} are three $I(1)$ variables and that x_{1t} and x_{2t} are cointegrated such that $x_{1t} - \beta_2 x_{2t}$ is stationary. A regression of x_{1t} on the other two variables should give the stationary relationship $x_{1t} = \beta_2 x_{2t} + 0x_{3t}$. Likewise, a regression of x_{2t} on the other variables should give the stationary relationship $x_{2t} = (1/\beta)x_{1t} + 0x_{3t}$. However, a regression of x_{3t} on x_{1t} and x_{2t} cannot declare the cointegrating relationship. Nonetheless, the possibility of a contradictory result is a weakness of the test (Enders, 2015, p.367).

Table 23

LIMPC Equation, Engle-Granger Cointegration Test, 1998-2019, 22 Observations

	t-statistic	prob.*
ADF test statistic	-2.319	0.176
Test critical values:1% level	-3.831	
5% level	-3.029	
10% level	-2.655	

Notes. Null Hypothesis: Residuals have a unit root.
*: MacKinnon (1996) one-sided p-values.

6.3.3. Imports of Capital goods, LIMPK

Here, our VAR model includes three endogenous variables: imports of capital goods, LIMPK, gross domestic product, LGDP and terms of trade in the consumption goods sector, LTOTK. According to E-Views lag order selection criteria, the optimal lag length is 1 in this VAR model (Table 24).

Table 24

LIMPK Equation, the Determination of Lag Length of the VAR Model, 1998-2019, 22 Observations

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	22.251	NA	2.93e-05	-1.925	-1.775	-1.896
1	86.484	102.772*	1.19e-07*	-7.448*	-6.851*	-7.331*
2	90.109	4.711	2.20e-07	-6.910	-5.865	-6.706

Notes. * indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at the 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SIC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

Table 25 shows that the p-value of lag 1 is higher than 5%, thus we accept the null hypothesis of no serial correlation in the residual at the 5% significance level. Therefore, we determine the lag length to be 1.

Table 25

LIMPK Equation, VAR Residual Serial Correlation LM Test, 1998-2019, 22 Observations

Lag	LM-Stat	Prob.
1	0.445	0.898

Note. Null Hypothesis: No serial correlation at lag h.

Table 26 shows the results of Jarque-Bera normality test of the estimated VAR (1) model. Based on the test results, the variables (except component 1: imports of capital goods, LIMPK variable) have normal distributions individually but they have not normal distributions jointly. The joint p-value is less than 5%, thus we reject the null hypothesis that residuals are multivariate normal.

Table 26

LIMPK Equation, VAR Residuals Normality Tests, 1998-2019, 22 Observations

Component	Jarque-Bera	df	prob.
1	12.600	2	0.001
2	0.653	2	0.721
3	0.324	2	0.850

Joint	13.577	6	0.034

Notes. Null Hypothesis: Residuals are multivariate normal.
Orthogonalization: Cholesky (Lutkepohl).

Table 27 shows that VAR (1) model has a stable structure because all values of the modulus are less than unity. Therefore, the estimated VAR (1) satisfies the stability condition.

Table 27

LIMPK Equation, Roots of Characteristic Polynomial, 1998-2019, 22 Observations

Root	Modulus
0.990542	0.990
0.795177	0.795
0.660020	0.660

Notes. No root lies outside the unit circle. VAR satisfies the stability condition.

After the goodness of fit tests for residuals (except the J-B normality test) were carried out following estimated VAR (1) model, the Johansen cointegration test was applied to the estimated VAR (1) model to reveal a cointegration relation among the variables. But Table 28 shows that both the trace test and the max-eigenvalue test statistics are less than their 5% critical values, so we cannot reject the null hypothesis of no cointegration between LIMPK, LGDP and LTOTK variables (for H_0: r = 0, H_1: r = 1). Therefore, we could not obtain the normalized cointegration equation for imports of capital goods.

