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Estimation of the Distribution and Demand Dynamics in Turkey: Structural Vector Autoregression Approach to a Post-Keynesian Model

Kaleckiyen Model Çerçevesinde Talep ve Bölüşüm Dinamikleri: SVAR Modeli Yaklaşımı

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ABSTRACT

In this study, we present an empirical investigation into demand and distribution dynamics using structural vector autoregression analysis for Turkey between the period 1970-2017. The theoretical analysis is based on a Kaleckian dynamic macro model where distributive shares are determined endogenously by introducing Rowthorn's conflicting claims on income by workers and firms and labor productivity is allowed to vary with the level of capacity utilization due to economies of scale due to Kaldor–Verdoorn effects and wage-push effects according to Marx. Our findings indicate that increases in wage share lead to an increase in accumulation and growth which suggests wage-led effective demand, while distributive dynamics demonstrate profit-squeeze results, at least in the short run. Moreover, the empirical model confirms most of the typical Kaleckian results.

Keywords: Income distribution, Kaleckian model, effective demand, structural vector autoregression model, Turkish economy

JEL Classification: E12, E25, C32

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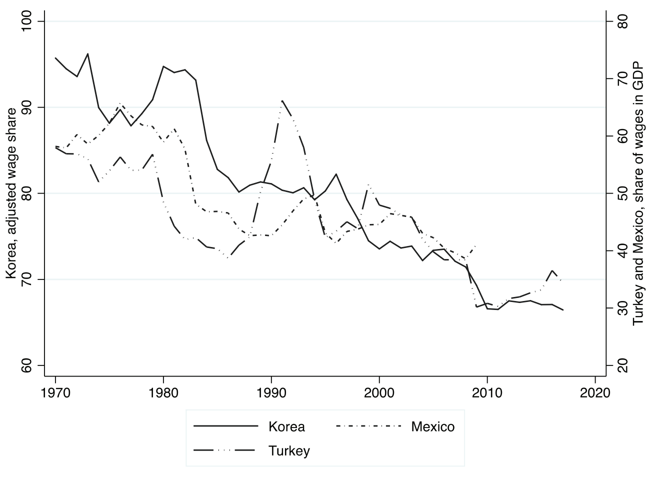
1. Introduction

After the demise of the Golden Age capitalism that built on a cooperative relationship between capitalists and labor, and oil-price shocks that materialized in the 1970s, economic policies emphasized on supply-side performance to restore profitability and promote growth to be achieved by deregulation of labor markets. Consequently, income inequality levels measured by both the absolute and the relative gaps between the richest and the poorest groups of people have remained at historically high levels worldwide. Data shows that following the 1980s, there has been a significant decline in the share of wages in gross domestic product (GDP) in Turkey, and many other developing countries (Figure 1). However, by the end of the 1990s, it was observed that the macroeconomics performance of the economies did not improve: the growth rates after the 1980s did not perform satisfactorily; especially in the expansion period after stagflation, and the GDP growth remained at low levels compared to the 1960s (Table 2). The recent global financial crisis and the failure of pro-capital redistribution of income to stimulate investment, growth, and productivity stresses the need for understanding the relationship between income distribution and aggregate economic performance. Especially the experience of Turkey as a major developing country that followed the IMF and World Bank prescribed structural adjustment programs in addressing short-term instability in Turkey for almost four decades can help to explore why market-oriented reforms and pro-capital distribution policies have not brought satisfying growth and accumulation rates and even exacerbated the macroeconomic instability. The selection of Turkey as a case study for demand and distribution dynamics was not an arbitrary choice. The rationale is that Turkey has not only played a pioneering role in trade and financial liberalization among developing nations since the early 1980s, but also the commitment to liberalization policies through labor market deregulation and profit-led growth model has exposed Turkey to the potential adverse consequences, as evidenced by sluggish employment and income growth, unsatisfactory fixed capital formation rates, macroeconomic instability and two significant financial crises in 1994 and 2000-2001. Thus, it is possible to discern i) the role of demand in growth and accumulation, ii) the impact of pro-capital distribution policies on growth and demand by analyzing the experience of Turkey.

Current economic orthodoxy emphasizes on individual incentives and market imperfections, and is based on a weak assumption that neglects the dual role of wages as a cost to firms as well as the main source of consumption and demand. The implications of Post-Keynesian macroeconomics in terms of income distribution and growth relationships differ from that of supply-driven new growth models. Arguing that real wage restraint policies based on weak economic foundations, they emphasize the social classes, and focus on the role of effective demand in the long-run economic performance and independently determined investment from saving. In particular, Kaleckian growth models based on the work of Michal Kalecki (1971) and further extended by Rowthorn (1981), Dutt (1984, 1990)Bhaduri and Marglin (1990), and Blecker (1989, 1999) provides a useful way to formalize the relative magnitude of the dual role of wages. On the one hand, rising wage share promotes effective demand and allows for a higher profit rate by causing higher capacity utilization because of a strong accelerator effect in the investment function. On the other hand, firms' investment and net exports negatively depend on real wages via costs of production and unit labor costs. Depending on the relative magnitude of these effects, the demand regime can be either *wage-led* or *profit-led*.

Figure 1. Wage share in selected developing countries



Sources: For Korea, we use adjusted wage share dataset from European Commision (2019) AMECO database (annual macro-economic database of the European Commission's Directorate-General for Economic and Financial Affairs) which calculated for the total economy as a percentage of GDP at current factor cost (Compensation per employee as a percentage of GDP at factor cost per person employed.) Data on labor income share for the total economy for Mexico and Turkey is obtained from OECD (2014) (Organisation for Economic Co-operation and Development). Labor income share in Gross Domestic Product (GDP) from TurkStat (2020) (Turkish Statistical Institute) is used for Turkey after the period 2009.

Under these labels, several versions of neoclassical economics which propound that there is a fundamental trade-off between efficiency and equity implicitly assumes, a priori, that aggregate demand regimes of the economies are profit-led. But the theoretical ambiguity of the relationships among distribution, demand and growth from both mainstream and heterodox approaches makes the discussion open to empirical research. The empirical counterparts of the Post-Keynesian/Kaleckian theoretical models have sought to characterize demand regimes as either stagnationist (wage-led) or exhilarationist (profit-led), following Bhaduri and Marglin's (B&M henceforth) contributions and terminology. Although studies have reached a consensus for some countries, there are two interrelated and notable issues in both theoretical and empirical fronts. First, many theoretical studies following the Kaleckian models built on the simplifying assumption of the exogenously determined distribution of income. However, income distribution is endogenous to the growth process, especially when labor productivity is taken into account. Second, most empirical studies typically estimate separate econometric equations for each component of the aggregate demand to determine the demand regime of the country by taking distribution of income as given. Although this approach is more appropriate to test the implications of B&M's extension to the Kaleckian model, Blecker (2016) argues that this approach is likely to introduce endogeneity bias since it focuses on longer horizons and disregards the dynamic interaction between demand and distribution (see e.g., Onaran & Galanis, 2012; Onaran & Obst, 2016; Stockhammer, Hein, & Grafl, 2011; Stockhammer & Wildauer, 2016). On the other hand, studies that address the simultaneity issue between demand and distribution by systems approach, by and large, do not have control variables and focus only on the short-term behavior of the system (e.g., Barbosa-Filho & Taylor, 2006; Carvalho & Rezai, 2016; Diallo, Flaschel, Krolzig, & Proaño, 2011; Jesus, Araujo, & Drumond, 2018; Kiefer & Rada, 2015) (Blecker, 2016, p. 378)

Many theoretical and empirical studies contributed to the debate on wage-led and profit-led regimes so far. However, few studies are contributing to the literature on the structuralist macroeconomic analysis of effective demand and distribution of Turkey. This study is one of the few attempts to determine the demand and distribution relationship by testing the relevance of the Post-

Keynesian/Kaleckian models for the Turkish economy. To address the above issues and overcome endogeneity bias, this study follows the Kaleckian tradition and deals with a dynamic model of accumulation, effective demand, functional income distribution, and labor productivity.

Table 1. Average Annual Growth Rates of Selected Countries (1960-2018, sub-periods)

	1961-72	1973-79	1980-89	1990-99	2000-07	2008-10	2011-18
USA	4.29	3.38	3.14	3.23	2.69	-0.18	2.08
UK	3.21	2.27	2.68	2.10	2.74	-1.01	1.80
Japan	9.53	4.15	4.37	1.63	1.43	-0.77	1.03
Austria	5.11	3.45	2.14	2.78	2.01	0.38	1.37
European Union	-	-	-	1.93	1.96	-0.71	1.12
OECD	5.09	3.52	3.03	2.70	2.61	-0.09	1.90
Korea	9.62	10.99	8.78	7.13	4.97	3.34	2.90
Mexico	6.46	6.46	2.24	3.51	2.94	0.61	2.54
Turkey	*6.50*	*4.40*	*4.08*	*4.02*	*7.14*	*1.62*	*5.66*

Source: OECD (2017), Economic Outlook No 101, June 2017.

The theoretical model draws on several studies that endogenize income distribution and labor productivity by extending the Kaleckian demand-led growth model (Bhaduri, 2006; Cassetti, 2003; Dutt, 1987; Sasaki, 2011; Sasaki, Sonoda, & Fujita,, 2013). Our central claim is that endogenous profit share and labor productivity play a significant role since any change in productivity has a feedback effect on both aggregate demand and functional income distribution. These interactions are analyzed in a reformulated version of B&M (1990) from the perspective of Kaleckian macro model. To endogenize income distribution and labor productivity, we incorporate Rowthorn's theory of conflicting claims and Kaldorian system of productivity-growth enhancing effects of higher demand and higher real wages, respectively.

In the empirical part of the study, a Kaleckian dynamic model estimated by a structural vector autoregression (SVAR) approach with variables of accumulation, adjusted wage share, capacity utilization rate, and labor productivity for Turkey between the period 1970-2017. This model has the advantage of identifying the model by imposing restrictions relying on the theoretical model.

The organization of the paper is as follows. In the next section, we look into stylized facts of income distribution and some trends in macroeconomic performance to link the effects of the pro-capital distribution of income and growth in Turkey. In the third section, we present the structure of the theoretical model. To solve the problem of their simultaneous determination and identify the model, we introduce the SVAR approach in the fourth section. The fifth section presents the empirical results. The last section concludes the paper with final remarks.

2. The failure of mainstream narrative: Some stylized facts on Turkey

Do pro-capital distributional policies deliver on its promise for higher growth and investment? We begin by examining some basic trends on income distribution and the macroeconomic performance of Turkey to search for an answer to this question.

The idea that the trajectory of economic development passes through a series of predetermined stages as experienced by England, the United States and Japan was taken almost as gospel, which led less-developed countries such as Turkey, Brazil, and South Korea to imitate the development policies of those countries. The initial stage for the development strategy necessitates trade-protectionist policies which improve the domestic industries, and then help to boost the exports of simple manufactures. The economy then moves into increasing sophistication of the products (Milanovic, 2019, p. 152). Accordingly, economic policies in Turkey epitomized a prolonged inward-looking development model characterized by direct trade, domestic price and exchange rate controls, promotion and protection of local industries, heavy subsidization of domestic producers, and financial repression policies. During this period, the dual role of wages in creating a self-sufficient domestic market and promoting investment, which generated rapid productivity growth and boom in domestic output was recognized. However, debt-crisis in 1977 led to a problem of balance of payments coupled with hyper-inflation fueled by second oil shock in 1979 (Celasun, 1994, p. 42). Stagnant productivity and investment, deep foreign exchange crises and major downswing of the economy paved the way for the launch of a radical orthodox program, following a military coup in 1980 to enforce neoliberal economic policies.

After the neoliberal counter-revolution in economic theory and policy, the Turkish economy experienced two prominent changes, which were essential for the International Monetary Fund (IMF) and World Bank policy prescriptions along its structural adjustment path after the 1980s. First, a shift from inward-looking policies to outward-oriented growth strategies that aim to integrate the economy into the global market, which covers the period 1980-88. Second, financial deregulation and liberalization of the capital account in 1989 to allow capital flows and complete the integration of the economy into the global financial market.

