Systems Estimation of a Structural Model of Distribution and Demand in the U.S. Economy

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Abstract

Many studies have analyzed whether output is positively or negatively affected by a redistribution of income away from capital ("profits") and toward labor ("wages"). Studies that use structural models (separate equations for individual components of GDP) typically find wage-led demand in most large, advanced economies (including the U.S.) but profit-led demand in some small or developing economies, while studies that use aggregative models (measures of total output or the utilization rate) usually find profit-led demand even in larger and more advanced economies. All structural studies to date have used "single equation" models, that is, they estimate the various functions (consumption, investment, etc.) separately, taking total output and the wage share as exogenously given. Critics contend that such estimates could suffer from simultaneity bias, given that these variables are likely to be endogenous.

This paper tests whether such a bias exists and how it has influenced the results by using systems GMM estimation, treating the wage share and other income or distributional variables as endogenous, applied to U.S. data for 1963–2016. This paper is also the first to provide separate estimates of nonresidential and residential investment functions, and improves the specification of net exports and the way that income distribution and labor costs are modeled to make them more theory-consistent. Surprisingly, the GMM estimates imply that U.S. private aggregate demand is more, rather than less, wage-led compared with OLS estimates of an identical set of equations. Thus, the bias from ignoring simultaneity and common shocks seems to go in the opposite direction from what critics of the structural method have generally presumed. The present results are based on exogenous variations in one determinant of the wage share (labor cost competitiveness); future research in this project will consider the impact of changes in other determinants such as firms' monopoly power.

Keywords: Income distribution, wage-led demand, profit-led demand, U.S. economy
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1 Introduction

In response to growing inequality, policy makers in many countries today are debating the use of redistributive policies and what their likely macroeconomic consequences would be. For example, Mexico and South Korea have recently legislated increases in their minimum wages, the latter as part of an "income-led growth" strategy. In the United States, presidential candidates like Bernie Sanders and Elizabeth Warren have advocated raising taxes on high-income or wealthy households while redistributing the benefits to working-class and middle-class families. In this context, the question naturally arises as to how such redistributive measures would affect aggregate economic performance. While there are many dimensions to this question, in this paper we limit ourselves to one key aspect: the impact of reversing the recent decline in the labor ("wage") share[1] of national income on aggregate demand and national income (output) in the short run.

Figure 1 shows that the wage share has declined sharply since around 2000 in the U.S. economy, by three alternative measures, and has tended downward over a longer period (since at least the 1970s), according to two of those measures. The notable decrease after 2000 is associated with a slowdown in average U.S. economic growth, which makes it plausible that this aspect of worsening inequality could be a contributing factor toward "secular stagnation" in the U.S. economy (see Summers, 2015; Blecker, 2016a; Cynamon and Fazzari, 2017).

The existing empirical literature on the relationship between the functional distribution of income and aggregate demand is deeply divided, with results that largely align with the methodologies and time frames employed. Those who follow an aggregative approach by directly estimating relationship between the capacity utilization rate (ratio of actual to

[1]The terms "wage share" and "labor share" are used interchangeably in this paper to mean total labor compensation as a percentage of national income for the whole economy, or as a percentage of value added for particular sectors like nonfarm business or nonfinancial corporations. Similarly, "profit share" refers to all capital income as a percentage of the same aggregates; we do not distinguish a theoretical equilibrium return to capital from oligopolistc rents, as is done in some neoclassical studies of income distribution.

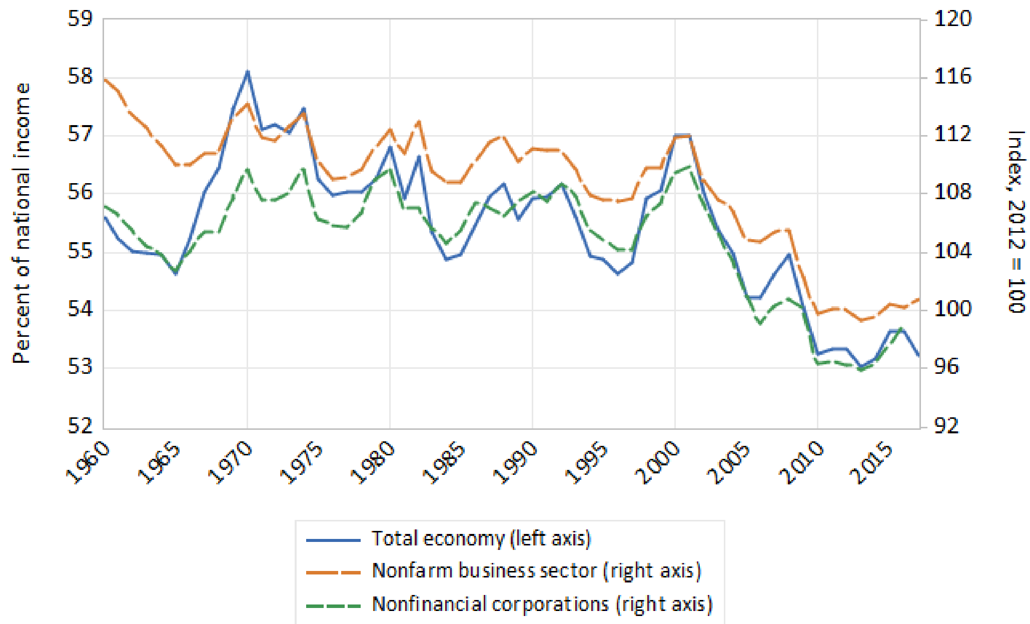

Figure 1: Three alternative measures of the U.S. wage share, 1960–2017
Sources: U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, and authors' calculations.

potential output) and the wage (or profit) share generally find evidence of profit-led demand and a profit-squeeze in distribution (increasing utilization raises the wage share) in the short run (e.g., Barbosa-Filho and Taylor, 2006; Kiefer and Rada, 2015; Carvalho and Rezai, 2016). On the other hand, those who follow a structural approach by separately estimating the effects of the wage share on each component of aggregate demand (such as consumption and investment), while treating the wage share as exogenous, usually find evidence of wage-led demand in larger, more closed economies like the United States, Germany, and the European Union (EU) as a whole, but often find profit-led demand in smaller or more open economies like Austria, China, and Mexico (e.g., Onaran et al., 2011; Stockhammer et al., 2011; Onaran and Galanis, 2012; Stockhammer and Wildauer, 2016). While all of these results pertain to short-run relationships, Blecker (2016b) has suggested that wage-led effects may dominate in the long run, a hypothesis recently supported empirically by Charpe et al. (2019) using an aggregate model of the growth rate and wage share at very long time horizons (several decades).

Much of the debate about the short-run estimates has focused on whether the methodologies employed by one approach or the other may lead to biased results. On the one hand, Lavoie (2017) has suggested that the finding of profit-led demand in the aggregative studies may stem from failing to control for the procyclical effects of capacity utilization on labor productivity, so that what appears to be profit-driven demand is, in reality, a positive effect of increased demand on profits—an argument supported by the recent empirical findings of Cauvel (2019). On the other hand, critics of the structural studies fault them especially for treating the wage share as exogenous. For example, Barrales and von Arnim (2017) find evidence of bi-directional Granger-causality between the utilization rate and the wage share, which implies that ignoring the effects of output on the wage share is likely to result in simultaneity bias.

In addition, Blecker (2016b) argues that existing structural estimates may not properly capture the dynamic interactions between variables, such as accelerator and multiplier effects, because—using what is often called a "single equation" approach—they estimate the equations for each component of aggregate demand separately, instead of as a system. The separate estimation of individual equations for various macroeconomic aggregates also ignores the possibility that there may be common shocks to each equation, in which case the residuals could be correlated and the coefficient estimates would be inefficient. Kiefer and Rada argue that it is misleading to interpret estimates of separate equations for consumption, investment, and net exports as adding up to constitute a valid aggregate demand equation, and that the results of the single-equation studies should instead "be interpreted as the joint outcomes of the random shocks to distribution and utilisation that have been typical and the inherent dynamic behaviour of these variables . . ." (Kiefer and Rada, 2015, p. 1337). Even some proponents of the structural approach (e.g., Onaran and Galanis, 2012) have acknowledged that overlooking the systemic dimension of their models could potentially lead to biased results. To the best of the authors' knowledge, however, this supposition has never been tested.

This paper contributes to the literature by testing the extent to which structural models are biased by failing to account for the systemic relationships between variables, including both the endogeneity of key right-hand side variables and possible cross-equation correlation of the residuals. To accomplish this, the paper compares estimates for a structural model obtained using the traditional method of estimating each equation separately to those found by estimating the same model as a system, using the generalized method of moments (GMM). The models are estimated for the U.S. economy, which is a prime candidate for this exercise given the availability of sufficient data over a long historical period (since the 1960s). Long data series are needed to generate enough observations to estimate complex systems with large numbers of parameters. Also, the fact that the U.S. economy has been the subject of many previous studies on this topic, using both structural and aggregative approaches, helps to make the present results comparable to those in a large segment of the literature.