Table 28

LIMPK Equation, Johansen Cointegration Test, 1998-2019, 22 Observations

Number of	Trace statistic	Critical value, 0.05	Prob.	Max-Eigen statistic	Critical value, 0.05	Prob.
H_0: r = 0 H_1: r = 1	20.766	29.797	0.372	13.417	21.131	0.414
H_0: r ≤1 H_1: r = 2	7.349	15.494	0.537	6.573	14.264	0.540
H_0: r ≤ 2 H_1: r = 3	0.776	3.841	0.378	0.776	3.841	0.378

Note. Trace test and Max-eigenvalue test indicates no cointegration at the 5% level.

To check that there is no long run relationship between the variables we carried out the Engle-Granger cointegration test procedure. Table 29 shows the results of ADF unit root test on residuals obtained from the LIMPK equation in VAR model. According to estimation results, we cannot reject the null hypothesis that residuals have a unit root since the p-value is higher than 5% (i.e., residuals are nonstationary in level), so we can say that there is no cointegration relationship between LIMPK, LGDP and LTOTK variables, and this result is consistent with the results obtained from Johansen method.

Table 29

LIMPK Equation, Engle-Granger Cointegration Test 1998-2019, 22 Observations

	t-statistic	prob.*
ADF test statistic	-2.802	0.075
Test critical values:1% level	-3.808	
5% level	-3.020	
10% level	-2.650	

Notes. Null Hypothesis: Residuals have a unit root.
*: MacKinnon (1996) one-sided p-values.

6.4. Determination of the Rate of Growth of Income from BPCG Model and the Rate of Growth of Income from Basic Thirlwall Law, based on VAR Model

In this section, we will calculate the rates of growth of income for the Turkish economy from our extended BPCG model, y_B, as given by Eq. (62) above, and the growth rate of income for the basic Thirlwall Law (See Appendix A for the data measurement).

When calculating the extended BP- equilibrium growth rate, we used the estimated elasticities of demand for imports of intermediate, consumption and capital goods with respect to the income, from Eq. (79), Eq. (80) and Table 8 (column 1), respectively. We used the estimated elasticity of demand for imports of consumption goods with respect to the price from Eq. (80) and used the estimated elasticity of demand for imports of intermediate goods with respect to manufactured exports, from Eq. (79). We also used the shares of intermediate, consumption and capital goods out of total imports. The estimate of the growth rate of income for the basic Thirlwall Law

is calculated by dividing the average growth rate of real exports by the imports sectors' shares-weighted income elasticity of demands for imports for these three industries: intermediate, consumption and capital goods.

All elasticities are obtained from the estimated normalized cointegration equations using Johansen cointegration method except the income-elasticity of capital goods imports. Since no cointegration relationship was found between the LIMPK (imports of capital goods), the LGDP (income) and the LTOTK (the terms of trade of capital goods) variables, we used the estimated elasticity of demand for imports of capital goods with respect to the income (which is obtained from the first differences method) from Table 8 (column 1). The results are reported in Table 30 for the entire period 1998-2019.

Both the extended BPCG model and the basic Thirlwall Law provide quite close yearly average predictions, 6.04% and 5.57% respectively, compared to the average growth rate of actual income of Turkey, 4.37% for the 1998-2019 period.

Table 30

Actual GDP Growth Rate, GDP Growth Rate from the Extended Model, GDP Growth Rate from the Basic Thirlwall Model, and their Determinants from VAR Model (averages for the period shown)

	1998-2019
Actual GDP growth rate, y	4.37
Extended BP-equilibrium growth rate, y_B[a]	6.04
GDP growth rate from the basic Thirlwall model	5.57
Average annual growth rates:	
Exports, x_n	6.01