During the trade liberalization period, the flexible crawling-peg regime, export subsidies and grants provided by the government became new policy instruments in the post-1979 adjustment process to achieve stabilization objectives and export promotion (Metin-Ozcan, Voyvoda, & Yeldan, 2001, p. 224). The new export-orientation era regarded the role of external markets as the main source of effective demand and replaced the conspicuous role of real wages in the near-autarkic economy of the 1970s. New policy regime entailed a sharp cut in labor costs to depress effective domestic demand, alongside the exchange rate depreciation to improve the ability to create an exportable surplus.

Owing to the suppression of real wages through weakening of labor organizations in Turkey as in many other developed and developing countries after 1980s, there has been a remarkable decrease in the wage share, following the relative constancy of the factor shares over long periods which considered to be a 'stylized fact' by (Kaldor, 1961)attributing this contrary movement to the compensating (or more than compensating. Figure 1 compares Turkey with two other countries over the same historical period who adopted similar export-oriented development strategies in the post-war era. The share of wages in GDP receded from its average of 55.49% between 1970-80 to 38.69% in 1986 and 42.41% in 1988 in Turkey. Resembling patterns can be observed for Korea and Mexico, as well.

The full integration of the Turkish economy into the global market had been completed with the second phase of the structural adjustment through financial liberalization in 1989, which brought about a new wave of populist policies. We observe a drastic reversal of earlier trends based on the erosion of wage incomes and a period of recovery in real wages, which came to be known as "wage explosion" following the gains of labor unions resulting from the reemergence of populism. The share of wages in GDP increased at an annual rate of 10.8% on average from 1989 to 1993. Yet, post-1988 populism came at costs of upcoming growing fiscal gaps, hasty rise in borrowing requirement of the public sector, and ever-increasing current account deficit, which sooner led to twin deficits (Yeldan, 2000). Leaving capital incomes untaxed, financing ever-increasing current account deficit through foreign capital inflows and large fiscal deterioration proved to be unsustainable. While these prolonged instabilities ultimately caused a severe crisis in 1994, all the realized wage gains by workers from 1989-1992 had been revoked once again by the April 1994 stabilization program in the aftermath of the 1994 crisis (Figure 1).

Next, we examine how the Turkish economy responded to pro-capital distributional shifts. Performance indicators on production and distribution for different macroeconomic phases in the Turkish economy illustrated in Table 2. Based on the preeminent policy shifts, we consider ten sub-periods with four crisis periods. GDP growth averaged around 4.5% during the period 1980-1988, gaining relative macro-economic stability with the new policy reforms until 1983. While domestic saving rates as a share of GDP slightly diminished from 32.8 to 30.8 after the first adjustment process, investment as a share of gross national product (GNP) decreased to 22.8, correspondingly. Despite the rapid recovery of GDP in the first sub-period, Turkey's potential growth rate settled down on a lower and unstable trajectory, while savings and investments failed to generate significant and stable improvement (Boratav, Türel, & Yeldan, 1996, p. 374). This was partly due to favorable but temporary effect of wage cuts on enhancing production costs and international competitiveness, besides price subsidies and generous grants provided by the government. The overall impact of wage suppression and price subsidies on GDP growth eventually faded away by the end of the decade, as the preceding gains from productive industrial investments during the import-substitutionist period couldn't be retained after switching the existing capacity to the international markets.

Careful analysis of the composition of the sectoral structure of investments also helps to uncover the underlying processes of the immense failure of neo-liberal policies following the adjustment period after the 1980s. Typically, financial liberalization reforms expected to transform savings into investments more efficiently, thereby lowering investment costs, as reflected by the monetarist postulates. Contrary to expectations, the deregulation of financial markets rendered the link between financial and real spheres of the economy more disconnected as the international finance capital claimed its dominance over the real economy. Substantial financial capital inflows in a poorly regulated financial market incited the search for short-term financial gains and precipitated the property and real estate booms rather than long term sustainable growth.

Table 2 displays the composition of fixed investments by pointing out the sectoral differentials over time. Although the share of private sector in total output increased since 1985, the expansion mostly arose from the investment boom in the housing sector which grew about 18% during 1980-1988. Meanwhile, the growth rate of private gross fixed capital formation (GFCF) in manufacturing remained at very low levels, less than 2.5% growth on average in the 1980s, and only slightly increased by about 3 percentage points in the 1990s. The orientation of private investments from the productive manufacturing sector to housing and real estate precipitated the unsustainable structure, leaving the real economy stagnating, or even in declining terms.

Table 2. Main economic indicators on production, accumulation and distribution, 1970-2007

	ISI policies 1970-1977	Fiscal and BoP crisis 1978-1979	Neoliberal restructuring and EOI 1980-1988	Financial liberalization 1989-1993	Financial crisis 1994	Capital-led growth 1995-1998	Banking crisis 2001	Regulatory neo-iberalism 2002-2007	Global financial crisis 2008-2009	Post- global financial risis 2010-2017
GDP growth, %	6.1	0.4	4.5	4.9	-5.5	7.2	-6	7.1	-1.9	6.8
Gross fixed capital formation										
Public, share in total output (%)*	7	8.2	9	7.3	4.9	5.4	6.4	4.9	3.9	4
Private, share in total output (%)*	15	14.9	12.6	16.4	19.6	19.5	12.6	15.3	20.7	24.1
Private manufacturing, real rate of growth	11.9	-14.8	1.91	16.9	-9	7.8	-42	25.5	-20.6	9.7
Private manufacturing, as share of private investments	40.7	32.8	28.8	27.2	23.6	25.3	23.3	38.5	38.1	38.8
Private housing, real rate of growth	-	-	18.4	2.2	18.1	-2.2	-12	13.3	-	-
Private housing, as share of private investments	32.4	41.5	32.4	41.1	44.7	39.1	26.7	16.8	18.1	16.2
Savings and investments										
Gross savings (as share of GDP)	32.8*	32.2	30.8	20.6	18.1	21.8	20.8	22.2	15.1	14.1
Gross fixed investments (as share of GNP)*	22.8	23.1	22	23.7	24.5	24.9	19	20	18.7	20.6
Wages and productivity										
Real wage growth rate (for the total economy)	5.71	2.86	2.23	11.07	-17.57	1.71	-7.48	0.96	-	-

Labor productivity growth rate (for the total economy)	4.9	-0.15	3.83	3.3	-10.9	4.07	-5.7	7.8	1.7	4.6

Notes: ISI, BoP and EOI refers to import-substitution industrialization policies, balance of payments and export-oriented industrialization.
Sources: GDP growth (in real terms) and savings as % of GDP are obtained from World Bank (2018) national accounts data. Real wage growth rate and labor productivity growth rate data sets are extracted from the OECD (2020) productivity statistics. For investment, we use main economic indicators from Presidency of Strategy and Budget (2020)- SBB (previously known as State Planning Organization-SPO). To calculate the real wage growth rate, we divide total labor costs deflated for consumer price index by average number of hours worked per worker in a year for the total economy. *Gross savings are calculated as gross national income less total consumption, plus net transfers for the period between 1974-1977, reflecting the data availability.

The new profit-led growth model which aims to decrease the public-sector involvement in the real sector, suppress wages by restricting the labor union power, and implementing fiscal policies by lowering taxes on capital continued with mass privatization program after 2000. However, the gains achieved during the capital-led growth period (1995-2000) were undermined following the 2000-2001 crisis. The most pronounced impacts of the economic crises in 2000 and 2001 was disproportionately reflected on labor markets. Real wages fell by 7.5% in 2001, while GDP growth declined by 6% in 2001. After this period, GDP growth shows a highly volatile path. The strong economic recovery following the 2001 banking crisis resulted in remarkable recovery in GDP growth due to significant improvements in the political and institutional environment, rising by 7% during 2002-2007, before it falls almost 2% during the global financial crisis. However, the corresponding upward reversal in growth rates was not achieved in terms of real wages and employment. An interesting fact during this period is the evident widening gap between the real wages and labor productivity: real wages and the share of labor displayed a falling trend after 2002, while productivity gains accelerated. According to Yeldan (2005, p. 10-11), "…this productivity surges was due mostly to labor shedding, rather than increased labor efficiency originating from advances in technology."

Despite the substantial increase in capital flows during the structural adjustment policies, Turkey has witnessed slower rates of gross fixed investments and gross savings. Throughout the era of import substitution industrialization (ISI) policies, the average share of gross savings in Gross National Product (GNP) stood at 32.8%. However, this share exhibited a steady decline until 2017, reaching its lowest level 14.1% during 2010-2017. Similarly, the average share of gross fixed investments in GNP stood at 24% prior to the 2001 banking crisis, but declined to 20.6% during the post-global financial crisis period. Meanwhile, the share of public investment expenditure in GDP continued to fall from around 6.4% in 2001 and 4.9% during 2002-2007, to its lowest level, 4% during 2010-2017. Surely, the prevailing factors contributing to this unsatisfactory investment performance can be attributed to structural deficiencies, namely high real interest rates during this period, limited credit availability, imperfections in capital markets, and other factors such as increased macroeconomic risks and uncertainties due to heightened volatility.

To sum up, the inability of the neoliberal policies in promoting manufacturing exports to yield necessary long-run accumulation patterns as it promised and the reliance on wage repression as a short and medium-term policy was proved to be harmful to the long-run sustainable development of Turkey. Although real wages significantly restrained in the 1980s and 1990s to allow recovery of profitability, the period after the 1990s characterized by unsatisfactory economic growth rates, sluggish productivity growth and stagnant investment rates. The recent global financial crisis and the failure of pro-capital redistribution of income to stimulate investment, growth, and productivity stresses the need for understanding the relationship between income distribution and aggregate economic performance.

3. A model in distribution and demand

In this section, we present the theoretical model based on the earlier works that attempted to endogenize income distribution and labor productivity by extending the Kaleckian demand-led growth model (Cassetti, 2003; Dutt, 1987; Lavoie, 1992; Sasaki et al., 2013). First, we obtain the dynamics of income distribution over the business cycle by drawing on the conflicting-claims theory of inflation developed by Rowthorn (1977), which is a preeminent and commonly used way to model the endogenous income distribution in a Kaleckian approach. Second, we consider the saving behavior of the individuals and investment decisions of the firms to derive the dynamics of demand in a closed economy without a government sector, following the seminal work of B&M (1990), Marglin and Bhaduri (1990), and Steindl (1952).

The economy produces one homogenous good with homogeneous labor and homogeneous and non-depreciating capital. Capital is the produced good and the goods produced by firms can be used for both consumption and investment purposes. There are two social classes; workers who receive wage bill and capitalists who are the owners of the firms and receive the residual income in the form of profits. Firms operate with the Leontief-type fixed coefficient production function. Thus, the value of income and production is as follows:

$$PY = WL + rPK \tag{1}$$

where P is the price level, Y is the real output, W is the money wage, L is the level of employment, r is the profit rate, and K is the capital stock. The nominal income PY is distributed to the wage bill, WL, and profits, rPK. Dividing both sides of Equation (1) by PY, we can derive the profit share π as follows from this accounting relationship:

$$\pi = 1 - \omega a_0 \tag{2}$$

where $\omega = W/P$ is the real wage, $a_0 = L/Y$ which denotes the fixed unit labor requirement, $\pi = r/u$, u is a measure of capacity utilization rate $(u \equiv Y/K)$, where firms hold excess capacity, so $u \leq 1/a_1$, and a_1 is the fixed minimally required capital-output ratio.

If we differentiate the profit share with respect to time from the definition of the profit share, $\pi = 1 - WL/PY$ we obtain the following relationship:

$$\frac{\dot{\pi}}{(1-\pi)} = \frac{\dot{p}}{p} + \frac{\dot{x}}{x} - \frac{\dot{w}}{w} \tag{3}$$

where x is the average labor productivity, Y/L.