In addition to testing the extent to which previous structural estimates are biased, this study makes several other contributions. First, this study develops a framework for estimating the relationship between demand and distribution that is more in line with theoretical models of open economies in the neo-Kaleckian tradition, dating back to Blecker (1989), compared with previous empirical studies. In the model developed here, the wage share is determined by unit labor costs and the monopoly power of firms, the wage share and net exports are direct functions of unit labor costs, and unit labor costs influence consumption and investment indirectly through the wage share. Second, this paper estimates equations for the wage share and unit labor costs simultaneously with estimating the various demand functions (consumption, investment, exports, and imports). Other studies (e.g., Stockhammer, 2017a; Kohler et al., 2019) have examined the determinants of the wage share previously, but none have incorporated a wage share equation into a broader structural macro model as this paper does. The methodology used here allows us to estimate the effects of changes in the underlying determinants of the wage share, such as unit labor costs and monopoly power of firms. Third, this paper disaggregates total investment into nonresidential and residential investment, which are very different variables that (as will be seen below) have very different determinants. To the authors' knowledge, only one previous study in this literature Stockhammer et al. (2018) has differentiated between corporate and total investment, and none has estimated a separate equation for residential investment—which is an important component of aggregate demand, as evidenced by the significance of the housing sector in the financial crisis and Great Recession of 2008–9. As will be seen, this decomposition allows us to detect statistically significant effects of income distribution that go in opposite directions for the two types of investment, which are missed in studies that lump both kinds of investment together.[2]

Surprisingly, this paper finds no evidence that the separate estimation of the structural equations or treatment of the wage share as exogenous biases the results toward finding more strongly wage-led demand. On the contrary, the systems GMM estimates reported here find that demand is more, not less, wage-led compared with the estimation of separate "single equations" for the components of aggregate demand. Thus, any bias caused by use of the single equation approach appears to go in the direction of underestimating wage-led demand effects, rather than overestimating them. Of course, the precise results in these preliminary estimates also depend on other aspects of the model specification, such as the functional forms used in the consumption, investment, and net export equations, but other experiments we have run (in results not reported here) consistently show that the bias in the single-equation estimates is toward less, not more, wage-led findings. Future drafts of this paper will report results for sensitivity tests using alternative specifications of various equations or alternative measures of some of the variables.

[2] As a sensitivity test, in future drafts of this paper we plan to report results for a model with one equation for total investment, instead of separate equations for residential and nonresidential investment.

Like any study of this nature, this paper is subject to some important qualifications and limitations. First, all of the estimates in this paper are concerned only with short-run relationships between distribution and demand; none of the results presented here relate to longer-term dynamics. Thus, this paper does not address criticisms like that of Razmi (2018), who argues that dynamic stock-flow adjustments required for balance-of-payments equilibrium in the medium run could offset or reverse any short-run wage-led demand effects. Second, this paper considers only the broad "functional" distribution of income between labor and capital, not any other dimensions of inequality (for example, wage inequality between different types of workers or the distribution of income or wealth across households). Third, the findings in this paper pertain only to the U.S. economy; results could differ in other national contexts. Fourth, in terms of the two empirical approaches outlined above (and discussed in more detail below), this paper focuses only on the structural approach.

The rest of this paper proceeds as follows. Section 2 discusses the relevant literature. Section 3 presents a theoretical model used to motivate the empirical specifications that follow. Section 4 describes the econometric methods and data set employed, while section 5 discusses the estimation results. Section 6 provides some concluding remarks.

2 Literature Review

2.1 Overview

The main theoretical framework for analyzing the relationship between income distribution and short-run economic performance (for example, the growth rate of output or the rate of capacity utilization) has been the neo-Kaleckian approach. Inspired by the earlier work of Kalecki (1954), a large series of theoretical papers written between the mid-1970s and the 1990s (surveyed by Blecker, 2002) established the basic parameters of this approach. The approach starts from the national income identity written as

$$Y = C + I + G + NX \tag{1}$$

where Y is output (GDP), C is consumption, I is investment, G is government purchases, and NX is net exports (all in real terms measured in domestic goods). As will be shown more formally in section 3 below, each of the components of GDP on the right-hand side of this equation (usually with the exception of G) is modeled as a function of the distribution of income between wages and profits, as well as other variables.

The general expectation is that a redistribution of income toward wages will stimulate consumption, since wage recipients are expected to be in lower income brackets and hence tend to have a higher marginal propensity to consume than profit recipients. On the other hand, investment—at least the corporate or business portion—is generally expected to be positively related to profitability (often measured by the profit share of national income or the profit rate, i.e., rate of return to capital). However, the demand for new housing is an important part of investment which, if anything, could be positively related to the level or share of wages in a country (like the United States) where homeownership is widespread. The net effect of a distributional shift toward wages on private domestic demand thus depends on whether the boost to household spending (consumption plus residential investment) outweighs the possible reduction in business investment. Finally, although it is more complicated (again, details are reserved for the next section), a redistribution toward wages associated with a rise in labor costs would be expected to reduce net exports, although this need not occur for a redistribution toward wages caused by other factors (for example, a reduction in monopoly power that reduces firms' markups). The net effect of such a redistribution on total output then depends on the sum of the effects on private domestic demand $(C + I)$ and net exports (NX). Theoretical models of this type (and critiques thereof) are reviewed extensively in Hein (2014), Lavoie (2014), and Blecker and Setterfield (2019).

What we have referred to as the "aggregative approach" to empirical estimation ignores the underlying details of what determines consumption, investment, and net exports, and instead estimate the effects of a measure of distribution (usually either the wage or profit share) on total output or some transformation thereof (for example, its growth rate or, more commonly, the rate of capacity utilization[3]). Although there were a few earlier efforts, this approach has been largely defined by the "neo-Goodwin cycle" model of Barbosa-Filho and Taylor (2006), whose finding of profit-driven demand (a negative effect of the wage share on the utilization rate) and a profit-squeeze in distribution (positive impact of the utilization rate on the wage share) in U.S. macro data spawned a whole new literature revolving around the authors' idea of counterclockwise short-run cycles in utilization-and-distribution space. The same basic pattern of results has been confirmed several times in later studies of the United States and other countries, including Nikiforos and Foley (2012), Kiefer and Rada (2015), and Carvalho and Rezai (2016).

However, critics have noted that the appearance of neo-Goodwin cycles in the data could result from other causal mechanisms besides profit-led demand and a profit squeeze, for example the dynamics of Minskyan financial fragility or consumer debt accumulation, or the fact that the wage share varies countercyclically due to procyclical variations in labor productivity (see Stockhammer and Michell, 2016; Stockhammer, 2017b; Lavoie, 2017; Setterfield and Kim, 2017). Blecker (2016b) observes that the profit-led demand findings at best pertain to short-run cyclical behavior, while Charpe et al. (2019) find empirically that U.S. output growth is wage-led in the very long term (30–50 year cycles) but profit-led over shorter time horizons. Cauvel (2019) reports that the findings of profit-led demand and a profit-squeeze in the short run disappear from the U.S. data once one controls for the positive effect of output (utilization) on labor productivity, a key component of the wage share (which

[3] In principle, the utilization rate is the ratio of actual output to potential output. In practice, many empirical studies use an output gap, defined as the difference (often the log difference) between actual output and a measure of trend output. See Barrales and von Arnim (2017) on alternative measures of the utilization rate for the U.S. economy.

is essentially the ratio of the real wage to labor productivity). By either using the numerator and denominator of this ratio as separate variables, or alternatively removing the cyclical component of productivity from the wage share, U.S. demand (capacity utilization) is, if anything, wage-led according to Cauvel's estimates.

In contrast, what we have called the "structural approach" involves separately estimating functions for the individual components of private-sector aggregate demand (C, I, and NX) to determine how each is affected by a redistribution toward labor. The distributional effects on each component are then added up to determine the total effect of a change in the functional distribution of income on aggregate demand. Most such studies treat government spending as exogenous (or, at least, independent of income distribution) and focus on the effects of the wage or profit share on private aggregate demand (the sum of consumption, investment, and net exports).[4] Early studies in this vein reached mixed conclusions, often finding opposite results (either wage-led or profit-led demand) for the same countries, including the United States (e.g., Bowles and Boyer, 1995; Gordon, 1995; Naastepad and Storm, 2006). Since around 2008, however, the structural modeling literature has coalesced around a more common set of findings. All structural studies since that time have found wage-led demand in the United States and other large, advanced economies, like Germany and the EU as a whole, while often (but not always) finding profit-led demand in smaller and more open economies including Austria, Australia, Netherlands, Canada, Argentina, China, Mexico, and South Africa (see Hein and Vogel, 2008; Stockhammer et al., 2009; Onaran et al., 2011; Onaran and Galanis, 2012; Stockhammer and Wildauer, 2016; Onaran and Obst, 2016).[5]

[4] Some studies further limit their analysis to private *domestic* aggregate demand by excluding exports and imports (see e.g., Stockhammer and Stehrer, 2011; Stockhammer et al., 2018), whereas Naastepad and Storm (2006) estimate an export equation, but not an import equation (they treat imports as exogenous).

[5] Some studies also examine the cross-country effects of globally correlated changes in wage shares by estimating the impact of a simultaneous increase (or decrease) in the wage share in all countries in the sample on each individual country. Onaran and Obst (2016), Obst et al. (2017), and Onaran and Galanis (2012) find that for some countries demand switches from profit-led to wage-led when the distributional shifts also occur in their trading partners (since the negative effects of higher labor costs on net exports roughly cancel out in this situation).