Terms of trade, (p_x-p_m)	-0.74
Capital flows, c^b	11.04
Time varying shares	
Share of intermediate goods in total imports, θ_1	72%
Share of consumption goods in total imports, θ_2	12%
Exports earnings as a proportion of the total imports bill, α	66%
Capital flows as a proportion of the total imports bill, (1-α)	34%
Elasticities:	
LGDP-elasticity of intermediate goods imports, π_i	0.44
LGDP-elasticity of consumption goods imports, π_c	3.49
LGDP-elasticity of capital goods imports, π_k	2.14[c]
LTOTC-elasticity of consumption goods imports, ε_c	5.88
LMANEX-elasticity of intermediate imports, β	0.34

Notes. All growth rates are calculated as log difference in real series and showed at annual average percentage rates. The arithmetic average of annual growth rates and the time variability of shares were calculated for 22 years.
[a]: Calculated using Eq. (62).
[b]: The growth rate of nominal capital flows.
[c]: Comes from Table 8 (column 1)

6.5. Findings

For the imports of intermediate goods, the income and the manufactured exports variables (cointegration was found between these variables (Section 6.3.1)) and for the imports of capital goods, the income and the terms of trade of capital goods variables (no cointegration was found between these variables, (Section 6.3.3)), the results obtained from Engel-Granger cointegration test technique are consistent with the

results obtained from Johansen cointegration test technique. However, for the imports of consumption goods, the income, the terms of trade of consumption goods, and the manufactured exports variables, the Johansen cointegration test technique found a cointegration between these variables whereas the Engle-Granger cointegration test technique did not find a relationship (in Section 6.3.2). This contradictory result may be due to the weakness of this test. Namely, if there were only two variables, then Engle- Granger cointegration test technique would be more useful to capture cointegration relationship.

For the imports of intermediate goods (Eq. (79)), the elasticities with respect to domestic income (0.44) and to manufactured exports (0.34) were found to be lower compared to the estimated elasticities of domestic income (1.05, in Table 6 (column 4)) and of manufactured exports (0.67, in Table 6 (column 4)) from the first differences approach, respectively. For the imports of consumption goods (Eq. (80)), the elasticity with respect to domestic income (3.49) was found to be higher compared to the estimated elasticity of domestic income (2.52, in Table 7 (column 1)) from the first differences approach. The elasticity of the terms of trade in the consumption goods sector was found 5.88 (in Eq. (80)) and statistically significant. Note that the terms of trade in the consumption goods sector are calculated by dividing the price of manufactured exports by the price of imports of consumption goods. Therefore, a decrease in the prices of imports of consumption goods (increasing the terms of trade in the consumption goods sectors) leads to increase in the demand for imports of consumption goods. In the imports of consumption goods equation (Eq. (80)), as expected, the manufactured exports are statistically insignificant to determine the demand for imports of consumption goods.

Based on the results, the variables in the imports of intermediate and the consumption goods equations (normalized cointegration Eqs. (79) and (80), respectively) are cointegrated. However, we could not obtain the normalized cointegration equation for imports of capital goods since there is no cointegration relationship between the variables which are the imports of capital goods, the income, and the terms of trade of capital goods. Therefore, when calculating the rates of growth of income from our extended BPCG model and the growth rate of income for the basic Thirlwall Law, we used the estimated elasticity of demand for imports of capital goods with respect to the income (which is obtained from the first differences method) from Table 8 (column 1). As shown in denominator of the Eq. (62), we found the imports sectors' share-weighted income elasticity of demands for intermediate, consumption and capital goods is 1.08. This share-weighted income elasticity of 1.40 is somehow lower than the income elasticities found in our ARDL estimation method (in Section 5.2.6), and those from the other authors who also investigated the BPCG model using Turkish data in different time periods and using different versions of the BPCG model: the estimated income elasticities of demand for total imports are 2.07 for the 1960-2004 yearly period (Elitok & Campbell, 2008), 1.82 for the 1980-2008 yearly period (Halicioglu, 2012), 2.60 for the 1968-2011 yearly period (Gokce & Cankal, 2013) and 2.07 for the 1950-2014 yearly period (Tatliyer, 2017) for the Turkish economy.