3.1. Distribution Dynamics

Considering that there is imperfect competition in the goods market, and mark-up pricing is valid in price-setting behavior, the wage and price dynamics structurally take the following equations:

$$\widehat{w} = \vartheta_w(\pi - \pi_w) \ ; \vartheta_w > 0 \text{ and } \pi_w = \pi_w(u, \omega) \ ; \pi_{wu} < 0 \ , \pi_{w\,\omega} < 0 \quad (4)$$

$$\hat{p} = \vartheta_f(\pi_f - \pi) \ ; \vartheta_f > 0 \text{ and } \pi_f = \pi_f(u, z) \ ; \pi_{fu} > 0 \ , \pi_{fz} > 0 \quad (5)$$

The hat symbol denotes the time rate of change in variables. Here, workers set the nominal wage , and negotiate over the gap between actual profit share π and their target profit share π_w. We assume that the target profit share of workers is decreasing function of the rate of capacity utilization and the real wage (ω). In a similar manner, firms set their prices, p, to close the gap between actual and target profit share π_f to achieve their target mark-up. The target profit share of firms is an increasing function of capacity utilization and mark-up, so, the profit share is determined endogenously in the model. ϑ_w and ϑ_f measures the speed of the reaction of workers to a gap between actual and desired real wage, and adjustment speed of the price to the gap between actual and desired profit share, respectively.

We deal now with the specification of endogenous labor productivity. There are several growth models that take into account the endogenous technological progress relying on different concepts. This study will endogenize labor productivity based on Kaldor-Verdoorn law (Kaldor, 1966; Verdoorn, 1949) which emphasizes on the positive impact of output growth on labor productivity due to dynamic economies of scale (see Cassetti, 2003; Hein & Tarassow, 2010; Naastepad, 2006a; Naastepad & Storm, 2006; Storm & Naastepad, 2009) and the concept of induced technical change as stressed by Marx (1867) and Hicks (1932) (see Barbosa-Filho & Taylor, 2006; Foley & Michl, 1999; Lima, 2004; Taylor, 1991)[1].

[1] Another way of endogenizing labor productivity is to consider the potential effect of the employment rate and labor market rigidities on technological progress (see Dutt, 2006; Palley, 2012; Sasaki, 2010). But, since the dual economy argument is valid for Turkey, the labor market is not considered to be a constraint for increasing production and firms may hire more labor without offering higher wages.

For our theoretical model, this results in the following labor productivity function:

$$\hat{x} = g_x(u, \omega) \text{ and } g_x'(u) > 0;\ g_x'(\omega) > 0 \tag{6}$$

where $\hat{x}$ denotes the rate of change in the level of labor productivity. Here, we assume that labor productivity growth is an increasing function of both the rate of capacity utilization (u) and real wages (ω).

Substituting equations (4), (5), and (6) into the equation (3), we obtain the dynamics of the profit share:

$$\dot{\pi} = (1-\pi)\{\vartheta_f[\pi_f(u,z) - \pi] - \vartheta_w[\pi - \pi_w(u,\omega)] + g_x(u,\omega)\} \tag{7}$$

Around a steady state, the sign of $\partial\dot{\pi}/\partial\pi$ which shows the effect of a profit share increase on the profit share itself is determined by $-\xi - (1-\pi)(\vartheta_f + \vartheta_w)$ where $\xi = \vartheta_f[\pi_f(u,z) - \pi] - \vartheta_w[\pi - \pi_w(u,\omega)] + g_x(u,\omega)$, and is ambiguous due to the sign of ξ. For the sign of $\partial\dot{\pi}/\partial\pi$ to be positive, the conditions that $\xi < 0$ and $|\xi| > |(1-\pi)(\vartheta_f + \vartheta_w)|$ must both hold. However, the sign of the $(1-\pi)(\vartheta_f + \vartheta_w)$ is necessarily positive, and a set of economically meaningful parameter values for the coefficients corresponds to ξ makes this expression positive. Thus, we can assume that $\partial\dot{\pi}/\partial\pi < 0$.[2]

The sign of the $\partial\dot{\pi}/\partial u$ is also ambiguous. From Equation (7), a change in the profit share is decomposed into the rates of change in price, wages and labour productivity. From Equation (4), the rate of change in wages is positive in response to an increase in capacity utilization through the reserve-army effect: $\vartheta_w\pi_{wu} < 0$.

[2] Some studies exploring the neo-Goodwinian growth cycle which uses labor share as a state variable alongside with an economic activity variable in a two-dimensional dynamical system assume that the own-feedback of labor share, $\partial\dot{\psi}/\partial\psi$, is stable, where $\psi = 1-\pi$ (see Ernst, Flaschel, Proaño, & Semmler, 2006; Flaschel & Krolzig, 2006; Tavani, Flaschel, & Taylor, 2011; Taylor, 2011). However, as Taylor (2004, pp. 235–236) stated, the endogeneity of labor productivity raises the possibility of locally unstable system, where $\partial\dot{\psi}/\partial\psi > 0$, if productivity responses negatively (positively) to the labor share (profit share). In Equation (6), we introduced the existence of induced labor-saving technical change whenever the real wage increases, $g_x'(\omega) > 0$, which later may reduce the labor share, and makes labor productivity pro-cyclical to the profit share. But for $\partial\dot{\psi}/\partial\psi$ to be positive according to Equation (7), $|\vartheta_w[\pi - \pi_w(u,\omega)]| > |\vartheta_f[\pi_f(u,z) - \pi] + g_x(u,\omega)|$ must hold.

A rise in capacity utilization rate increases the bargaining power of the firms according to Equation (5): $\pi_{fu} > 0$. From Equation (6), an increase in capacity utilization rate leads to increased labour productivity: $g'_x(u) > 0$. Hence, summing up these effects, the rate of change in the profit share due to a rise in demand depends on whether the bargaining power of capitalists and productivity gains prevails the bargaining power of workers. Next, we add the following definition regarding the two types of income distribution regimes for Equation (7):

Definition 1. The distributive regime is labeled *profit*-squeeze if the profit share gets eroded as capacity utilization approaches to its potential level. That is, $\left[\vartheta_f \pi_{fu} + g'_x(u) < -\vartheta_w \pi_{wu}\right]$ is established in the profit-squeeze regime. In contrast, if a fall in the output gap leads to an increase in the profit share, the economy displays *wage-squeeze*, or forced savings, where profit share moves pro-cyclically. That is, $\left[\vartheta_f \pi_{fu} + g'_x(u) > -\vartheta_w \pi_{wu}\right]$ is established in the case of forced savings.

The counter-cyclical movement of profit share is similar to Marxian models of the industrial reserve army, where in a phase of an economic boom, workers try to increase their wage share. On the other side, pro-cyclical movement of profit share may occur, because capitalists have higher propensity to save than workers, and as economy gets closer to the potential output level, the economy will have higher overall savings as profit share increases.

3.2. Demand dynamics

Next, we define the dynamics of demand by specifying the saving behavior of the society and investment decisions of firms. Workers are assumed to spend all of their income, while capitalists save a fraction of their profits. According to B&M (1990), the profit rate (r) can be decomposed into the components of profit share (π), capacity utilization (u), and capital productivity ($\bar{k}$). Assuming that the ratio of capital stock to the potential output is constant, expected profitability is given by $r = \pi u$. Real savings normalized by capital stock, $g_S = \frac{S}{K}$, leads to the following equation:

$$\frac{S}{K} = g_s(u,\pi) \text{ and } g_{su} > 0\ ;\ g_{s\pi} > 0 \tag{8}$$

In line with the classical and Keynesian/Kaleckian tradition, the saving propensity of the capitalists is assumed to be higher than that of workers: $g_{s\pi} > 0$. Also, we assumed that higher income level and capacity utilization rate increase savings: $g_{su} > 0$.

Following the argument of Marglin and Bhaduri (1990), we specify the ratio of the real investment to the capital stock, $g_d = \frac{I}{K}$, as follows:

$$\frac{I}{K} = g_d(u,\pi) \text{ and } g_{du} > 0, g_{d\pi} > 0 \tag{9}$$

Here, g_{du} captures the accelerator effect on the investment determination, and $g_{d\pi}$ represents the positive effect of profitability in investment decisions. Finally, we assume that saving and investment must be equal for goods market clearing.

The dynamics of the output level can be specified based on the adjustment of the actual output level to excess demand (or supply). Because, in Kaleckian models, the economy is driven by the demand, so excess investment over saving increases the level of capacity utilization. At equilibrium, $g_s(u,\pi) = g_d(u,\pi)$. Equation (10) represents the quantity adjustment in the goods market, where λ denotes the adjustment speed of a change in the output level in response to disequilibrium in the goods market:

$$\dot{u} = \lambda[g_d(u,\pi) - g_s(u,\pi)] \text{ and } \lambda > 0 \tag{10}$$

At the steady-state equilibrium, $\partial\dot{u}/\partial u$ shows the quantity adjustments in the goods market. A rise in demand increases both investment and savings of capitalists and workers: $g_{du} > 0$ and $g_{su} > 0$. We impose the following assumption on the dynamics of the actual output level for a stable quantity adjustment.

Assumption 1 *The condition* $g_{du} < g_{su}$ *holds.*

The assumption above is the so-called Keynesian stability condition (Marglin & Bhaduri, 1990), and is often imposed on Kaleckian models. This means that savings react to changes in output more than that of investments.

Another important macroeconomic debate among heterodox economics is the relationship between the level of economic activity and distribution, which is motivated by the slope of the demand schedule, $\partial\dot{u}/\partial\pi$. The effect of a change in the distribution of income on capacity utilization can be negative or positive depending on whether saving reacts more than investment to a change in the profit share. The sign of the $\partial\dot{u}/\partial\pi$ is ambiguous and it needs to be tested empirically. Imposing Assumption 1, we introduce the following definition that classify the demand regime according to how a profit share increase affects capacity utilization.

Definition 2 The steady-state equilibrium is called *a profit-led demand regime* if the relation $g_{d\pi} > g_{s\pi}$ holds. By contrast, the steady-state equilibrium is called *a wage-led demand* regime if the relation $g_{d\pi} < g_{s\pi}$ holds.

3.3. Model Dynamics and Stability Analysis

From Equations (7) and (10), we have a two-dimensional set of differential equations with two state variables (u^*, π^*)[3] linearized around the steady state. The Jacobian matrix $\mathbf{J}$ which its entries show the partial derivatives of the differential equations describing the model can be summarized as follows.

$$\mathbf{J}(u^*,\pi^*) = \begin{bmatrix} \frac{\partial\dot{u}}{\partial u} & \frac{\partial\dot{u}}{\partial\pi} \\ \frac{\partial\dot{\pi}}{\partial u} & \frac{\partial\dot{\pi}}{\partial\pi} \end{bmatrix} = \begin{bmatrix} \lambda(g_{du} - g_{su}) & \lambda(g_{d\pi} - g_{s\pi}) \\ (1-\pi)\left[\vartheta_f\pi_{fu} + \vartheta_w\pi_{wu} + g'_x(u)\right] & -(1-\pi)\left(\vartheta_f + \vartheta_w\right) - \xi \end{bmatrix}$$

[3] To avoid complex notation, we use (u, π) is used instead of (u^*, π^*).