2.2 Details

In most applications of the structural approach (e.g., Naastepad and Storm, 2006; Hein and Vogel, 2008; Stockhammer et al., 2009, 2011; Onaran and Galanis, 2012; Onaran and Obst, 2016), the effect of the functional distribution of income on consumption is found by regressing consumption (C) on total wages (W) and profits (R), along with any control variables (for example, household debt or net worth), to estimate the marginal propensities to consume (MPCs) out of wages and out of profits, c_W and c_R, respectively.[6] Researchers employing this methodology almost invariably find that the MPC out of wages is greater than the MPC out of profits. Some studies (see Onaran et al., 2011; Stockhammer and Stehrer, 2011; Stockhammer and Wildauer, 2016; Stockhammer et al., 2018) take a more direct approach to estimating the marginal effect of income distribution on consumption by including the wage share along with national income or GDP in the consumption equation, instead of using wages and profits as separate variables. These studies generally find that an increase in the wage share (or decrease in the profit share) increases consumption, although there are exceptions for a few countries, and this specification of the consumption function is less supported theoretically.[7]

Using versions of the investment function proposed by Bhaduri and Marglin (1990) and Marglin and Bhaduri (1990), investment I (or the ratio of investment to GDP, I/Y) is usually regressed on a measure of income distribution (the profit or wage share) and an output variable (such as the GDP growth rate or capacity utilization rate) representing the

[6] In practice, many researchers transform the variables (for this equation and the others discussed below) into natural logarithms, because the aggregate data series exhibit exponential trends. Alternatively, some studies express macroeconomic aggregates like consumption as percentages of GDP in order to make them stationary. Many studies use first differences (in levels or logs) to eliminate unit roots, or else estimate error correction models (ECMs) if there is evidence of cointegration, and lags of both independent and dependent variables are often included in any kind of estimation.

[7] Onaran et al. (2011) also take the additional step of disaggregating profits into rentier and non-rentier profit shares. They find that increases in either the rentier or non-rentier profit share have a negative effect on consumption.

accelerator effect, along with any control variables (e.g., Hein and Vogel, 2008; Naastepad and Storm, 2006; Onaran and Galanis, 2012; Stockhammer and Wildauer, 2016; Stockhammer and Stehrer, 2011; Stockhammer et al., 2018; Onaran and Obst, 2016). These studies almost uniformly find strong evidence for significant, positive accelerator effects. Empirical findings about distributional effects on investment are much more varied, however. While these studies do find the theoretically expected positive effects of the profit share[8] (or negative effects of the wage share) in many countries, they often find that such effects are statistically insignificant or even that the coefficients have the "wrong" signs in various countries.

For the U.S. case, estimated distributional effects on investment have varied widely. Naastepad and Storm (2006) found a strong and significant positive effect of profitability on U.S. investment, which was large enough to make U.S. demand profit-led overall. However, that finding has not been replicated in later studies. For example, Hein and Vogel (2008) and Onaran and Galanis (2012) did not find statistically significant effects of the profit share on investment in the U.S. economy. Onaran et al. (2011) found some evidence that firms' retained ("non-rentier") profits have a positive effect on investment, at least in the short run, while rentiers' profits have a negative long-run effect, but the statistical significance of these results was sensitive to the precise specification used. Using long-term historical data, Stockhammer et al. (2018) find a positive effects of the wage share on total U.S. investment and a negative effect on U.S. corporate investment, but again statistical significance varies according to the specification.

The lack of robust evidence for positive profitability effects (or negative wage share effects) on total investment could simply indicate that distribution does not have a strong effect on investment, and that the latter is largely determined by accelerator mechanism, but there are also other possible explanations. Most importantly for present purposes, the weak

[8] Stockhammer et al. (2009) and Stockhammer and Stehrer (2011) use total profits in place of the profit share.

estimated effects of the profit share on total investment could be a result of the functional distribution of income having different effects on the two components of fixed investment, residential and nonresidential. The theories that predict a positive profitability effect (or negative impact of the wage share) are concerned only with the latter type of investment, not the former, but the former is a large share of total investment in many countries. In the U.S. case, residential investment averaged about one-quarter of total gross private fixed investment between 1960 and 2018, with a range of about one-sixth to one-third.[9] To investigate this issue further, the present paper will disaggregate fixed investment into its residential and nonresidential components, using a different function for each one (see sections 3 and 5, below).

With regard to net exports, some early studies (e.g., Hein and Vogel, 2008; Stockhammer et al., 2009) used a simple approach of regressing this variable (often taken as a ratio to GDP) directly on the profit (or wage) share, measures of domestic and foreign income, and other variables, with mixed results for whether distribution has a significant effect for various countries and specifications.[10] More recently, most studies (e.g., Stockhammer et al., 2011; Onaran et al., 2011; Onaran and Galanis, 2012; Obst et al., 2017; Onaran and Obst, 2016) have estimated separate equations for export and import demand as functions of relative prices of domestic and foreign goods as well as appropriate income variables (foreign for exports and domestic for imports) and control variables. These later studies then usually estimate separate equations for domestic and export prices as functions of unit labor costs and other variables. A hybrid version is found in the international panel study of Stockhammer and Wildauer (2016), who estimate separate equations for exports and imports, but include the wage share directly in both equations.

[9]Authors' analysis of GDP data from U.S. BEA, accessed September 28, 2019.

[10]Bowles and Boyer (1995) used a rather idiosyncratic specification in which net exports (as a ratio to GDP) were modeled as a function of the profit rate, domestic employment, and either a time trend or a shift dummy.

On the whole, these studies usually find the expected negative effects of the wage share (or unit labor costs) on exports, positive effects on imports, and/or negative effects on net exports for most countries, but the magnitudes of these effects and their statistical significance vary widely, and in some cases even the "correct" signs are not found for particular countries.[11] Although the stepwise process of estimating price functions along with export and import functions is more theoretically grounded than the simpler methods, the way that distribution is linked to trade in all these models seems theoretically ad hoc. This is most obvious for the studies that simply regress net exports on the wage or profit share. But also, many of the other studies model unit labor costs as a function of the wage share (which they treat as exogenous), whereas in a model that recognizes the endogeneity of the wage share the causality should be the reverse: the wage share should be a function of unit labor costs. In the next section, we will derive a more theoretically consistent approach to estimating distributional effects on net exports.

Many studies have investigated the determinants of the labor (wage) share, although not in the context of a structural macro model as defined here. In the aggregative literature on neo-Goodwin cycles, most studies (e.g., Barbosa-Filho and Taylor, 2006; Kiefer and Rada, 2015; Carvalho and Rezai, 2016) have found evidence of a "profit-squeeze," in the sense that rising output (capacity utilization) drives up the wage share during the expansion phase of a business cycle, and conversely during a downturn—in both U.S. and panel data. Nikiforos and Foley (2012) found a U-shaped distributional relationship, such that a rise in utilization reduces the wage share at low utilization rates but increases it at higher utilization rates, i.e., closer to the peak of a cycle, in U.S. data. However, most of the aggregative studies have included few (if any) control variables, suggesting possible omitted variable bias. Also, as noted earlier, Cauvel (2019) found that when he controlled for the reverse direction of

[11] Naastepad and Storm (2006) estimate only an export equation, finding that real unit labor costs have a negative effect on export growth in all countries except the United States, where they found a positive but insignificant effect. Rather oddly, they treat imports as exogenous.

causality (positive effects of utilization on productivity, and hence negative effects on the wage share), the supposed profit-squeeze effect was no longer observed. Cauvel's results suggest that the utilization rate mainly affects labor productivity, not the real wage, in U.S. time-series data, but this is still important because productivity is a key component of the wage share.

Stockhammer (2017a) found that financialization, globalization, and the decline of the welfare state were significant factors in explaining the decline of wage shares in a panel of OECD economies. [NOTE: I ADDED THE FOLLOWING SENTENCE.] Pariboni and Tridico (2019) similarly examined the determinants of the labor share in a panel of OECD economies, finding significant effects of financialization, globalization, deindustrialization, and changes in employment protection. Kohler et al. (2019, p. 964) further investigate the channels for financialization effects, and conclude that "International financial openness and financial payments of firms [viewed as part of firms' overhead costs] have the most robust negative impact on the wage share." In a study of 59 countries using a neoclassical framework, Karabarbounis and Neiman (2014) found that falling labor shares could be attributed to falling relative prices of investment goods, which induced substitution of capital for labor. Elsby et al. (2013) found that falling wage shares in US industries were mainly driven by increasing import penetration and offshoring of labor-intensive activities, especially in manufacturing. De Loecker et al. (2018), who find that average markups in large U.S. firms increased sharply between the 1980s and 2016, argue that these rising markups have contributed to the decreasing labor share in the U.S. economy. Autor et al. (2017) found that the falling U.S. labor share was driven by increasing industrial concentration: because the firms that have increased their market shares the most also have the highest profit shares, weighted-average industry-level profit shares have also increased. Jayadev (2007) and Furceri and Loungani (2018) have found a negative effect of capital account liberalization on the labor share in international panel data.