Finally, both the extended BPCG model and the basic Thirlwall Law provided quite close yearly average predictions (from VAR), 6.04% and 5.57% respectively, compared to the average growth rate of actual income of Turkey, 4.37% for the 1998-2019 period. These yearly average predictions were found to be higher compared to the predictions, 4.33% and 4.29%, (from the bounds testing and the first differences approaches) showed in Section 5.2.6.

7. CONCLUSION

Harrod and Thirlwall were able to independently formulate a simple rule stating that the rate of long-run growth of income could be approximated by the ratio of the growth of exports to the income elasticity of imports of the country, assuming away foreign capital inflows and changes in the terms of trade (or the real exchange rate). This model has become to be known as the balance-of-payments-constrained growth model (BPCG) (Harrod, 1933; Thirlwall, 1979). In this thesis, we considered an extended version of the BPCG model incorporating the capital inflows, the disaggregated imports and allowing also for some possible structural changes. We abstained from the services imports and exports, incomes earned/paid on investments at home/abroad and unilateral transfers so that the current account reduces to the trade balance of goods (TB) only (merchandise trade balance). We have also taken into account time-varying weights for the disaggregated imports sectors and for the composition of exports and capital flows in financing the imports bill and defined the trade balance (TB) in terms of foreign currency ($), as opposed to a trade balance (TB) expressed in terms of domestic currency.

We descriptively analyzed the Turkish economy considering the 2001 and 2008 recessions which corresponded to changes in Turkey's economic conditions, and therefore we divided 22-year data set into three periods: Collapse of the exchange rate-based stabilization program (1998-2001) and 2001 crisis; Recovery from the 2001 crisis, 2008 global crisis (2002-2008) and Recovery from the 2008 global crisis (2009-2019). According to the analysis results, the 2001 crisis was internal and the level of public budget deficits, the structural problems of the banking system and some political instabilities were the most important issues in Turkey. The 2001 crisis led to the capital inflows to the country be interrupted and resulted in net capital outflows from the

country. On the other hand, the 2008 crisis was a global one experienced throughout the world and once again led to a decrease in the amount of capital inflows into Turkey slowing the growth performance of the economy. This shows that, in Turkey, the economic growth was almost always accompanied with heavy capital inflows which helped the financing of the merchandise trade deficits. Moreover, the fluctuations in the Turkish terms of trade do not seem to influence the merchandise trade much.

We examined the percentage changes in trade aggregates (manufactured exports and three types of imports) for the 22-year period (1998-2019) and concluded that the average share of manufactured exports as a proportion of total exports is 93% per annum and the average shares of intermediate, consumption and capital imports as a proportion of total imports are 72%, 12% and 16% per year, respectively. In 22 years, the manufactured exports and intermediate imports that have a large share in their respective totals did not change much.

When we look at the structure of foreign trade of Turkey, on the exports side, according to Eurostat Technology Classification (Eurostat, 2020), (as of 2019), a significant proportion of Turkey's manufactured exports consists of medium high-tech and low-tech products. The shares of medium high-tech (motor vehicles and machinery and equipment), medium low-tech (basic metal industry) and low-tech exports (textile products, clothing and food and beverage products) in total manufactured exports are 26.77%, 10.20%, and 24%, respectively. It may be important for a country whether the composition of manufactured exports consists of advanced manufactures (such as electronic products, transportation equipment) which have a high foreign income elasticity or staple foods and basic industrial goods (such as cotton textiles) which have a low foreign income elasticity. Turkey, here, needs to move from the production of low-tech goods to the production of goods with high-tech content. From the view of

export-led growth, the manufactured exports which consist of high-tech goods may be a key factor to drive economic growth, relaxing the balance of payments constraint.