Using the analysis of the eigenvalues, we can characterize all possible cases, including stable and unstable ones. The equilibrium point is **locally asymptotically stable** if all the eigenvalues of the linearized system have negative real parts. By contrast, if at least one eigenvalue has positive real part, the equilibrium is **unstable.**

From here, for the case of both eigenvalues are real $(tr(\mathbf{J}))^2 > 4\, det\, \mathbf{J})$, in our model, the necessary and sufficient condition for local stability is when the trace of the Jacobian, $tr(\mathbf{J})$, is negative, i.e., the sum of the eigenvalues is negative, and its determinant, $det(\mathbf{J})$, is positive, i.e., the product of the eigenvalues is positive:

$$tr(\mathbf{J}) = \lambda(g_{du} - g_{su}) - (1-\pi)\big(\vartheta_f + \vartheta_w\big) - \xi < 0$$

$$det(\mathbf{J}) = \lambda(g_{du} - g_{su})[-(1-\pi)\big(\vartheta_f + \vartheta_w\big) - \xi] - \lambda(1-\pi)(g_{d\pi} - g_{s\pi})\big[\vartheta_f \pi_{fu} + \vartheta_w \pi_{wu} + g'_x(u)\big] > 0.$$

The other possible case for $tr(\mathbf{J}) < 0$ is when $det(\mathbf{J}) < 0$. This situation corresponds to a saddle, where points move towards the equilibrium in one direction, but away from the equilibrium in the other.

When $tr(\mathbf{J}) > 0$ and $det(\mathbf{J}) > 0$; the system is unstable.
When $tr(\mathbf{J}) > 0$ and $det(\mathbf{J}) < 0$; we have saddle-path instability.

Examining these conditions in our model, we introduce the following propositions. Let's consider a case where $\partial\dot{\pi}/\partial\pi < 0$ and the Assumption 1 holds.

Proposition 1 *Suppose that the steady-state equilibrium exhibits a profit-led demand regime. The steady state is locally asymptotically stable, if the distribution regime is profit-squeeze.*

Proof. See Appendix A.

Proposition 2 *Suppose that the steady-state equilibrium exhibits a wage-led demand regime. The steady state is locally asymptotically stable, if the distribution regime is wage-squeeze.*

Proof. See Appendix A.

According to Propositions 1 and 2, the combinations of the profit-led demand regime/profit-squeeze effects, and wage-led demand regime/wage-squeeze effects present self-stabilising mechanisms. For the former case that typically found in many aggregative studies, the economy jumps to a higher level of demand level after a positive shock to an exogenous profit share shock, which in turn increases the labor share squeezes the profits as the economy slowly converges toward its equilibrium value. By contrast, a rise in the wage share stimulates demand in the latter case, whereas a higher demand translates into forced savings and restrains wage share.

4. Estimation strategy of demand and distribution dynamics

In this section, our goal is to estimate the relationship between aggregate demand and income distribution by relying on the Kaleckian dynamic demand-led growth model for the period between 1970-2017 for Turkey. The empirical motivation of this paper grounds on two main reasons. First, there are methodological issues in the empirical literature related to both endogeneity and identification issues that need to be addressed. Second, from the theoretical perspective, we identify two issues: (i) simultaneous determination of demand and distribution, (ii) endogeneity of labor productivity. Based on these theoretical concerns, our empirical approach addresses the issue of endogeneity problem with the SVAR model which can capture dynamics in multiple time series.

4.1. Empirical literature

Concerning the empirical literature, studies contributing to income distribution and aggregate demand literature by testing the Kaleckian models with B&M extensions follow two distinctive paths in their methodology. The works of Gordon (1995) and Bowles and Boyer (1995) are the precursor studies representing this distinction. Bowles and Boyer estimated separate econometric equations for saving, investment and net exports for five developed economies over the post-war period and found that increased real wages are likely to lead a decline in aggregate demand, especially when net exports are taken into account. Although their approach to the modeling of time series casts a shadow on the reliability of their findings due to lack of tests on time series properties of the data (such as unit root tests) and robustness check, their work inspired many subsequent empirical studies.

Empirical studies constructed around the methodology of Bowles and Boyer intended to decide the demand-regime of the countries under different circumstances. Accordingly, they extended the B&M model to different directions such as inclusion of monetary variables by Hein and Ochsen (2003), productivity channels by Naastepad (2006b) and Naastepad and Storm (2006), globalization by Stockhammer, Hein and Grafl (2011), and open economy considerations by Ederer and Stockhammer (2007) and Hein and Vogel (2008) following the theoretical work of Blecker (1999, 2002). Although the economies may exhibit different demand regimes in diverse circumstances, main findings of these studies point out that most economies have wage-led demand regime domestically, and larger economies have overall wage-led demand regime, while small and more open countries are more likely to have profit-led demand regime since net exports component is considered. Other studies in line with separate econometric equations methodology by Onaran and Galanis (2012), Onaran and Obst (2016) and Stockhammer and Wildauer (2016) have also confirmed this pattern.

The primary drawback of the above literature is that the endogeneity does induce bias in the estimation of the effect of functional income distribution on aggregate demand by OLS, and parameter estimates will also be inconsistent. To obtain unbiased and accurate measures of estimates, a sufficiently large sample size and addition of exogenous variables are needed. However, unless including sufficient control variables to encompass everything determining the distribution and demand, this method will still be biased. The presence of these problems is also acknowledged by Blecker (2016) and Stockhammer (2015) in their surveys of empirical literature on demand regimes. The simultaneity problem calls for the use of simultaneous equation estimators as an ultimate solution. This method suggests finding variables that are correlated with the distribution variable, but not with the error terms; that is instrumental variables. Two-stage least squares (2SLS) approach, VAR, SVAR, and Vector error correction (VEC) models are the most widely used methods in the literature in addressing the endogeneity issue.

The first study that uses the instrumental variable approach in estimating the interrelationship between demand and distribution starts with Gordon's (1995) work, who uses the quarterly data on profit share and capacity utilization rate between 1955-1988 for the US economy. Remarking that the indicators of capitalist power are also functions of the level of capacity utilization, he tackled the endogeneity issue by estimating the reduced-form profit equation, and using 2SLS method in predicting the coefficient of the demand schedule. He found that both domestic and over-all demand regime of the US economy is profit-led. Inspired by the Gordon's econometric approach, later studies typically estimated the demand and distributional schedules with an equation-systems method. Barbosa-Filho and Taylor (2006), Fernandez (2005), Barrales and von Arnim (2017) Carvalho and Rezai (2016) and Kiefer and Rada (2015) used different versions of the equation-systems method such as IV, VAR, Threshold VAR, and wavelet analysis and they reached to similar conclusions, especially for the US case: demand is profit-led while distributive schedule exhibit profit-squeeze patterns.

The notable works of Stockhammer and Onaran (2004) and Onaran and Stockhammer (2005) are especially useful and guiding for our analysis. In their first study, Stockhammer and Onaran tested the US, UK, and France by controlling employment rate and productivity, and included additional control variables, such as the real interest rate, inflation and the change in inflation. Their findings are in contrast with the previous findings of the studies using similar methodology, and indicating that there is no significant effect of distribution on demand and wage-squeeze effects are valid. The latter study by the same authors tests the Post-Keynesian open economy model for Turkey and South Korea for the periods of 1965-1997 and 1970-2000, respectively. They found that demand regime of the two countries are wage-led, although the effect seems to be weaker for the case of Turkey. It is worth mentioning here that economies may exhibit different demand regimes in diverse circumstances. Thus, the idea of incorporating the labor market into the analysis to explicitly reflect a reserve army effect while addressing the simultaneity issue seems reasonable. Though modeling Okun's law recoups the criticisms raised by Skott (2016) in leaving out the specification of the labor market along with the goods market in Kaleckian analysis, the validity of the dual-economy argument for Turkey brings the question of whether the growth of the labor supply is endogenous and the inclusion of employment variable in the SVAR model meaningful for a developing economy that has no labor constraints.

Built upon the theoretical and empirical motivation, the empirical approach of this paper follows the SVAR model, which can be counted as a version of the stochastic difference equation models but differ in its identification approach. Although the SVAR methodology has not remained without criticisms, and whether SVAR estimates outperform the OLS estimates depends on several criteria such as the sample size, SVAR is a more powerful statistical method due to our theoretical concerns. The theoretical model that we rest our analysis and our aim to reveal the dynamic interaction among the variables justifies our claims on choosing the SVAR model over the OLS method.

4.2. Empirical methodology

Following the seminal work of Sims (1980), SVAR models have become an increasingly popular method in macroeconomic analysis mainly because of its ability to simulate dynamic responses of macroeconomic variables to particular structural shocks. SVAR models use a set of restrictions that are broadly consistent with the economic theory to identify the system. A common way to differentiate between correlation and causation and to solve the "identification problem" is to disentangle the contemporaneous relations among the variables within the system, as introduced by Blanchard and Watson (1986) and Sims (1986). To specify the contemporaneous links, one must rely on the economic theory or the theoretical model under consideration.

SVAR model of order p can be formally written as in the following structural form:

$$Ay_t = d + C(L)y_t + e_t \ , \ e_t \sim N\ (0, I) \tag{12}$$

where y_t is $(n \times 1)$ dimensional vector of endogenous variables at time t, L represents a lag operator, C is $(n \times n)$ matrix of coefficients which concerns the lagged variables, d is $(n \times 1)$ dimensional vector of constants, A is $(n \times n)$ matrix of structural coefficients which represents the simultaneous relationships of the model, e_t is n-dimensional vector of serially uncorrelated, zero-mean structural shocks with an identity contemporaneous covariance matrix, $E[e_t e_t'] = I$ where I is a diagonal matrix. All the variables in the equation (12) are endogenous. Thus, the ordinary least squares (OLS) method is not appropriate to estimate the model. On condition that is non-singular, solving for y_t provides the reduced-form representation of the VAR. The structural form VAR model can be written in reduced form by multiplying equation (12) by A^{-1}:

$$y_t = v + B(L)y_t + \varepsilon_t\ ;\ \ \varepsilon_t \sim N(0, \Sigma_\varepsilon) \tag{13}$$

where $B = A^{-1}C$, $v = A^{-1}d$, $\varepsilon_t = A^{-1}e_t$ or $e_t = A\varepsilon_t$. Here, ε_t's are linear combination of e_t's and are called reduced form errors. Although equation (13) can be estimated via ordinary least squares (OLS) method, reduced-form innovations (ε_t) have no meaningful economic interpretation. To recover the structural parameters (A, C, I) and obtain the structural form of the reduced form, we need to identify restrictions to draw conclusions about the structural model. There are several methods to identify the SVAR model. Cholesky decomposition is one of the methods to restrict coefficients of SVAR model which yields interpretive impulse response functions. This method imposes a triangular structure on matrix A to solve the model. However, it is a non-theoretical tool and less technical method. The theoretical model presented in section 2 is appropriate for using another method suggested by Sims (1986) who suggests utilizing economic intuition to identify the model.

4.3. SVAR and the identification strategy of the model

Our identification strategy follows Sims' (1986) approach, which suggests a non-arbitrary orthogonalization scheme and imposing short-run restrictions by specifying zero elasticities within the period.[4] To initiate the analysis, we estimate a baseline model that is consistent with the extended Kaleckian model given in equations (1-10) in guiding the causal ordering of the variables. Then, we change the structure of the current SVAR model and provide an alternative model with alternative restrictions for a more complete specification.

Baseline model

In the baseline model, we estimate the dynamic interactions between the four variables of interest for the row vector $y_t = [D\psi_t, u_t, Dk_t, Dx_t]'$, and we set up the SVAR model by imposing the following contemporaneous structure for the identification expressed in equation $A\varepsilon_t = e_t$, where and denote structural e_t and ε_t reduced form shocks, respectively:

$$\begin{bmatrix} e_t^{D\psi} \\ e_t^{u} \\ e_t^{Dk} \\ e_t^{Dx} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ 0 & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{D\psi} \\ \varepsilon_t^{u} \\ \varepsilon_t^{Dk} \\ \varepsilon_t^{Dx} \end{bmatrix}$$

[4] There are three major identification strategies in the SVAR literature: short-run restrictions, long-run restrictions, and sign restrictions. Post-Keynesian/Kaleckian approaches stress more on the short-run analysis and does not deal with aggregate demand-aggregate supply analysis. In this case, long-run restrictions make little sense. Moreover, theoretical models do not imply a specific relationship between the variables which leaves room for empirical research. Thus, we simply use short-run restrictions for identification and do not apply sign restrictions. In addition, although the short-run restrictions with zero elasticities within the period seems to be a plausible identification scheme, the frequency of the data comes into prominence in that it dictates the endogenous variables within the system react to impulse variable only with a lag. This is especially a more valid argument for our annual data set since it implies that, e.g., the capacity utilization rate reacts to a wage share only after a year. However, the interactions we are interested in are more likely to arise in the longer horizon. Thus, we consider that the short-run identification scheme for our analysis is still an appropriate approach.