2.3 Evaluation

The structural approach to estimating the relationship between aggregate demand and the functional distribution of income has a number of advantages, especially the ability to identify the effects of distribution on individual components of aggregate demand and hence to compare effects on (private) domestic demand and net exports (Blecker, 2016b; Onaran and Galanis, 2012; Onaran and Obst, 2016; Stockhammer, 2017b). In comparison to the techniques generally used by practitioners of the aggregative approach, such as vector autoregressions, the structural models also allow for greater flexibility in functional forms, the inclusion of more control variables, allowing different variables to affect different components of aggregate demand, and varying which distributional variables are included in each equation (Onaran and Obst, 2016).

However, the methodology used by previous structural studies also has some significant weaknesses. The primary criticism of these studies has been that their treatment of the wage (or profit) share as an exogenous variable could lead to simultaneity bias, potentially rendering the results spurious. The assumption of exogeneity is likely not accurate, as Stockhammer and Stehrer (2011) find that causality flows from both consumption and investment to the wage share in Granger-causality tests, while Barrales and von Arnim (2017) show that both demand and the wage share Granger-cause one another. Similar problems could also arise from treating other variables as exogenous. For example, GDP is often included in equations for individual components of aggregate demand, but of course GDP is the sum of consumption, investment, net exports, and government spending. Failing to account for this relationship could also yield simultaneity bias. A number of structural studies acknowledge the potential bias caused by endogeneity (as well as ignoring the systemic aspect of the model), while simply asserting that the benefits of the approach outweigh the problems (Onaran and Galanis, 2012; Onaran and Obst, 2016; Obst et al., 2017).

Some studies have tried to eliminate potential endogeneity bias by excluding contemporaneous effects of the wage (or profit) share from one or more equations, and including only lagged distributional variables, which can be considered predetermined (e.g., Naastepad and Storm, 2006; Stockhammer and Stehrer, 2011; Onaran et al., 2011). However, while this resolves the endogeneity problem, it also loses information, thus creating another source of potential misspecification bias by ignoring potentially significant contemporaneous effects of distribution on demand. Excluding contemporaneous effects may also cause other econometric problems. For example, Stockhammer et al. (2018) find evidence of autocorrelation in specifications with no contemporaneous effects, but no evidence of autocorrelation when they are included.

Another problem with this empirical approach, as usually implemented, is that it does not account for the systemic aspects of the structural models. By estimating each equation separately, previous studies have not accounted for potential cross-equation correlation of the residuals, which makes ordinary least squares (OLS) estimation inefficient. It is also likely that separately estimating each equation will not properly capture indirect distributional effects. As Blecker (2016b) observed, estimated accelerator (output) effects on investment may partially reflect distributional effects on consumption (since consumption is about two-thirds of output), while estimated income effects on consumption could partially reflect distributional effects on investment (which determines income through the multiplier), but neither of these indirect effects would be included in standard estimates—which only capture *direct* effects of income distribution on the various components of aggregate demand. Recently, however, Onaran and Obst (2016) have partially addressed this last concern by estimating indirect effects of the wage share on investment and net exports (but not on consumption).

To the best of the authors' knowledge, no structural study has yet attempted to overcome the endogeneity problem and the associated potential for simultaneity bias by estimating a system of equations in which the functional distribution of income and the components of private aggregate demand are simultaneously determined. This paper is intended to fill precisely that gap in the literature. Stockhammer and Stehrer (2011), Onaran and Galanis (2012), and Onaran and Obst (2016) have noted that distribution could be endogenized using an instrumental variables approach, but cite econometric challenges, such as the difficulty of finding good instruments and the need for long data samples, as reasons for not pursuing it. They make a good point, and indeed we have found that the difficulties in obtaining valid instruments in a structural model with a large number of parameters and limited number of observations are not trivial. Nevertheless, our use of U.S. data allows for a sufficiently long sample period and enough exogenous instruments to obtain valid systems estimates. We will discuss our estimation approach in more depth in section 4, below, but first we turn to the theoretical model that underlies that estimation.

3 Theoretical Model

The theory developed in this section is not new or original; rather, it is an amalgam of elements from previous neo-Kaleckian models for open economies including those of Taylor (1983), Blecker (1989, 1999, 2011), and Bhaduri and Marglin (1990) in the theoretical domain and Stockhammer et al. (2011) and Onaran et al. (2011) in empirical studies, among many others. The model is presented here mainly to motivate the econometric specifications discussed in the next section. However, this is the first empirical paper that uses the approach to modeling an endogenous wage share and how it is linked to the real exchange rate (RER) and net exports originally developed by Blecker (1989, 2002) in an econometric model of demand and distribution. Time subscripts are suppressed to avoid cluttering the notation; issues about lags will be introduced in later sections.

The model assumes an industrialized economy characterized by an oligopolistic market structure and excess capacity, so that prices are set by a gross markup $\tau > 0$ over unit (average variable) costs and output is demand-driven in the short run. For simplicity (and because of data limitations), only unit labor costs are considered explicitly, so other variable costs (especially energy) as well as "overhead" (fixed) costs would be reflected in (gross) markups. Unit labor costs ULC can be written as the ratio of the nominal wage w to labor productivity $y = Y/L$ (where L is total labor hours employed), so that the pricing equation for a representative firm is

$$P = (1+\tau)\frac{w}{y} = (1+\tau)ULC \tag{2}$$

In an open economy, firms adjust their markups depending on the competitiveness of domestic goods relative to foreign goods: firms are able to increase their markups when domestic goods are more competitive, and are forced to reduce ("squeeze") them when domestic goods are less competitive (in order to prevent too large a loss of market share). For mathematical convenience, this adjustment is modeled by assuming that the representative firm's markup factor or gross margin $(1+\tau)$ has a constant elasticity $\theta > 0$ with respect to the real exchange rate:

$$1 + \tau = \mu \left(\frac{EP_f}{P}\right)^{\theta} \tag{3}$$

where E is the nominal exchange rate (measured in domestic currency per unit of foreign exchange), P_f is the foreign price level, and $\mu > 1$ represents the firm's target markup factor reflecting the Kaleckian "degree of monopoly" (defined in more detail below).

It is easily seen that the profit share π in this model is positively related to the markup

$$\pi = \frac{\tau}{1+\tau} \tag{4}$$

while the wage share ψ is inversely related to the markup, positively related to productivity, and equivalent to real unit labor costs:

$$\psi = 1 - \pi = \frac{1}{1+\tau} = \frac{w/P}{y} \tag{5}$$

Using the second of these expressions for ψ and the pricing equation (2), the real exchange rate can be written as

$$\frac{EP_f}{P} = z\psi \tag{6}$$

where $z = EP_f/(w/y)$ is the ratio of the domestic-currency price of foreign goods (EP_f) to nominal unit labor cost (w/y). Hence, the z ratio can be considered to reflect home country competitiveness. Then, substituting this equation for the RER into equation (3) and using the definition of z and (5), we can solve for the (endogenous) wage share as a function of the target markup factor μ and the labor cost competitiveness ratio z:

$$\psi = \mu^{\frac{-1}{1+\theta}} z^{\frac{-\theta}{1+\theta}} \tag{7}$$

so that increases in either μ or z cause the wage share to decrease. To the authors' knowledge, this approach to modeling the relationship between unit labor costs, monopoly power, and the wage share has not been implemented previously in a structural econometric model.[12]

Next, we turn to the aggregate demand (income-expenditure) side of the model. First, we rewrite the national income identity, equation (1), to disaggregate investment into residential (res) and nonresidential (nr) fixed investment (we ignore inventory accumulation for simplicity) and to express the export and import components of net exports ($NX = X - M$) separately:

$$Y = C + I_{res} + I_{nr} + G + X - M \tag{8}$$

In addition, we can specify the income side of the national accounts in real terms as follows:

$$Y = W + R = (w/P)L + rK \tag{9}$$

[12] Fernandez (2005) estimated an aggregative model using z as a variable in the equation for the profit share, but did not include an empirical proxy for the target markup μ, as we will below.

where $W = (w/P)L$ is total real labor ("wage") income, r is the profit rate, K is the capital stock, and $R = rK$ is total real capital ("profit") income. The real wage is $w/P = y/(1+\tau)$ and the profit rate can be written as $r = (1-\psi)(Y/K)$.

Consumption is a function of wage and profit income as well as a vector of control variables A_{cons}, where the latter are usually measures of consumers' financial positions such as household debt and/or wealth:

$$C = C_0 + c_W W + c_R R + \alpha_{cons} A_{cons} \tag{10}$$

where c_W and c_R are the marginal propensities to consume, as defined previously, C_0 is a constant, and α_{cons} is the coefficient vector for A_{cons}. We assume $0 < c_R < c_W < 1$, but of course this set of inequalities is really a set of hypotheses that will be tested econometrically below.