On the imports side, although the increase in the share of manufactures in the value of total exports is quite high, 93% per annum, this positive effect on the balance of payments may be reduced due to imports of intermediate goods rising with the manufactures. When looking at the shares of sectors in the value of imports of intermediate goods, as of 2019, processed materials incidental to industry is 47.03%, crude oil and natural gas is 16.84%, parts of transportation vehicles is 8.65%, unprocessed materials incidental to industry is 7.48%, parts of investment goods is 6.84%, and processed fuels and is 6.41%. Almost half of the intermediate imports consists of processed materials which are important for the Turkey's industrial production. In this context, we can say that Turkey has limited domestic capacity to produce certain key goods and to relieve this supply limitation by increasing domestic capacity could eliminate domestic bottlenecks and thus increase BP-equilibrium growth rate. The bulk of energy imports consists of crude oil and natural gas which are the significant factors of Turkey's foreign trade imbalance. Therefore, Turkish government needs to pay attention to research and development efforts on alternative energies such as wind and solar that could help reduce the dependence on foreign-sourced energy.

We estimated the demand for imports separately at a disaggregated level: intermediate, consumption and capital goods. As far as the demand for intermediate imports equation is concerned, we found that the elasticities with respect to the real GDP, to the relative prices and the manufactured exports to be 1.05%, 0.26% and 0.67% respectively. In the demand for consumption imports equation, we concluded that only the real GDP variable was statistically significant, and its elasticity was found to be

2.52%. Finally, with respect the demand for capital imports equation, again only the real GDP variable was found to be statistically significant, and its elasticity was estimated to be 2.14%.

Both the extended BPCG model and the basic Thirlwall Law provided quite close yearly average predictions, 4.33% and 4.29% respectively, compared to the average growth rate of actual income of Turkey, 4.37% for the 1998-2019 period. We also pointed out that the short-run variations may be more important from a policy perspective, where the policy-makers may be more concerned for the next two or three years by taking into account the variable short run influences of especially those of expected abrupt changes in capital flows rather than an assured long run growth of income dictated by the Thirlwall law which depends solely on an average long-run growth of exports. In trying to interpret the data by inspection, we also observed that the economic growth in Turkey was almost always accompanied with heavy capital inflows which helped the financing of the merchandise trade deficits. We argued that this policy of allowing the real exchange rate to appreciate (by not preventing the nominal exchange rate to appreciate) by the Turkish government authorities stood in sharp contrast with the economic policies of some countries like China and some others where the exchange rate is perhaps purposely depreciated to insure an exports-led growth of income.

Even though the real exports increased by an average of 6.01% during 1998-2019 period, its relatively small contribution to the rate of growth of income was due to the fact that we took into account the rise in intermediate imports due to an increase in manufactured exports. This additional channel which gave rise to higher intermediate imports was an additional factor confining the growth of income in the BPCG model.

We also found that an average of 0.74% decrease (deterioration) in the terms of trade had a very small effect on the rate of growth of Turkish income (-0.43%) during the 1998-2019 period. Our finding was also consistent with the basic Thirlwall hypothesis that the relative price changes are not important for the growth rate of income in the long run. We formulated a model in which a weak version of BPCG without assuming that the relative prices are constant, was used. The Marshall Lerner Condition of this model then amounted to considering the imports price elasticities only (not the exports price elasticities). In this formulation we estimated a very small imports sectors weighted price elasticity of 0.18 which did not cause any significant effect on the growth of income coupled with the fact that the deterioration (0.74%) itself was not notable.

Furthermore, we examined the relationship between the rates of growth of Turkish GDP and growth of capital flows. Firstly, we noticed that a stylized fact for the Turkish economy seemed to be abrupt decreases in capital flows before/during the recessions like those in 2001 and 2009. The second stylized fact about the Turkish economy seems to be that the periods when the GDP grew rapidly have been associated with heavy increases in capital inflows, generally after the recessions, for example in 2002-2007 and 2010-2011. The August 2018 was the beginning of the last recession Turkish economy experienced as of today and as we could expect from our extended BPCG model, the capital flows decreased by 28% in the year of 2018 and falling again by 43% in the year of 2019.