SVAR model above assumes the following:

i. The accumulation rate is affected contemporaneously by the wage share and capacity utilization rate, considering the B&M type of investment function in which the profit share and capacity utilization rate are expected to influence current investment decisions via expected profit rate, as shown in Equation (9).

ii. In accordance with the neo-Kaleckian literature, wage share influences consumption, which would have a direct unlagged impact on the capacity utilization. Thus, we place the variable u_t after $D\psi_t$, allowing for the current and lagged values of wage share on demand.

iii. In the model above, capacity utilization does not have a contemporaneous effect on the wage share.

iv. The baseline model incorporates endogenous labor productivity which depends on the capacity utilization rate and accumulation rate, as emphasized by Kaldor-Verdoorn law according to Equation (6). While we expect that higher wages may induce firms to substitute away from labor through capital deepening, this is mainly a long-run phenomenon. Thus, we set . the impact of output growth on labor productivity due to dynamic economies of scale is positive.

Alternative model

The alternative model uses the row vector $y_t = [Dk_t, u_t, D\psi_t, Dx_t]'$, and the SVAR model is as follows:

$$\begin{bmatrix} e_t^{Dk} \\ e_t^{u} \\ e_t^{D\psi} \\ e_t^{Dx} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ 0 & a_{32} & 1 & 0 \\ a_{41} & a_{42} & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{Dk} \\ \varepsilon_t^{u} \\ \varepsilon_t^{D\psi} \\ \varepsilon_t^{Dx} \end{bmatrix}$$

i. The alternative ordering above imposes a difference structure about the determinants of accumulation rate. If firms are making their investment decisions based on the past values of the wage share and capacity utilization and the role of animal spirits are more dominant in the short run, the accumulation rate must be placed as the most exogenous variable. Thus, we set $a_{12} = a_{13} = a_{14} = 0$

ii. Investment effects wage share only with a $\text{lag}: a_{31} = 0$.

iii. Blecker (2016, p. 385) argues that the sensitivity of consumption of workers' to changing levels of wage income may be low in the short run and could be stronger over longer terms, considering that households might reluctant to change their consumption expenditures in response to short-term fluctuations in income. This consumption behavior had also been predicted by Duesenberry's (1949) relative income hypothesis and permanent income/life-cycle hypothesis. Palley (1994), Cynamon and Fazzari (2008, 2012), Dutt (2005) and Kim et al. (2014) also suggested similar insights. Concerning these theoretical issues, the contemporaneous effect of effective demand on the wage share is allowed in the alternative specification of the model.

To identify the short-run SVAR and structural form parameters, we needed to place $(n^2 - n)/2$ restrictions on the non-singular matrices of A and C. In our case, the number of necessary restrictions is 6. However, our model is over-identified and the identification of the SVAR model based on a Kaleckian demand-led growth model.

4.4. Data construction and preliminary analysis

The Kaleckian SVAR model is estimated for Turkey, using annual data from 1970 to 2017. Our starting and ending periods are constrained by the availability of data on the labor share, and capital stock, respectively. The two main variables used are the labor share, ψ and the capacity utilization rate, u. We use capital accumulation ratio, k to reflect the investment decision of private firms and labor productivity, x to control for the possible biased evidence of Goodwin cycle effects due to cyclical effects of demand on labor productivity. The description of the data and sources are below.

Accumulation rate (k_t): The capital stock data is not available in the national accounts. For the proxy of capital stock, we use the data on the share of gross capital formation at current PPPs which were obtained from Penn World Tables (PWT) 9.1. (Feenstra, Inklaar, & Timmer, 2015).

Capacity utilization rate (u_t): The data-smoothing technique of Hodrick–Prescott (HP) filter has been criticized in the literature.[5] Thus, to approximate effective demand, the capacity utilization rate is calculated by cointegration and output-capital ratio methods developed by Shaikh and Moudud (2004).

The labor share (ψ_t): An increasing number of studies (e.g., Glyn, 2011; Gollin, 2002; Krueger, 1999) indicated that problems arise if the labor share is calculated as the fraction of compensation of employees in GDP. The use of unadjusted income shares may bias the results, since self-employed income is often treated as capital income and this underestimates the labor share. Particularly, the considerable size of the informal sector and agricultural workers in Turkey may exacerbate these biases. Accordingly, unlike most of the other related studies in the literature, we use adjusted labor share as a proxy for functional income distribution which is obtained from. Following Gollin's (2002) methodology, the adjusted labor share is calculated according to the formula below:

$$Adjusted\ labor\ Share = \frac{\frac{Compensation\ of\ Employees\ (COE) \times Total\ Workforce}{Number\ of\ Employees}}{Value\ Added\ (-indirect\ taxes - fixed\ capital)}$$

[5] We tried different filter parameters (λ=6.25, 100, and 400) as there are different suggestions on HP filter smoothing parameters in the literature (e.g., Baxter & King, 1999; Hassler, Lundvik, Persson, & Soderlind, 1992; Ravn & Uhlig, 2002). The use of different filter parameters indicated that as the value of the filter parameter increases, the magnitude of the interaction among the variables strengthens. Moreover, there are several criticisms due to the use of the HP filter to calculate the utilization rate. According to Cogley and Nason (1995), when HP filter applied to a persistent time series, it may generate business cycles dynamics even there is none in the original data. Barrales and von Arnim (2017) states that HP filter removes medium-term trends and it allows only to examine the short-run effects. Blecker (2016) also argues that the use of HP filter biases the results towards finding profit-led demand since demand is more likely to be profit-led in the short run. To address the issue of sensitivity of the results to the alternative measures, we also use the growth rate of real GDP series obtained from OECD. Undocumented results indicate no remarkable changes in the relationship between the main variables of interest, while the magnitude of the effects differs. However, we argue that the capacity utilization rate is a better proxy for the aggregate demand.

The data on adjusted labor share in GDP for Turkey between 1970–2006 was obtained from the Organization for Economic Co-operation and Development (2014) (OECD) Unit Labor Costs Database. The data for 2006–2017 period was constructed according to the following formula:

$$Total\ labor\ compensation = \frac{COE\ \times Total\ Employment}{Number\ of\ Employees}$$

COE: European Commission (2019), AMECO database, Compensation of employees: total economy.

Employees: OECD (2014) Productivity and ULC – Annual, Total Economy, Level of GDP per capita and productivity. Total employment (number of persons employed): in thousands of people.

GDP at current factor cost: European Commission (2019), AMECO database, Gross domestic product at current factor cost.

GDP: European Commission (2019), AMECO database, Gross domestic product at current prices.

Self-employed: European Commission (2019), AMECO database, Number of self-employed: total economy (National accounts).

Total employment = Self-employed + Employees

Labor productivity index (x_t): Labor productivity index is calculated as GDP per hour worked and is obtained from PWT 9.1. The index of labor productivity was calculated by choosing 2010 as a base year.

Table 3. Sample statistics for the endogenous variables within the SVAR system

Variables	Mean	SD	Min	Max
k_t	0.264	0.058	0.140	0.423
u_t	96.018	8.0716	79.078	113.949
ψ_t	122.633	20.514	95.240	174.099
x_t	64.886	28.593	28.815	131.866
N: 48				

Notes: Observations are indexed by year (t). N stands for the total number of observations. The mean for adjusted labor share is above 100, because the study links different data sources, when constructing the adjusted labor share series. The index of adjusted labor share was calculated with base year as 2010 was equated to 100.

Table 3 presents the summary statistics for the raw data. As a preliminary step to empirical analysis, we test for stationarity of the time series variables. We perform an augmented Dickey-Fuller (ADF) test and DF-GLS test that has been developed by Elliott, Rothenberg, and Stock (1996) to check for the presence of a unit root. The power of ADF test is low when the root of a stationary process is close to non-stationary boundary. For this reason, we also use Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test. Due to the labor movements in 1989-1993, the impact of the economic crisis in 2001 and 2007, and other conditions unique to the Türkiye, the data exhibit a structural break in their deterministic component. Lee Strazicich (LS) (2003) unit root test which allows the endogenous determination of structural breaks is performed to get around this issue.

For the correct specification of the deterministic part, we followed the testing strategy based on Elder and Kennedy (2001). We also checked the plots of the series and autocorrelation functions, besides economic reasoning. For all of the four variables in levels, the tests are specified to allow for constant term, while time trend is added as the labor share and labor productivity index display a linear trend.[6] The results from the unit root and stationarity tests are summarized in Appendix B. The ADF, DF-GLS and KPSS test results reported in table

[6] The labor share series does not have a clear negative trend over the sample period considered. Because of this uncertainty, ADF and DF-GLS regressions include both a constant term and a linear trend.

demonstrate that the labor share, capital accumulation and labor productivity series are not stationary in level, but they are stationary in first differences. We conclude that only capacity utilization rate (u_t) is stationary, while other three series exhibit unit root (ψ_t, k_t, p_t). Thus, we use the first difference of the ψ_t, k_t, and p_t. In the following section, our VAR specification takes all 4 variables in levels.

5. Estimation results

We first estimate the reduced form equation (13), using variables of accumulation rate (Dk_t), capacity utilization rate (u_t), adjusted wage share ($D\psi_t$) and labor productivity (Dx_t).[7] The VAR is estimated with one lag according to Final Prediction Error (FPE), Hannan-Quinn (HQ) and Schwarz (SIC) lag length criteria for both models.[8] The autocorrelation LM tests indicate that there is no residual autocorrelation at lags 1-4 for the VAR model. We cannot reject the null hypothesis

[7] Sims, Stock, and Watson (1990, p. 136) expressed that "…the common practice of attempting to transform models to stationary form by difference or cointegration operators whenever it appears likely that the data are integrated is in many cases unnecessary…. It will often be the case that the statistics of interest have distributions unaffected by the nonstationarity, in which case the hypotheses can be tested without first transforming to stationary regressors." Arguing that stationarizing the variables and using the transformed model comes at the cost of losing important relationships between the levels, they added: "…the OLS estimator is consistent whether or not the VAR contains integrated components, as long as the innovations in the VAR have enough moments and a zero mean, conditional on past values of ." Following this argument, initially, we estimated the SVAR model with nonstationary series of the variables and examined the impulse-response functions. However, we observed that shocks given to the wage share didn't die out in the long run, and the confidence intervals widened considerably. Shapiro and Watson (1988) and Blanchard and Quah (1989) also pointed out that when the variables are not stationary, shocks to the economy accumulates over time and leaves permanent effects in the long run. If the VAR model is estimated on a level in the presence of unit root, we may encounter the spurious regression problem. Moreover, the diagnostic tests and over-identifying restrictions tests were not appropriate for this model. Subsequently, we based our analysis on the model where we used the stationary series of the variables.

[8] Akaike information criteria (AIC) is one of the most popular information criteria which aims to find the best-approximating model to the unknown true data generating process. AIC is known to perform better under small samples. AIC and Sequential modified LR test statistic in Appendix B.2 indicate that the use of four lags is appropriate. SVAR(4) model is estimated with four lags for the accuracy of the impulse responses functions. Although the interaction among the main variables of interest demonstrates similar dynamic responses to structural shocks, the model does not seem to be stable, and the variables do not converge to their long-run equilibrium values. Thus, we base our analysis on the SVAR model with one lag insofar as the data is annual, and the degree of freedom is already low.

of homoskedasticity for the model according to Breusch-Pagan/Cook-Weisberg and White Tests for the alternative model. However, the baseline model present heteroskedasticity problems. According to the single-equation and the joint Jarque–Bera statistics for the alternative model, we cannot reject the null hypothesis that the data is normally distributed. However, the accumulation rate variable and the joint Jarque–Bera statistics for the baseline model indicates that the data is not normally distributed. The models are stable with one lag, all roots lying within the unit circle. The diagnostic tests are provided in the Appendix C.