Following most of the structural literature, nonresidential (business or corporate) investment is modeled by a linearized Bhaduri-Marglin specification with control variables A_{nr} included:

$$I_{nr} = b_0 + b_1 Y + b_2 \psi + \alpha_{nr} A_{nr} \tag{11}$$

where $b_1 Y$ captures the accelerator effect[13] and the traditional assumption about the distributional effect is that $b_2 < 0$. The control variables for nonresidential investment A_{nr} could

[13]Theoretically, the accelerator principle states that the level (flow) of investment should be linked to the change (increase) in output, since net investment is the change in the capital stock and firms are assumed to increase their capital stocks in proportion to (expected) increases in the level of output. From that perspective, equation (11) is probably misspecified. However, this equation derives from theoretical models like those of Taylor (1983), Dutt (1984), Bhaduri and Marglin (1990), and Marglin and Bhaduri (1990), which link the level of investment (or the ratio of investment to capital) to the capacity utilization rate (ratio of actual output to potential output, often proxied by the output-capital ratio). Ignoring the normalization by potential output or the capital stock, the latter approach results in the static formulation shown in equation (11), where investment is a function of the level of output.

include, for example, a real interest rate[14] or measures of corporate debt (additional control variables will be discussed in section 4).

Residential investment is modeled in parallel fashion as

$$I_{res} = h_0 + h_1 Y + h_2 \psi + \alpha_{res} A_{res} \tag{12}$$

where we hypothesize that $h_2 > 0$, assuming that homeownership is widely distributed among wage earners and the middle class (of course, even if workers rent their housing, increased demand for rental units could also stimulate residential investment). The control variables for residential investment A_{res} could include, for example, indicators of household debt or house prices, or the mortgage interest rate. Note that, if one estimates a function for *total* fixed investment, one is essentially estimating the *sum* of equations (11) and (12), in which case the coefficients on Y and ψ are $b_1 + h_1$ and $b_2 + h_2$, respectively. If it is true that, as hypothesized, $b_2 < 0$ and $h_2 > 0$, the estimated coefficient on the wage share $(b_2 + h_2)$ in a regression for total fixed investment $(I = I_{nr} + I_{res})$ would be biased toward zero.

Lastly, we turn to the open economy bloc of the model and link it to the real exchange rate and income distribution.[15] Real home country exports X are assumed to be imperfect substitutes for foreign good, so they are a function of the relative price of foreign goods (i.e., the real exchange rate), and to be produced with infinitely elastic supply, so their quantity is explained entirely by demand.[16] We assume the constant-elasticity export demand function

[14] One of the most commonly tested control variables is the interest rate, which is considered to be a major determinant of investment in neoclassical models. However, interest rate variables are often found to have very small or statistically insignificant effects, or to have the wrong (positive) sign, when they have been included in the investment functions in this literature—a finding that is also consistent with many mainstream studies.

[15] This part of the model builds most directly on Blecker (1989). This specification of the trade side of the model has never been used previously in econometric studies, with the partial exception of Fernandez (2005) who used a similar specification of income distribution but in an aggregative model.

[16] These assumptions have been questioned by Razmi (2016) and Ros (2016) for small, open developing economies, which they argue are international price-takers that face significant domestic supply constraints. However, given that the United States is a large economy that helps to set global prices and trades mainly

$$X = X_0 \left(\frac{EP_f}{P}\right)^{\varepsilon_X} Y_f^{\eta_X} \tag{13}$$

where $\varepsilon_X > 0$ is the relative price elasticity (in absolute value) and $\eta_X > 0$ is the foreign income elasticity. Similarly, imports are imperfect substitutes for domestic goods and are assumed to have an infinite elasticity of supply in the world market, so their level is determined by the constant elasticity import demand function

$$M = M_0 \left(\frac{EP_f}{P}\right)^{-\varepsilon_M} Y^{\eta_M} \tag{14}$$

where $\varepsilon_M > 0$ and $\eta_M > 0$ are the relative price and domestic income elasticities, respectively (again, the price elasticity is defined as the absolute value). Transformed into natural logarithms, these equations become

$$\ln X = \ln X_0 + \varepsilon_X(\ln E + \ln P_f - \ln P) + \eta_X \ln Y_f \tag{15}$$

and

$$\ln M = \ln M_0 - \varepsilon_M(\ln E + \ln P_f - \ln P) + \eta_M \ln Y \tag{16}$$

Of course, control variables could be added into these equations, but (aside from using lags) we did not find that any other variables were necessary for obtaining good estimates in our empirical model (see section 4, below).

Then, substituting equation (7) into (6), we can write the real exchange rate as

$$\frac{EP_f}{P} = \left(\frac{z}{\mu}\right)^{\frac{1}{1+\theta}} \tag{17}$$

in differentiated products for which the "law of one price" does not apply, and in which industries typically operate with excess capacity, we think these are reasonable assumptions for the U.S. case.

or, in natural logs,

$$\ln E + \ln P_f - \ln P = \left(\frac{1}{1+\theta}\right)(\ln z - \ln \mu) \tag{18}$$

Next, substituting this expression for the real exchange rate into equations (15) and (16), the log-linear export and import demand functions become

$$\ln X = \ln X_0 + \varepsilon_X \left[\left(\frac{1}{1+\theta}\right)(\ln z - \ln \mu)\right] + \eta_X \ln Y_f \tag{19}$$

and

$$\ln M = \ln M_0 - \varepsilon_M \left[\left(\frac{1}{1+\theta}\right)(\ln z - \ln \mu)\right] + \eta_M \ln Y \tag{20}$$

Finally, equation (7) for the wage share can be rewritten in natural logs as

$$\ln \psi = -\left(\frac{1}{1+\theta}\right)\ln \mu - \left(\frac{\theta}{1+\theta}\right)\ln z \tag{21}$$

Thus, demand for exports and imports can each be expressed as a function of three underlying variables: the labor cost competitiveness ratio z, the monopoly power of firms μ, and foreign or domestic income (Y_f or Y). We expect labor cost competitiveness to have a positive effect on exports and a negative effect on imports, and the reverse for the degree of monopoly (target markup factor). However, this last prediction should be taken with caution, because if firms price-discriminate between domestic and foreign markets, the degree of monopoly may not have the same impact on export sales as it does for goods sold domestically. For example, highly monopolistic firms at home might charge lower prices on exports than they do domestically, as in the standard model of a price-discriminating monopolist that "dumps" in a foreign market. In any case, equations (19) and (20) suggest functional forms that can be econometrically estimated.

Also—and this will turn out to be important in the econometrics below—we should not forget that $\ln z$ can be further decomposed into $\ln z = (\ln E + \ln P_f) - (\ln w - \ln y)$, in other words, the difference in logarithms between prices of foreign goods and nominal unit labor costs, both measured in domestic currency. So, another way to express the demand for exports (imports) is that it should be increasing (decreasing) in foreign prices measured in domestic currency (EP_f) and decreasing (increasing) in nominal unit labor costs ($ULC = w/y$). The former of these variables will be treated as exogenous in our econometric modeling; the latter will be endogenized using an approach discussed in section 5, below. But first, the following section explains our econometric approach

4 Econometric strategy

As in many previous structural studies (e.g., Onaran and Galanis, 2012), all included variables were transformed into natural logarithms because most of the data series exhibit exponential time trends.[17] The series in natural logs were then tested for stationarity using three alternative unit root tests: the Augmented Dickey Fuller (ADF) test with lag length determined by Modified Akaike Information Criterion (MAIC) (Ng and Perron (2001)); the Phillips-Perron (PP) test; and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The first difference of a series was taken unless at least two of the following conditions is met: the ADF test rejects the null hypothesis of a unit root at the 5% level; the PP test rejects the null hypothesis of a unit root at the 5% level; and the KPSS test fails to reject the null hypothesis of stationarity at the 5% level. The same unit root tests were then performed on the differenced series to see if the variables were integrated of a higher order than unity. Since all of the series were found to be nonstationary in log levels but stationary in log differences, it was determined that nearly all had unit roots in log levels and therefore the variables were expressed in first differences of natural logarithms in the regressions. The only exceptions

[17]The only exceptions were dummy variables, inflation expectations, and the real interest rate. The real interest rate was left as a percentage, as is common practice in the literature. Inflation expectations were left as a percentage because some values of the series were negative, although none of the observations in the sample period were.

to this were dummy variables, inflation expectations, and the real interest rate—the latter two of which were found to be stationary in levels and therefore not differenced.[18]

In order to test whether treating the wage share and other income variables as exogenous and ignoring the systemic character of the model has biased previous structural estimates, we compare the results of models estimated using the same data sets, sample periods, and structural equations, but two different estimation strategies. First, the equations were estimated separately using ordinary least squares (OLS) and treating the wage share and all income variables (total wages, profits, and GDP) as exogenous, as has traditionally been done in the structural literature surveyed earlier. Then, the same equations were estimated as a system of simultaneous equations using GMM, where income distribution (the wage share, as well as wage and profit income separately in the consumption function) and the components of private aggregate demand are all treated as endogenous variables, and using the exogenous and predetermined (lagged) variables in the model as instruments.

Using GMM, the parameters are estimated using moment conditions like those in equation (22), where t indexes time, the vector $\boldsymbol{Z_t}$ denotes the set of all exogenous variables in the model,[19] υ_{tj} is the error term for equation j, y_{tj} is the dependent variable for equation j, and $\boldsymbol{x'_{tj}}$ is the set of independent variables for equation j, and (see Greene, 2011, Chapter 13).

$$E[\boldsymbol{Z_t}\ \upsilon_{tj}] = E[\boldsymbol{Z_t}(y_{tj} - \boldsymbol{x'_{tj}\beta_j})] = 0 \tag{22}$$

In other words, the exogenous variables are assumed to be uncorrelated with the error term in each equation.