We also implemented Johansen cointegrating test technique to Turkish data in order to capture possible presence of more than one cointegration relationships between disaggregated imports (intermediate, consumption and capital goods imports) and

domestic income, terms of trade and manufactured exports which are very important variables for testing our extended BPCG model. Then, to clarify whether there is a long run relationship or not between our variables, we implemented Engle-Granger cointegration test technique. For the imports of intermediate goods, the income, and the manufactured exports (cointegration was found between these variables, in Section 6.3.1) and for the imports of capital goods, the income and the terms of trade of capital goods variables (no cointegration was found between these variables, in Section 6.3.3), the results obtained from Engel-Granger cointegration test technique are consistent with the results obtained from Johansen cointegration test technique. However, for the imports of consumption goods, the income, the terms of trade of consumption goods, and the manufactured exports variables, the Johansen cointegration test technique found a cointegration between these variables whereas the Engle-Granger cointegration test technique did not find a relationship (in Section 6.3.2). This contradictory result may be due to the weakness of this test. Namely, if there were only two variables, then Engle- Granger cointegration test technique would be more useful to capture cointegration relationship.

For the imports of intermediate goods (Eq. (79)), the elasticities with respect to domestic income (0.44) and to manufactured exports (0.34) were found to be lower compared to the estimated elasticities of domestic income (1.05, in Table 6 (column 4)) and of manufactured exports (0.67, in Table 6 (column 4)) from the first differences approach respectively. For the imports of consumption goods (Eq. (80)), the elasticity with respect to domestic income (3.49) was found to be higher compared to the estimated elasticity of domestic income (2.52, in Table 7 (column 1)) from the first differences approach. The elasticity of the terms of trade in the consumption goods sector was found 5.88 (in Eq. (80)) and statistically significant. Note that the terms of

trade in the consumption goods sector are calculated by dividing the price of manufactured exports by the price of imports of consumption goods. Therefore, a decrease in the LTOTC variable (a deterioration in the relative prices with respect to those of imports) leads to an increase in the demand for imports of consumption goods. In the imports of consumption goods equation (Eq. (80)), as expected, the manufactured exports are statistically insignificant to determine the demand for imports of consumption goods.

Based on the results, the variables in the imports of intermediate and the consumption goods equations (normalized cointegration Eqs. (79) and (80), respectively) are cointegrated. However, we could not obtain the normalized cointegration equation for imports of capital goods since there is no cointegration relationship between the variables which are the imports of capital goods, the income, and the terms of trade of capital goods. Therefore, when calculating the rates of growth of income from our extended BPCG model and the growth rate of income for the basic Thirlwall Law, we used the estimated elasticity of demand for imports of capital goods with respect to the income (which is obtained from the first differences method) from Table 8 (column 1). As shown in denominator of the Eq. (62), we found the imports sectors' share-weighted income elasticity of demands for intermediate, consumption and capital goods is 1.08.

We can compare the income elasticity for imports from our study and those found in the literature for Turkey, which is a very crucial parameter in the BPCG models. In this study, we found the elasticities of 1.40 (shown in Section 5.2.6) and of 1.08 (shown in Section 6.5) whereas those from the other studies were in the range of 1.82-2.60. This may be due to the time periods and the estimation methods that are somehow

different in our study and those of the other authors. We note that our study's data set extends up to 2019 whereas the other studies' latest data observations are in the year of 2014 or earlier.

Finally, both the extended BPCG model and the basic Thirlwall Law from VAR provided quite close yearly average predictions, 6.04% and 5.57% respectively, compared to the average growth rate of actual income of Turkey, 4.37% for the 1998-2019 period. These yearly average predictions were found to be somehow higher compared to the predictions from the extended BPCG model and the basic Thirlwall Law using the bounds testing and the first differences approaches (4.33% and 4.29%, respectively).