5.1. Estimation of the baseline model

We first estimate the SVAR model which deliver the structural parameters.[9] The main tool of interest in the analysis is the impulse-response functions (IRFs, henceforth), which measure the reaction of the SVAR system to shock to an endogenous variable. Figure 2 plots the structural IRFs derived for the 95% confidence intervals from the SVAR models using the identification strategy proposed in the baseline model which shows the impact of the shock to variables at a single point in time. For comparison, we also demonstrate the cumulative IRFs based on the structural VAR model which plots the accumulation of the impact of a shock to a variable of interest across time.

Panel (a) and (b) in Figure 2 show the structural responses of accumulation and capacity utilization rate to a one standard deviation shock in the wage share. Theoretically, the response of accumulation to a shock in wage share reflects the accumulation of the following three effects:

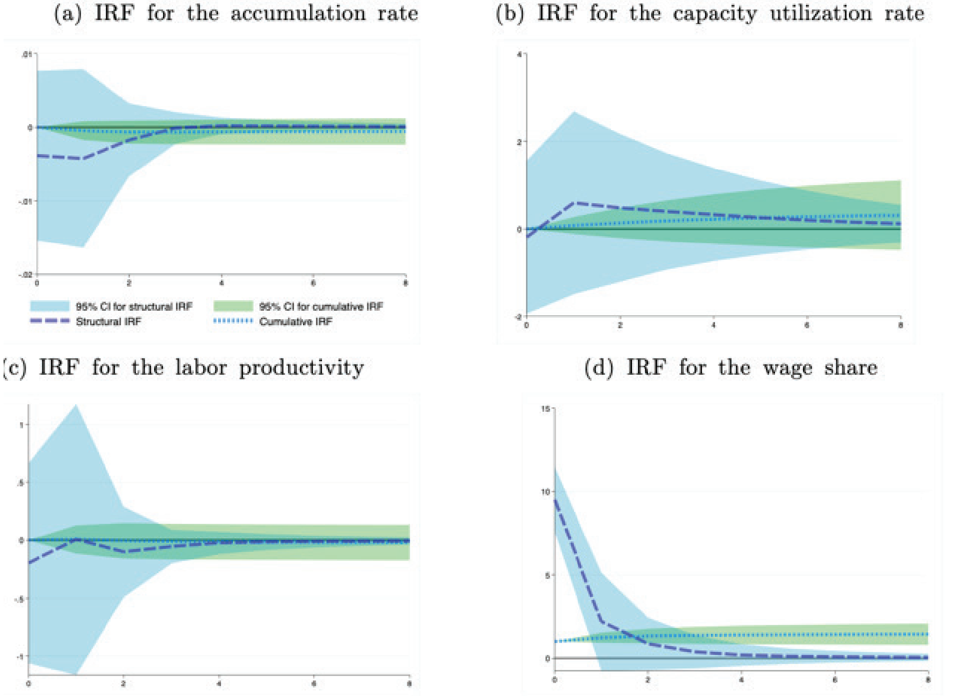
1. The direct negative effect of a decrease in expected profitability on investments.

[9] The short-run parameters from the SVAR model suggest that except for the contemporaneous effect of wage share on capacity utilization and accumulation rate $(a_{21} \text{ and } a_{31})$, all contemporaneous parameter estimates are statistically significant at 1% level. The coefficient estimates provide robust evidence that the contemporaneous restrictions imposed by our theoretical model correspond to our theoretical expectations: $a_{21}, a_{31} < 0$, and $a_{32}, a_{42}, a_{43} > 0$. The LR-test for over-identification verifies the validity of our restrictions.

2. The indirect negative effect of a fall in foreign demand on investments which materializes by an increase in unit labor costs and a decrease in international competitiveness through a rise in the wage share and on investments. This effect specifically becomes evident for more open and exporting economies such as East Asian countries.

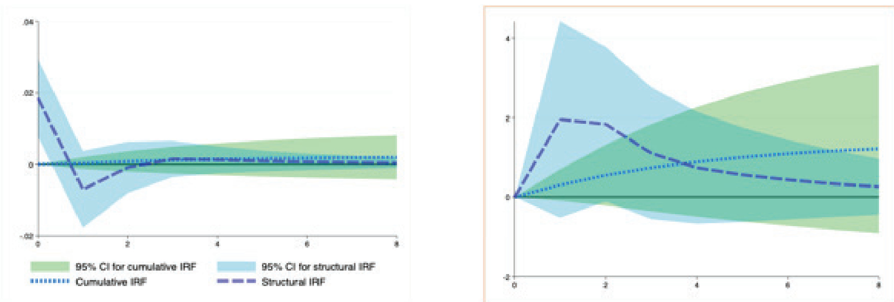
3. The positive and indirect effect of domestic demand on investment decisions through a rise in wage share, which refers to the accelerator effect.

Figure 2. Impact of a one-standard deviation shock to the wage share



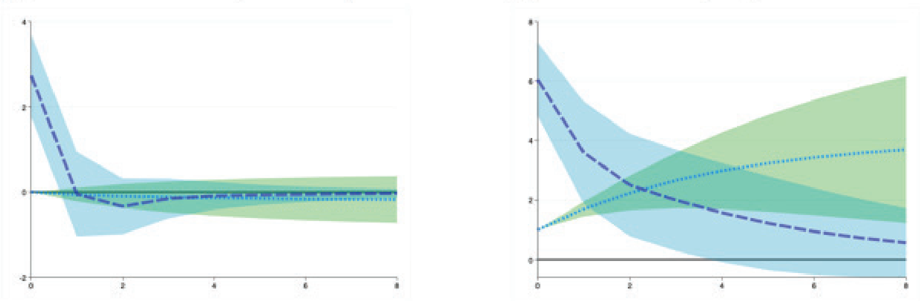
The relative importance of the two effects, (1) and (3) for closed economies are reflected by equation 9. The IRF in panel (a) implies that a shock to a wage share is associated with a slight negative effect on investments in the first period, then the effect of the shock dies after third year. In panel (b), the effect of the wage share leads to an initial decrease in capacity utilization, then the effect becomes positive and dies about after 3 years. However, the 95% confidence bands computed for the IRFs indicates that there is not strong statistical evidence that the response is different from zero. According to the accumulated impulse-response functions of accumulation rate, capacity utilization rate, and the wage share, an increase in the wage share continues to have a negative effect on the accumulation rate, while capacity utilization rate is positively affected by a one standard deviation shock in the wage share. Further, labor productivity reacts only marginally to wage share shocks, and the effect is found to be insignificant (Panel c).

Figure 3. Impact of a one-standard deviation shock to the capacity utilization rate



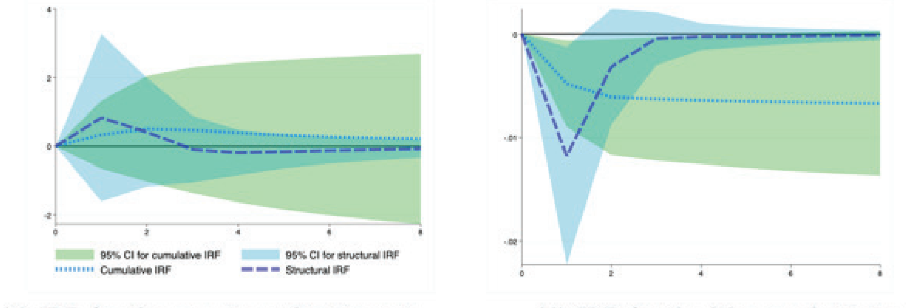
(c) IRF for the labor productivity

(d) IRF for the capacity utilization rate

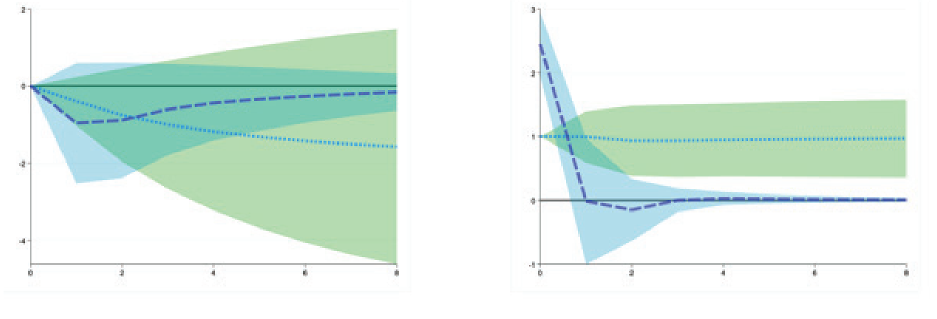


The IRFs results in Panel (a) of Figure 3 confirm that demand plays a vital role in determining investment decisions. The effect of demand on accumulation is positive and statistically significant, and the effect dies out after the first year. Panel (b) of Figure 3 shows that while a positive one standard deviation increase in the capacity utilization rate has a positive and long-lasting effect on the wage share which indicates the presence of a profit-squeeze, and the effect does not seem to be significant only in the second year. In the previous sections, by assuming that labor productivity is pro-cyclical to changes in capacity utilization, we allowed utilization rate to contemporaneously affect the labor productivity. Panel (c) in Figure 3 confirm our expectations that labor productivity is pro-cyclical to changes in capacity utilization rate. Yet this effect is only temporary and valid for the first period. Nevertheless, we are more interested in the initial response of the variables, since our data is annual. The cumulative response of labor productivity to capacity utilization shown displays contrary findings to short-run effects, and the cumulative effect is negative over the eight years. The short-run pro-cyclical behavior of labor productivity may stem from either the Kaldor-Verdoorn effect, or the presence overhead labor. Since the Kaldor-Verdoorn effect refers to a structural change in the production process, this concept is more useful to explain the long-run changes. In this vein, the overhead labor argument of Lavoie (1992;2017) seems more relevant for our consideration of time.

Figure 4. Impact of a one-standard deviation shock to the labor productivity



(c) IRF for the capacity utilization rate (d) IRF for the labor productivity

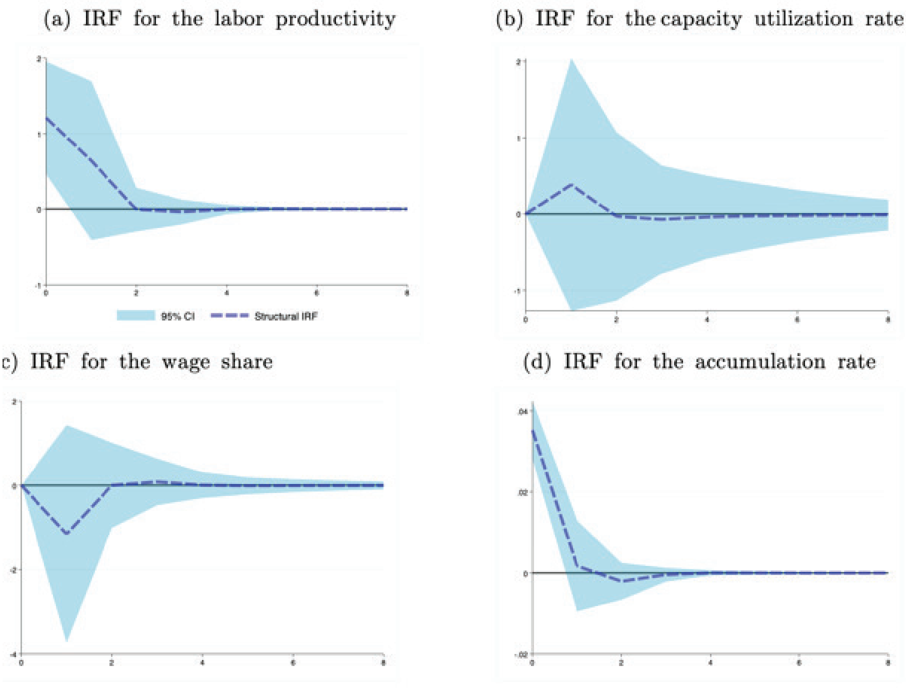


In the model specification, we didn't allow labor productivity to contemporaneously affect the wage share. Panel (a) of Figure 4 shows that wage share reacts positively to productivity shocks, while the effect is statistically insignificant. On the other hand, productivity shocks generate a large and statistically significant negative response of accumulation rate (Panel b in Figure 4). We also find a negative response of demand to productivity shocks in Panel (c) in Figure 4. However, the response is not statistically significant.