The GMM method comprises a class of estimators that encompasses other commonly used estimators such as linear and nonlinear least squares, instrumental variables, and maxi-

[18] Detailed results of the stationarity tests are available upon request.

[19] Note that the vector $\boldsymbol{Z_t}$ is not related to the ratio z used in the theoretical model in the previous section and in the regression results below.

mum likelihood estimators (Greene, 2011, Chapter 18). The method is well-suited to address the problem of endogeneity, and hence provides an appropriate estimation method for our system emphasizing the interaction between endogenous variables. Following the systems GMM approach, all of the endogenous variables are simultaneously determined. The same set of instruments, including all of the exogenous and lagged variables, is used for each equation in the system.

The system was initially estimated using only exogenous and lagged variables included in the model as instruments. This estimation method is identical to the three-stage least squares estimator, except that some of the variables that do not appear as dependent variables in any equation are treated as endogenous and therefore are not used as instruments. However, using this approach the overidentifying restrictions were found to be invalid based on Hansen's J-statistic. Therefore, additional lags of the variables included in the model were added as instruments, as will be described in more detail in the next section. The GMM estimates are calculated using a two-step approach, in which parameter estimates are found using an initial weighting matrix, which is updated based on these parameter estimates. The updated weighting matrix is then used to obtain the final parameter estimates. The initial weighting matrix assumes that the moment equations are independent and identically distributed, while the updated weighting matrix assumes that the errors are homoskedastic, conditional on the instruments, but does not assume that the equations are independent (StataCorp, 2017).

All regression equations were specified as autoregressive distributed lag (ARDL) functions, meaning that lags of both the dependent and independent variables were included. To determine the optimal lag lengths in the equations estimated by OLS, we used the Schwartz criterion (SIC) as a starting point. Initial specifications all included a constant,[20] one lag of

[20]It should be recalled that the constant terms (intercepts) in all the theoretical equations are eliminated by the differencing, so the constant term in a regression equation specified in log first differences represents

the dependent variable,[21] and zero to two lags for each independent variable. We did not allow for longer lags because of our use of annual data, and also because the sample size is limited and the system will be inestimable by GMM (or the overidentifying restriction will not be satisfied) if the number of parameters is too large. Similarly, we used the SIC to select the lag lengths because it imposes a higher penalty for each additional parameter than other information criteria, and therefore results in a model with fewer parameters. For the same reason, insignificant variables, and in most cases those whose contemporaneous and lagged coefficients were insignificantly different from zero when added together, were dropped. However, in some cases, described below, deviations from these initial lag lengths were made for any of the following three reasons: to improve the econometric properties of the OLS estimates (i.e., to satisfy various diagnostic tests, as described below); to further reduce the number of parameters in order to increase the degrees of freedom for the system GMM estimates (help satisfy the overidentifying restriction); and/or for consistency with the theoretical model. To further limit the number of parameters, the constant term was dropped from each equation if it was statistically insignificant in the OLS estimates, even if it was included by SIC, unless it was necessary to include the constant in order to improve the equation diagnostics.

Each OLS regression equation was subject to a battery of diagnostic tests to ensure that the residuals satisfy the necessary criteria—normality, homoskedasticity, and the absence of serial correlation or equation misspecification—for the hypothesis tests to be statistically valid. The Jarque-Bera test was used to test for normality, i.e., non-excessive degrees of skewness and kurtosis of the residuals. The Breusch-Pagan-Godfrey test was used to test for the presence of heteroskedasticity.[22] The Breusch-Godfrey Lagrange multiplier test was

an exponential time trend of the form $e^{\beta_0 t}$ where β_0 is the constant term in the regression and also the trend growth rate.

[21] The one exception is the equation for nonresidential investment, where for reasons discussed in the next section, we allowed two lags of the dependent variable.

[22] For some equations, there was an insufficient number of observations to use the White heteroskedasticity test. The Breusch-Pagan-Godfrey test was therefore used for all equations for the sake of consistency.

used to test for serial correlation up to 2 lags. The Ramsey RESET test was conducted using both one and two fitted terms to test for specification error. Except where noted below, the tests fail to reject the null hypotheses of homoskedasticity, no serial correlation up to 2 lags, normality, and no specification error at least at the 10% level for each test (but usually much better than that). Although it was not possible to conduct these same tests for the equations estimated by systems GMM, in all cases the same specification was used for each equation in both OLS and GMM.

5 Estimated equations and results

5.1 General aspects of model specification

The econometric model includes seven equations. Five of these are the functions for the components of private aggregate demand, C, I_{nr}, I_{res}, X, and M (essentially, all components of GDP except government purchases G and inventory accumulation), from the theoretical model, based on equations (10)–(12) and (19)–(20) in section 3, but with all variables expressed in log first differences[23] and the addition of lags and (in some equations) constants representing time trends as discussed in the previous section. The two remaining equations, for the wage share (ψ) and unit labor costs ($ULC = w/y$), examine the determinants of income distribution. The wage share regression is based on a differenced version of the wage share equation in logs (equation 21) from the theoretical model; the ULC regression—for which no theoretical function was specified earlier—is based on an admittedly ad hoc specification to be described below.

All regressions use annual data (see Table A.1 in the Appendix for a list of variable definitions and sources) for the sample period 1963–2016, which was determined by data

[23] Recall that, in the theoretical model, only the export and import functions were expressed in natural logs, but for purposes of econometric estimation, the variables in the consumption and investment functions were also logged, and then all equations were differenced, for the reasons discussed in section 4.

availability. Quarterly data were not used because they are not available for all variables, and using them could introduce complications such as seasonality that could distract from our focus on the distribution-demand relationship. At the front end, some of the data series begin in the early 1960s and are not available for earlier years; starting the regressions in 1963 allowed us to use up to two lags for all included variables but did limit the number of extra lags we could use for a few of the instruments in the GMM estimates. At the back end, the series we use for the average markup rate (as discussed below) ends in 2016, so we did not attempt to extend the sample beyond that point. (We may investigate alternative proxies for firms' monopoly power that could be extended beyond 2016 in future drafts.)

All of the variables except the components of aggregate demand (C, I_{nr}, I_{res}, X, and M) and the income or distributional variables (Y, ψ, W, R, ULC, and z) are assumed to be exogenous in the GMM estimation.[24] Lags of all variables included in the model are assumed to be predetermined and therefore are treated as exogenous. The instrument list includes four lags of each variable in the model, except those for which the addition of four lags would require the reduction of the sample size due to data limitations. For this reason, only two lags of z, EP_f, the real exchange rate, and the real oil price are included, and only one lag of foreign income is included. No lags are included for dummy variables or interaction terms used as instruments. A complete list of all instruments used in the GMM estimation is given in the Table A.2 in the Appendix.

5.2 Results for individual equations

Based on equation (21), we model the wage share as a function of the competitiveness indicator z (the ratio of foreign goods prices in domestic currency to nominal unit labor costs) and proxies for the target markup factor or "degree of monopoly" indicator μ (both

[24] Future iterations of this paper will test whether the results are sensitive to the treatment of some contemporaneous control variables as endogenous, subject to the models satisfying the overidentifying restriction.

measured in log differences). Because using z resulted in a very poor model fit for this equation, we replaced it with its two components, EP_f and ULC, which yields much better-fitting equations. With regard to μ, this is of course unobservable, and it should be recalled that the markup in the theoretical model is a gross markup that has to reflect fixed costs ("overheads") and costs of non-labor variable inputs (such as energy) as well as the monopoly power of firms. Hence, we use three proxies for μ, and our experiments showed that they are significant (with the expected signs) when included together but not when included separately. For monopoly power per se, our proxy is the average markup rate for large, publicly traded corporations, weighted by market shares, estimated by De Loecker et al. (2018). Although this is supposed to be a measure of markups, and it has been subject to some criticisms (for example, by Basu, 2019; Karabarbounis and Neiman, 2018), it is virtually the only estimate available in the literature that has attempted to capture the average underlying market power of U.S. firms for a long enough time period to be of use in this study. To proxy for non-labor variable costs, we use an index of the real price of oil in the U.S. market. In addition to reflecting energy costs (or perhaps because it does), this indicator also helps to avoid large residuals in years of oil shocks. To proxy for research and development (R&D) expenditures and overhead or fixed costs, we use a measure of capital intensity. Finally, we include an outlier dummy for 1986 that was necessary to correct for heteroskedasticity.

Results for the wage share equation are given in Table 1. All variables are found to be significant with the expected signs (at least for the long-run coefficients designated by "LR")[25] using both estimation methods (OLS and GMM). In fact, the coefficient estimates do not differ much quantitatively or qualitatively between the two estimates. As expected, unit labor costs (ULC) have a positive long-run effect, while import prices in domestic currency

[25] The procedure we used to test for the significance of the long-run effects in the GMM estimates does not report standard errors. Thus, the significance levels for the LR coefficients for those estimates are indicated by *'s based on the p-values for the chi-square statistics reported by Stata.