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Appendix A. Empirical Measures and Dataset

Data variables cover the period of 1998-2019 for a total of 22 yearly observations. All imports data by classification of large economic groups (BEC (Classification by Broad Economic Categories (UN)) is measured in dollars (or euro) and converted into Turkish Lira by Turkish Statistical Institutes (TurkStat) by using daily exchange rates reported by Central Bank of the Republic of Turkey (CBRT). All Imports volume indices measure the changes in foreign trade at constant prices of 2010.

Imports of Intermediate goods (LIMPI): The data variable covers both the period of 1998Q1-2019Q3 for a total of 87 quarterly observations and the period of 1998-2019 for a total of 22 yearly observations. The logarithm of the volume index of imports of intermediate goods.

Imports of Consumption goods (LIMPC): The logarithm of the volume index of imports of consumption goods.

Imports of Capital goods (LIMPK): The logarithm of the volume index of imports of capital goods.

Imports of Final Goods (LIMPF): The data variable covers the period of 1998Q1-2019Q3 for a total of 87 quarterly observations. Since TurkStat reported the volume indices of imports of consumption and capital goods separately, we constructed the imports of final goods index by adding up the consumption and capital goods volume indices.

Terms of Trade (relative price) of Intermediate Imports (LTOTI): The logarithm of (p_x/p_i) where p_i is the price index of intermediate imports (2010=100) in U.S. dollars and p_x is the price index of manufactured exports (2010=100) in U.S. dollars.

Terms of Trade (relative price) of Consumption Imports (LTOTC): The logarithm of (p_x/p_c) where p_c is the price index of consumption goods imports (2010=100) in U.S. dollars and p_x is the price index of manufactured exports (2010=100) in U.S. dollars.

Terms of Trade (relative price) of Capital Imports (LTOTK): the logarithm of (p_x/p_k) where p_k is the price index of capital goods imports (2010=100) in U.S. dollars and p_x is the price index of manufactured exports (2010=100) in U.S. dollars.

Real Exchange Rate (LRER): The data variable covers the period of 1998Q1-2019Q3 for a total of 87 quarterly observations. The nominal exchange rate is the weighted average value of the Turkish Lira according to the basket consisting of currencies of countries that have a significant share in Turkey's foreign trade. The real exchange is obtained by purifying the relative price effects of the nominal exchange rate and it calculated as the ratio of the consumer price index of Turkey to foreign country price index, multiplied by the inverted nominal exchange rate so that it indicates real appreciation. LRER index sets 2003 = 100. Source: Central Bank of the Republic of Turkey (CBRT).

Gross Domestic Product (LGDP): The real output, LGDP calculation is based on current prices and chained volume indices. Gross Domestic Product in chain linked volume index is expressed in local currency by expenditure approach and based on 2009. The effect from price changes must be eliminated so that only actual changes can be observed. In the chained volume indices, price changes are more reliable. Since 2016, the GDP data is calculated by the chained volume index and measures the quantity changes at given period by eliminating the price effect.

Manufactured exports (LMANEX): The logarithm of manufactured exports volume index using ISIC (International Standard Industry Classification (UN), Rev.3), (2010=100)).

x_m: The percentage change in exports obtained from the chained linked GDP volume index which is expressed in local currency by expenditure approach (2009=100)).

c: The percentage change in nominal capital flows.

p_f: : The percentage change in price index of imports (2010=100) in U.S. dollars.

Since the average share of manufacturing exports as a proportion of total exports is 93% per annum, in our econometric estimations, we preferred to use the manufacturing exports volume index (LMANEX) instead of total exports volume index. Similarly, we used the price index of manufactured exports, p_x, ((2010=100) in U.S. dollars) when calculating the three terms of trade variables for the three types of imports defined above. Unlike the LRER variable, an increase in the terms of trade variable represents a real depreciation of Turkish Lira (TL). The sources of data for all these measures (except LRER) are obtained from Turkish Statistical Institute (TurkStat).