The increase in the accumulation rate increases the labor productivity as would be expected (Panel a, Figure 5). Despite being positive, we couldn't find a significant effect on demand (Panel b, Figure 5). The panel (c) suggests that wage share react negatively to accumulation shocks. However, this operates for a very short period of time, and not statistically significant (Panel c, Figure 5).

Although the confidence intervals are large in the IRFs that we are mainly interested in, the results are suggestive. Our identification scheme generates wage-led demand and profit-squeeze demand results for Turkey. Our results confirm the findings of Onaran and Stockhammer (2005) that found evidence in favor of a stagnationist regime, although the effect on accumulation does not seem to be significant.

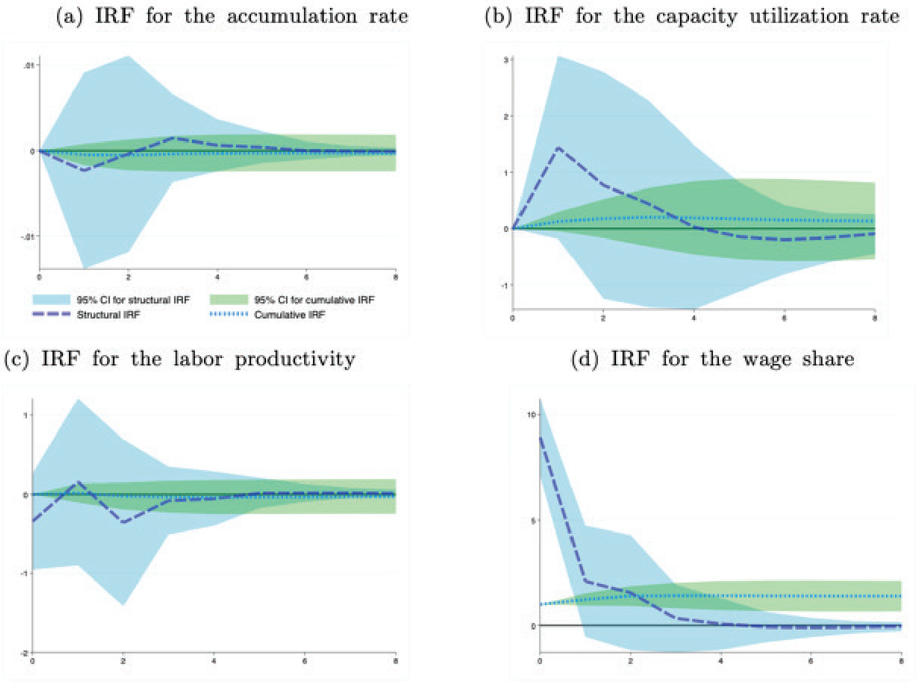
Figure 5. Impact of a one-standard deviation shock to the accumulation rate



5.2. Estimation of the alternative model

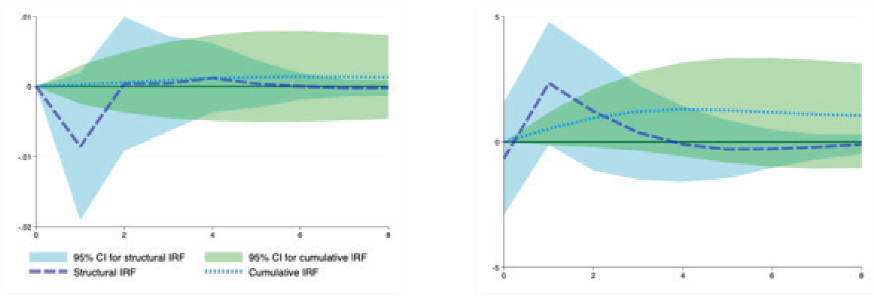
Figure 6 shows IRF for all four variables due to a 1-standard deviation positive shock to the wage share. Similar to the baseline model, the accumulation rate undergoes a negative effect in response to the increase in the wage share in the first two periods, but the effect becomes slightly positive before slowly converging to zero. The cumulative response of accumulation rate to wage share is negligible (Panel a). An increase in the wage share has a positive and long-lasting effect on the capacity utilization rate, confirming that demand is wage-led only in the first period. The confidence bands are somewhat wider in the following periods (Panel b). The negative effect of wage share on the labor productivity operates for a short period of time (Panel c).

Figure 6. Impact of a one-standard deviation shock to the wage share



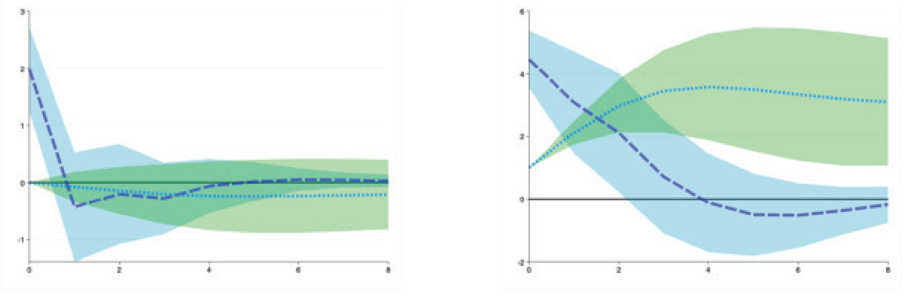
In the alternative SVAR model specification, we assumed that labor productivity is pro-cyclical to changes in capacity utilization, and wage share is counter-cyclical to changes in labor productivity. Thus, we allowed utilization rate to contemporaneously affect the wage share. We also suggested that both the capacity utilization rate and the wage share affect one another by pointing out the endogeneity of the distribution of income, although the timing of these effects is not clear and needs to be tested. The results corroborate the findings discussed in the baseline model, suggesting strong profit-squeeze results, and the effect is statistically significant only for the first year (Panel b).

Figure 7. Impact of a one-standard deviation shock to the capacity utilization rate



(c) IRF for the labor productivity

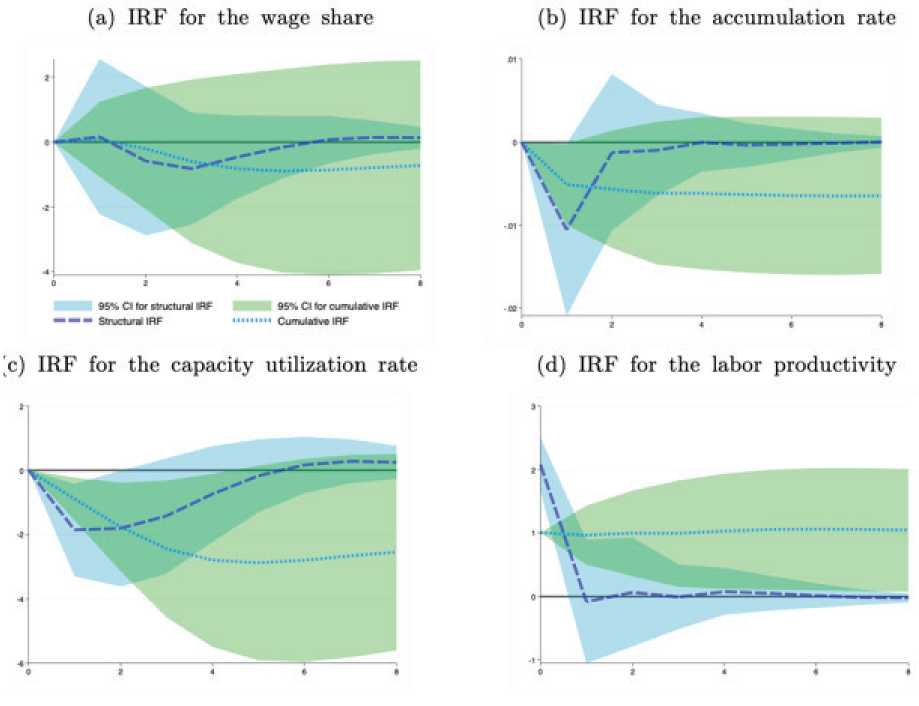
(d) IRF for the capacity utilization rate



Similar to the baseline model, Panel (c) in Figure 7 confirm our expectations that labor productivity is pro-cyclical to changes in capacity utilization rate, while demand and accumulation is affected negatively by the growth rate of labor productivity (Panel c, Figure 8). All results are statistically significant. Contrary to the baseline model, the response of wage share to labor productivity is negative, but insignificant (Panel a, Figure 8). The shock to demand decreases accumulation rate, but this result is mainly due to the ordering restrictions imposed by the alternative model.

Finally, as expected, we detect positive response of demand to capital accumulation in the first three years when we allow for the contemporaneous effect of capital accumulation on utilization rate (Panel b, Figure 9). The IRF plots for the accumulation rate are quite similar to that of baseline model (Figure 9).

Figure 8. Impact of a one-standard deviation shock to the labor productivity

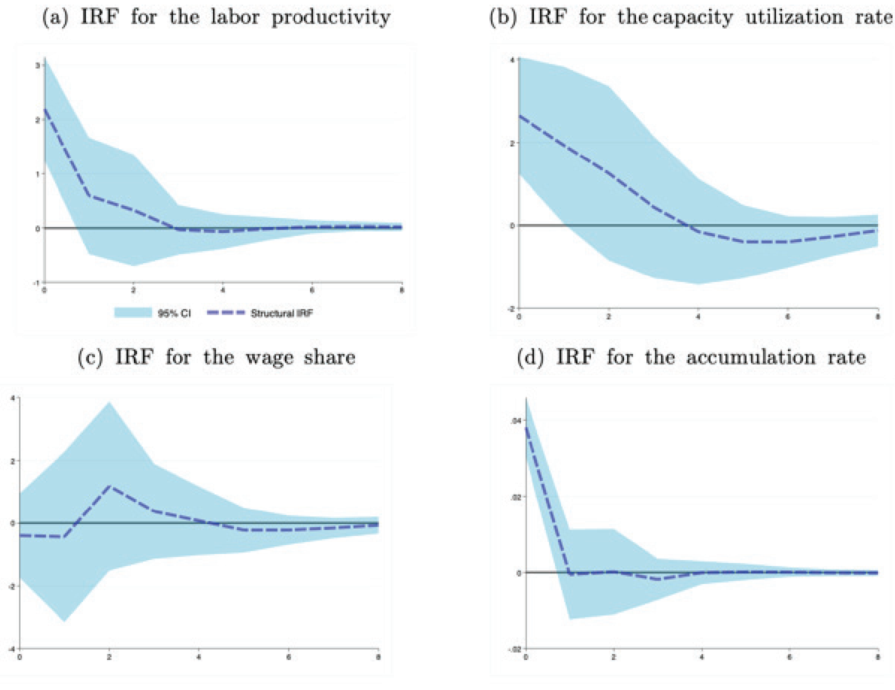


Conclusion and policy implications

The dominance of Keynesian economics as the school of macroeconomic thought in the post-war period challenged by supply-side economics after the declining rates of profit in major capitalist countries from the 1960s onward. The falling rate of profits had been seen as a crucial factor in the structural crisis in the 1970s. It has been widely acknowledged that the initial decline in profits at the end of the 1960s was mainly due to high real wage growth, and increases in energy prices exacerbated the squeeze of profits after the 1970s. Although the empirical literature was lack of sufficient evidence to support the arguments of neo-liberal policies and the view that higher real wages are the main reason for profit-squeeze, developing countries implemented structural adjustment policies after the 1980s. However, the modern wage-led growth theory that follows Keynesian theory is straightforward: wages play a dual role in capitalist economies.