Table 1: Estimated Wage Share Equations

Dependent Variable: Δ ln $Wage\ Share_t$

Variable	**OLS**	**Systems GMM**
Δ ln $Wage\ Share_{t-1}$	0.403***	0.424***
	(0.074)	(0.064)
Δ ln ULC_t	0.677***	0.659***
	(0.056)	(0.048)
Δ ln ULC_{t-1}	-0.572***	-0.558***
	(0.053)	(0.046)
LR ULC	0.175***	0.175***
	(0.051)	
Δ ln $EP_{f\,t}$	-0.058***	-0.052***
	(0.016)	(0.014)
LR EP_f	-0.097***	-0.090***
	(0.029)	
Δ ln $Markup_t$	-0.174**	-0.178**
	(0.086)	(0.072)
LR $Markup$	-0.292**	-0.310**
	(0.144)	
Δ ln $Capital\ Intensity_t$	-0.242***	-0.242***
	(0.061)	(0.051)
Δ ln $Capital\ Intensity_{t-1}$	0.181***	0.179***
	(0.064)	(0.054)
LR $Capital\ Intensity$	-0.102	-0.110*
	(0.076)	
Δ ln $Capital\ Intensity_t * ln\ Markup_t$	9.212**	9.985***
	(4.167)	(3.501)
LR $Capital\ Intensity * Markup$	15.441**	17.331***
	(6.993)	
Δ ln $Real\ Oil\ Price_t$	-0.008	-0.007*
	(0.005)	(0.004)
Δ ln $Real\ Oil\ Price_{t-1}$	-0.007*	-0.006**
	(0.004)	(0.003)
LR $Real\ Oil\ Price$	-0.024**	-0.025**
	(0.012)	
1986 $Dummy_t$	0.012**	0.010*
	(0.006)	(0.005)
LR 1986 $Dummy$	0.021*	0.017*
	(0.011)	
R^2	0.813	
Adjusted R^2	0.769	
Schwarz Criterion	-7.213	
Hansen J-statistic		366.263
Hansen J-statistic p-value		0.101
N	54	54

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$ Standard errors in parentheses

(EP_f) have a negative (but smaller) impact, in both equations. All three proxies for the target markup have negative long-run effects on the wage share in both estimates. However, we found that we could obtain sensible and statistically valid estimated coefficients only by including an interaction term for capital intensity and the markup rate from De Loecker et al. (2018).[26]

Among the variables included in the wage share equation, the only one likely to be endogenous is unit labor cost, which as noted earlier equals the ratio of the real wage to labor productivity. However, we did not have an equation for ULC in the theoretical model in section 3—and there is no standard equation for it in any of the previous literature—so we had to innovate.[27] To begin with, labor productivity in the U.S. economy is strongly procyclical (see Cauvel, 2019), and wages may also respond to GDP growth or the output gap (which is inversely related to the unemployment rate according to Okun's law), so we model ULC as a function of GDP (output) Y, with both variables measured as log differences (i.e., growth rates). In addition, the manufacturing share of employment is included to capture the effects of deindustralization on labor's bargaining power, and union activity is similarly included as a further proxy for the bargaining strength of labor. As inflation expectations are likely to affect the wage bargaining process, they are included as well. To capture the effects of international competition, we also include the real exchange rate as a control variable. Finally, we found that we needed to include an intercept dummy (representing a shift in

[26] We expect that this reflects the fact that observed markups are driven by more than the degree of monopoly power. Increased overhead costs or R&D expenditures will increase the observed markup but will not increase the profit share. In fact, because the wage share includes the wages of all workers, including overhead labor and production workers, increases in overhead labor will lead to both a higher wage share and a higher markup. As capital intensity is likely to be correlated with overhead costs and R&D spending, the interaction term likely captures these differing effects of different types of shocks to the markup on the wage share.

[27] In preliminary estimates of the ULC equation (not reported here), we tested a number of variables suggested by the literature on the determinants of the wage share (Stockhammer, 2017a; Pariboni and Tridico, 2019; Kohler et al., 2019; Karabarbounis and Neiman, 2014; Elsby et al., 2013, e.g.), such as indicators of financialization, globalization, technological change, deindustrialization, and labor bargaining power. On the assumption that these variables influence the wage share indirectly through ULC, it seems appropriate in principle to include them in this equation. However, most of these variables had to be dropped because they were insignificant or had theoretically implausible signs. Since many of these studies on the determinants of the wage share use international panel data, it is possible that their results are driven primarily by cross-country variation, rather than variation over time within a country. Nevertheless, we were able to find some proxies for deindustrialization, international competition, and labor bargaining power that worked in our U.S. data as described in the text.

the underlying time trend) for the years 1963–1983 in order to satisfy the RESET test; essentially, a model without this structural shift was found to be misspecified, suggesting that the relationship between Y and ULC differed in the periods before and after the early 1980s.

Estimation results for the two ULC equations (using OLS and GMM) are given in Table 2. The negative contemporaneous effects of GDP growth on changes in unit labor costs could reflect the positive effect of output on labor productivity mentioned above. However, the lagged effects of GDP growth are positive, possibly reflecting delayed impacts on wage setting. Since the positive lagged effects more than offset the negative contemporaneous effects, but only slightly, the long-run impact of GDP is positive but insignificant. All the estimated coefficients have the expected signs and are significant at least at the 10% level: inflation expectations, the manufacturing share of employment, and union activity all have positive effects, while the real exchange rate (real value of the dollar) has a negative effect. The constant was dropped because it was insignificant, but the positive coefficient on the pre-1984 dummy indicates a positive underlying time trend in the earlier part of the sample period that was not maintained subsequently, perhaps as a result of the weakening of labor and institution of "neo-liberal" policies starting in the early 1980s.

Turning to the consumption function, the OLS and GMM estimates shown in Table 3 are based on equation (10) with the variables measured in log differences. As expected, the elasticity of consumption with respect to wage income (total labor compensation) is much higher than for profits (total capital income); the corresponding marginal propensities to consume are calculated in the next subsection. It may be noted that the consumption functions shown in this table do not include any control variables or lags. Initially, we included measures of household debt and assets (net worth) as control variables based on the evidence in Stockhammer and Wildauer (2016) that debt and wealth are important factors

Table 2: Estimated Unit Labor Cost Equations

Dependent Variable: Δ ln ULC_t

Variable	**OLS**	**Systems GMM**
Δ ln ULC_{t-1}	0.370***	0.422***
	(0.136)	(0.119)
Δ ln GDP_t	-0.326***	-0.299***
	(0.064)	(0.057)
Δ ln GDP_{t-1}	0.403***	0.383***
	(0.063)	(0.056)
LR GDP	0.123	0.145
	(0.112)	
Δ ln $Inflation\ Expectations_t$	0.005***	0.005***
	(0.001)	(0.001)
LR $Inflation\ Expectations$	0.008***	0.007***
	(0.001)	
Δ ln $Manufacturing\ Share_t$	0.201**	0.163**
	(0.084)	(0.072)
LR $Manufacturing\ Share$	0.319*	0.282*
	(0.168)	
Δ ln $Real\ Exchange\ Rate_t$	-0.060**	-0.050**
	(0.027)	(0.024)
LR $Real\ Exchange\ Rate$	-0.095*	-0.086*
	(0.050)	
Δ ln $Union\ Activity_t$	0.010**	0.011***
	(0.004)	(0.004)
LR $Union\ Activity$	0.016*	0.018**
	(0.008)	
$Before$ 1984 $Dummy_t$	0.010**	0.011***
	(0.004)	(0.004)
LR $Before$ 1984 $Dummy$	0.016***	0.019***
	(0.005)	
R^2	0.872	
Adjusted R^2	0.853	
Schwarz Criterion	-6.112	
Hansen J-statistic		366.263
Hansen J-statistic p-value		0.101
N	54	54

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$ Standard errors in parentheses

to consider in the relationship between demand and distribution.[28] However, household

[28] For this same reason, we initially included these variables in the residential investment equation as well. Similarly, we included corporate debt in the nonresidential investment equation.

Table 3: Estimated Consumption Functions

Dependent Variable: Δ ln $Consumption_t$

Variable	**OLS**	**Systems GMM**
Constant	0.012***	0.011***
	(0.002)	(0.002)
Δ ln $Wages_t$	0.514***	0.544***
	(0.060)	(0.055)
Δ ln $Profits_t$	0.179***	0.165***
	(0.043)	(0.039)
R^2	0.769	
Adjusted R^2	0.760	
Schwarz Criterion	-6.494	
Hansen J-statistic		366.263
Hansen J-statistic p-value		0.101
N	54	54

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$ Standard errors in parentheses

assets were found to be insignificant in OLS, and were therefore dropped. Household debt and the insignificant lagged dependent variable were also dropped to reduce the number of parameters and increase the degrees of freedom in order to get valid estimates (satisfying the overidentifying restriction) for the system in GMM.[29] Nevertheless, we were able to obtain statistically valid estimates with this parsimonious specification, as the OLS equation shown in Table 3 satisfies all the diagnostic tests mentioned earlier, without any control variables or lags included, and the estimated coefficients on wage and profit income were robust regardless of whether the controls were included or not.

The estimated residential investment function is based on equation (12), with household net worth used as a control variable.[30] In addition to providing a control variable,

[29]Sensitivity of the results to including household debt and a lagged dependent variable will be tested in future drafts. One of the present authors also tested for measures of personal (household) income inequality, such as the aggregate Gini coefficient, in similar consumption functions (see Cauvel, 2018), but they were never significant and hence were not included here.