Profit squeeze cannot be explained solely by increases in wage share since wages are the main source of effective demand.

Figure 9. Impact of a one-standard deviation shock to the accumulation rate



The contribution of this paper is twofold. From the theoretical perspective, we argue that relatively less attention has been given to the endogeneity of income distribution and endogenous technical progress in the Post-Keynesian tradition. Following the contributions of B&M (1990) and Marglin and Bhaduri (1990) for the basic framework of our model, the construction of the theoretical model draws on the previous attempts of the studies that endogenize income shares and technological progress (see, e.g., Cassetti, 2003; Dutt, 1987; Lavoie, 1992; Rowthorn, 1977). In our model, we dealt with a Kaleckian dynamic model of accumulation, growth, and distribution in which the distribution of income and labor productivity are endogenized by Rowthorn's conflicting claims over distribution by workers and firms and the Kaldor-Verdoon law, respectively. The determination of wages and prices reflects the workers' and firms' attempt to achieve their target income shares and the bargaining process. We also emphasize the feedback effects involving the interaction between labor productivity and goods market in which increasing returns to scale provides motivation to the growth process from the supply side, but reduce wage share.

From the empirical perspective, we pointed out that although a large number of studies attempted to characterize the demand-regime of the economies, extensive body of research employed the single equations estimation approach, and neglected the endogeneity bias that may arise from the simultaneous determination of demand and distribution. We claim that the use of equations-systems is more suitable to test the endogenous Kaleckian demand-led growth model. To test the implications of the Kaleckian/Post-Keynesian macro model, the study presents an empirical analysis on the interaction between private investments, capacity utilization rate, adjusted wage share and labor productivity for the Turkish economy between the period 1970-2006, within a system approach by using SVAR model.

The results from our structural model are mostly in line with our hypothesis. The impulse response functions derived from the structural VAR model based on the theoretical restrictions indicated that the wage-led aggregate demand and profit-squeeze effects are valid for Turkey, at least in the short run. However, some IRF results from the main variable of interests are not significant, especially from the baseline model, the models explain the crucial aspects of the Kaleckian model. The results also provide evidence that when demand is allowed to have a contemporaneous effect on productivity, labor productivity varies pro-cyclically over the course of the business cycle, although this effect is valid only for the first period.

Overall, contrary to orthodox expectations, higher wage share stimulates effective demand. Although policies of pro-capital distribution of income are implemented after the 1980s to decrease unit labor costs and stimulate exports, the macroeconomic performance of Turkey does not seem to be improved. The findings of this paper indicate that consumer demand is the main driver of economic activities. Albeit foreign trade constitutes a large part of aggregate demand in Turkey, considering that the share of unit labor costs in unit production costs is only around 25-30% in the industrial sector, suppressing real wages will be limited by this amount in reducing production costs. The larger share of the production costs consists of imported intermediate goods and raw materials, and any depreciation in domestic currency will cause an increase in domestic prices. If the insufficient domestic demand caused by a higher price level and a lower share of wages are not supported by external demand, the economy will stagnate. In this manner, the neo-liberal policies that led to the lower share of wages, falling accumulation rates, unsatisfactory productivity growth and unstable and unsustainable growth rates in Turkey are compatible with the results of the analysis.

It should be noted that our model neglects the labor market and other factors that may lead to stagnation in accumulation such as financial markets, volatility, uncertainty and higher costs of capital goods. The incorporation of these factors could improve the results. However, it is argued that VAR methodology does not allow the inclusion of too many parameters on the model, i.e., the model should be parsimonious. Moreover, while adding dummy variables would enable us to consider the structural transformation of Turkey after the year 1980, the absence of higher frequency and long-run data limits our ability to improve the model. Such a short time period didn't allow us to estimate two separate models. The future studies could be based on regime-switching models which may help to capture the effects of such strong policy changes. Lastly, we argued that the economies may exhibit different demand patterns depending on the underlying shocks. Thus, another way for improvement could be the inclusion of alternative control variables.

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Author Contributions: Conception/Design of Study- B.M., A.I.; Data Acquisition- B.M.; Data Analysis/Interpretation- B.M.; Drafting Manuscript- B.M.; Critical Revision of Manuscript- A.İ., Final Approval and Accountability- B.M., A.I.
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Appendix A. Proof of Propositions 1 and 2

Using the Assumption 1 and Assumption 2 which is introduced below, the sign structure of the Jacobian matrix $\mathbf{J}$ is given as follows.

Assumption 2 *For all the positive adjustment parameters ϑ_f and ϑ_w, the condition $\vartheta_f \pi_{fu} + g_x'(u) > \vartheta_w \pi_{wu}$ holds, which makes $\xi > 0$.*

$$\mathbf{J} = \begin{bmatrix} \frac{\partial \dot{u}}{\partial u} & \frac{\partial \dot{u}}{\partial \pi} \\ \frac{\partial \dot{\pi}}{\partial u} & \frac{\partial \dot{\pi}}{\partial \pi} \end{bmatrix} = \begin{bmatrix} J_{11}(-) & J_{12}(+/-) \\ J_{21}(-/+) & J_{22}(-) \end{bmatrix}$$

We can confirm that stability conditions are satisfied in the model for the profit-led demand regime/profit-squeeze effects, and wage-led demand regime/wage-squeeze effects combinations:

$$tr(\mathbf{J}) = \underbrace{J_{11}}_{-} + \underbrace{J_{22}}_{-} < 0$$

$$det(\mathbf{J}) = \underbrace{J_{11}\, J_{22}}_{+} - J_{21}\, J_{12}$$

When the equilibrium exhibits profit-led demand regime/profit-squeeze effects, J_{21} becomes negative, and J_{12} becomes positive. In this case, $J_{21}\, J_{12} < 0$ and $det(\mathbf{J}) > 0$.

When the equilibrium exhibits wage-led demand regime/wage-squeeze effects, J_{21} becomes positive and J_{12} becomes negative. In this case, $J_{21}\, J_{12} < 0$ and $det(\mathbf{J}) > 0$.

Appendix B. Unit root and stationarity tests

	Levels		First differences	
	Intercept only	**Intercept and trend**	**Intercept only**	**No deterministic component**
ADF				
k_t	-2.544 (-2.941)	-2.645 (-3.516)	-6.704 (-2.941)	-6.780 (-1.950)
u_t	-3.214 (-2.941)	-3.173 (-3.516)	_	–
ψ_t	-2.455 (-2.947)	-3.314 (-3.524)	-3.618 (-2.944)	-3.627 (-1.950)
x_t	1.888 (-2.941)	-0.142 (-3.516)	-6.313 (-2.941)	-4.885 (-1.950)
ADF-GLS				
k_t	-1.691 (-2.321)	-1.826 (-3.247)	-3.862 (-2.329)	–
u_t	-2.804 (-2.321)	-2.978 (-3.247)	–	–
ψ_t	-1.809 -(1.948)	3.785 (-3.19)	-5.004 (-1.948)	–
x_t	2.605 (-2.321)	-0.407 (-3.247)	-3.919 (-2.329)	–
KPSS				
k_t	0.275 (0.463)	0.174 (0.146)	0.039 (0.146)	–
u_t	0.05 (0.463)	0.128 (0.146)	–	–
ψ_t	0.5 (0.463)	0.05 (0.146)	0.0601 (0.146)	–
x_t	0.823 (0.463)	0.1885 (0.146)	0.1 (0.146)	–
Lee-Strazicich	**Trend break model**	**Break dates**	**Trend break model**	**Break dates**
k_t	-5.1473 (-6.152)	1976 (TB1) 2004 (TB2)	-8.5190 (-6.108)	1975(TB1) 1979(TB2)
u_t	-3.9634 (-6.312)	1981 (TB1) 1988 (TB2)	–	–
ψ_t	-3.4939 (-6.166)	1987 (TB1) 1993 (TB2)	-6.9432 (-6.166)	1988(TB1) 1994(TB2)
x_t	-4.9283 (-6.375)	1986 (TB1) 2004 (TB2)	-8.5512 (-6.108)	2002(TB1) 2007(TB2)

Note: For ADF test, the null hypothesis is that the process is difference stationary, or has a unit root. KPSS test states the null hypothesis as trend stationarity against the alternative that the process is non-stationarity. Lag lengths were selected automatically using the Akaike information criterion (AIC). 5% critical values are in parentheses. To determine whether series have unit root or are nonstationary, test statistics for all the level variables are based on regressions including a linear trend besides a constant, expect for k_t and u_t. TB1 and TB2 in Lee-Strazicich test indicates trend break dates in the model.

Appendix C. Model selection and diagnostic tests

C.1 VAR lag order selection criteria for SVAR

Sample: 1975-2017
Endogenous variables: $D\psi_t$, u_t, Dk_t, Dx_t.
Exogenous variables: constant
Number of Observations: 43

Lag	LogL	LR	df	p	FPE	AIC	HQIC	SIC
0	-328.36	-	-	-	60.7728	15.4586	15.519	15.6225
1	-294.979	66.762	16	0.000	27.192	14.6502	14.9523*	15.4694*
2	-284.621	20.717	16	0.190	36.0967	14.9126	15.4563	16.3871
3	-263.414	42.413	16	0.000	29.8723	14.6704	15.4558	16.8002
4	-239.636	47.557*	16	0.000	23.0886*	14.3086*	15.3357	17.0938

Notes: LR: Sequential modified LR test statistic, FPE: Final Prediction Error, AIC: Akaike information criterion, HQ: Hannan-Quinn information criterion, SIC: Schwarz information criterion. Symbol (*) indicates an appropriate lag order selection by the criterion.

C.2 Residual serial autocorrelation LM test

H_0: no autocorrelation at lag order
Sample: 1970-2017
Variables: $D\psi_t$, u_t, Dk_t, Dx_t

Lag	LM Stat.	Prob.
1	16.4326	0.42320
2	10.5986	0.83356
3	22.2082	0.13659
4	22.8484	0.11785

Degree of freedom: 16

C.3 Heteroskedasticity tests

Breusch-Pagan/Cook-Weisberg test for Heteroskedasticity — H_0: Constant Variance

Baseline model		Alternative model	
Chi-Sq.	Prob.	Chi-Sq.	Prob.
8.71	0.0032	0.50	0.4792

White test — ***H_0*: Homoscedasticity**

	Chi-Sq.	Prob.		Chi-Sq.	Prob.
Heteroskedasticity	33.50	0.0001	Heteroskedasticity	3.92	0.9163
Skewness	5.45	0.1418	Skewness	2.13	0.5466
Kurtosis	1.40	0.2364	Kurtosis	1.13	0.2888
Total	40.35	0.0001	Total	7.18	0.8928

C.4 Normality test

Jarque-Bera test							
Baseline model				Alternative model			
	Chi2	Prob.	df		Chi2	Prob.	df
$D\psi_t$	0.090	0.95591	2	Dk_t	0.198	0.90557	2
u_t	1.957	0.37591	2	u_t	2.738	0.25440	2
Dk_t	13.877	0.00097	2	$D\psi_t$	0.025	0.98778	2
Dx_t	0.888	0.64154	2	Dx_t	0.888	0.64154	2
All	16.812	0.03212	8	All	3.848	0.87053	8

C.5 VAR stability check

Baseline model		Alternative model	
Eigenvalue	Modulus	Eigenvalue	Modulus
0.7732887	0.773289	0.7732887	0.773289
0.2438392	0.243839	0.2438392	0.243839
0.0561653 + 0.2252248i	0.232122	0.0561653 + 0.2252248i	0.232122
0.0561653 - 0.2252248i	0.232122	0.0561653 - 0.2252248i	0.232122

All the eigenvalues lie inside the unit circle. VAR satisfies the stability condition.