[30]A measure of home prices is also a significant determinant of residential investment, according to some estimates not reported here but available on request. However, after differencing this series to achieve stationarity, data were only available starting in 1964, which would have required us to shorten the sample period. In order to preserve degrees of freedom for the system estimates, we therefore excluded this variable

Table 4: Estimated Residential Investment Functions

Dependent Variable: Δ ln $Residential\ Investment_t$

Variable	**OLS**	**Systems GMM**
Δ ln $Residential\ Investment_{t-1}$	0.457***	0.509***
	(0.096)	(0.076)
Δ ln GDP_t	3.957***	3.981***
	(0.516)	(0.450)
Δ ln GDP_{t-1}	-3.597***	-3.700***
	(0.529)	(0.457)
LR GDP	0.663	0.573
	(0.566)	
Δ ln $Wage\ Share_t$	-0.113	0.444
	(1.182)	(0.985)
Δ ln $Wage\ Share_{t-1}$	2.326**	2.419***
	(1.048)	(0.877)
LR $Wage\ Share$	4.075	5.837**
	(2.899)	
Δ ln $Net\ Worth_t$	0.564**	0.435**
	(0.239)	(0.191)
LR $Net\ Worth$	1.038**	0.888**
	(0.460)	
R^2	0.688	
Adjusted R^2	0.656	
Schwarz Criterion	-2.059	
Hansen J-statistic		366.263
Hansen J-statistic p-value		0.101
N	54	54

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$ Standard errors in parentheses

including household net worth also helped to eliminate heteroskedasticity in the residuals. In earlier iterations of this equation, we tested controls for household assets and the real interest rate, but these variables were insignificant and were not included in the estimates reported here. Net worth was included in place of household debt because specifications including household debt required two lags of household debt to yield good econometric properties, therefore increasing the number of parameters in the system.

from the model, and the OLS equation shown here passed all the diagnostic tests without home prices included.

The results of estimating the residential investment function by both OLS and GMM are shown in Table 4. GDP growth has a strongly positive and significant contemporaneous effect in both estimates, but a negative lagged effect, resulting in long-run coefficients (elasticities) that are positive but insignificant. The wage share, in contrast, has an insignificant contemporaneous effect, a strongly positive and significant lagged effect, and a large, positive long-run effect (which is statistically significant only in the GMM estimate). Finally, household net worth has a positive and significant effect on residential investment, as expected.

The nonresidential (business) investment function is based on equation (11), with two control variables included. First, the manufacturing share of employment is used as a proxy for structural change in the economy. On the assumption that manufacturing production is more capital-intensive than most of the rest of the economy (which is largely services), we expect the manufacturing share to have a positive effect. Second, the ratio of corporate debt to GDP is included to account for the role of external finance of investment expenditures. Since the debt variable is measured in log differences, it reflects the flow of new corporate borrowing, which is expected to be positively associated with business investment.[31] We also tested for a real interest rate variable, but it was always insignificant or had the "wrong" sign (positive), so it was dropped from the model.

The results of estimating the nonresidential investment functions by OLS and GMM are shown in Table 5. For this equation, we found it necessary to include a second lag of the dependent variable, because when that was omitted the Ramsey RESET test suggested that the equation was misspecified. However, this change resulted in the EViews automatic ARDL procedure (using SIC) excluding the lagged wage share, which in turn eliminated any significant effect of the wage share on nonresidential investment. Because of the strong

[31] It is possible that the contemporaneous change in corporate debt could be endogenous because it is simultaneously determined along with investment spending. Although we treat corporate debt as exogenous here, we plan to test for treating it as an endogenous variable in future versions of this paper.

Table 5: Estimated Nonresidential Investment Functions

Dependent Variable: Δ ln $Nonresidential\ Investment_t$

Variable	**OLS**	**Systems GMM**
Δ ln $Nonresidential\ Investment_{t-1}$	0.391***	0.418***
	(0.078)	(0.061)
Δ ln $Nonresidential\ Investment_{t-2}$	-0.174**	-0.231***
	(0.076)	(0.058)
Δ ln GDP_t	1.452***	1.462***
	(0.163)	(0.135)
LR GDP	1.853***	1.798***
	(0.210)	
Δ ln $Wage\ Share_t$	-0.087	-0.294
	(0.443)	(0.370)
Δ ln $Wage\ Share_{t-1}$	-0.732*	-0.367
	(0.411)	(0.347)
LR $Wage\ Share$	-1.045	-0.814
	(0.851)	
Δ ln $Manufacturing\ Share_t$	0.710***	0.649***
	(0.182)	(0.143)
LR $Manufacturing\ Share$	0.906***	0.799***
	(0.286)	
Δ ln $Corporate\ Debt_t$	0.017	0.037
	(0.039)	(0.031)
Δ ln $Corporate\ Debt_{t-1}$	0.103**	0.104***
	(0.049)	(0.038)
LR $Corporate\ Debt$	0.153*	0.173***
	(0.087)	
R^2	0.829	
Adjusted R^2	0.803	
Schwarz Criterion	-4.023	
Hansen J-statistic		366.263
Hansen J-statistic p-value		0.101
N	54	54

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$ Standard errors in parentheses

theoretical reasons to expect a negative effect of the wage share and in order not to bias our findings in favor of wage-led demand, we included the lagged wage share in this equation even though that resulted in a slightly worse model fit according to SIC.[32] It seems theoretically plausible that the negative effect of the wage share could be stronger with a lag, if the wage share largely affects *planned* investment expenditures in advance of when the actual expenditures take place. While this keeps the lagged wage share in the model, it is only significant (with the expected negative sign) in the OLS estimate, and the long-run effect of the wage share is found to be negative but insignificant in both estimated equations. Otherwise, the results show strong and significant accelerator effects, with long-run GDP elasticities on the order of 1.80 to 1.85, and positive effects of the two control variables as expected.

Last but not least, Tables 6 and 7 report the results of estimating the export and import demand functions, based on theoretical equations (15) and (16), respectively, with all variables measured in first differences of the natural logs and using both econometric procedures (OLS and GMM). As in the case of the consumption function, no control variables were needed to obtain estimates of these functions with good econometric properties (i.e., satisfying all diagnostic tests). Unlike in the case of the wage share equation, we were able to obtain statistically valid estimates with good fits for these functions using the z ratio instead of its two components, which holds down the number of parameters that have to be estimated using systems GMM. Although the theoretical model suggests also including a proxy for the target markup factor μ in these equations, the markup measure from De Loecker et al. (2018) was never significant in the export or import equation and also had the wrong signs, so it was not included in the estimates reported here.

For the export demand function, foreign income has its expected positive effect, with a long-run elasticity of about 1.7. The z ratio, which reflects the labor cost competitiveness of U.S. goods, has the expected positive effect and a long-run elasticity of about 0.9 in the OLS

[32] This suggests a fairly obvious sensitivity test—using an investment function without a lagged wage share, as suggested by the SIC—for future drafts of this paper.

Table 6: Estimated Export Demand Functions

Dependent Variable: Δ ln $Exports_t$

Variable	OLS	Systems GMM
Δ ln $Exports_{t-1}$	0.456***	0.388***
	(0.121)	(0.101)
Δ ln $Foreign\ Income_t$	2.374***	2.188***
	(0.250)	(0.219)
Δ ln $Foreign\ Income_{t-1}$	-1.474***	-1.144***
	(0.359)	(0.302)
LR $Foreign\ Income$	1.654***	1.705***
	(0.214)	
Δ ln z_t	0.385***	0.372***
	(0.088)	(0.076)
Δ ln z_{t-1}	0.121	0.069
	(0.106)	(0.088)
LR z	0.929***	0.720***
	(0.215)	()
R^2	0.727	
Adjusted R^2	0.705	
Schwarz Criterion	-4.022	
Hansen J-statistic		366.263
Hansen J-statistic p-value		0.101
N	54	54

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$ Standard errors in parentheses

estimate and 0.7 in the GMM results. Although the lag of z is not statistically significant, its inclusion was found to be necessary to correct for the serial correlation in the residuals that appeared when it was omitted. All long-run coefficients (elasticities) are significant at the 1% level in both export equations.

In the import demand function, the domestic income effect is large and significant with a long-run elasticity of about 2.5. The fact that this estimated income elasticity for imports is greater than the one found for exports is consistent with many earlier studies, and is suggestive of a structural competitiveness problem for the U.S. economy (resulting either in a balance of payments constraint on U.S. growth, or the need for continuous real depreciation of the dollar, in the long run), as discussed by Blecker (1996, 1998). For present

Table 7: Estimated Import Demand Functions

Dependent Variable: Δ ln $Imports_t$

Variable	OLS	Systems GMM
Constant	-0.019**	-0.020**
	(0.009)	(0.008)
Δ ln $Imports_{t-1}$	-0.082	-0.131*
	(0.081)	(0.073)
Δ ln GDP_t	2.721***	2.792***
	(0.256)	(0.235)
LR GDP	2.514***	2.469***
	(0.252)	
Δ ln z_t	-0.176*	-0.112
	(0.099)	(0.091)
LR z	-0.163*	-0.112
	(0.091)	
R^2	0.704	
Adjusted R^2	0.687	
Schwarz Criterion	-3.587	
Hansen J-statistic		366.263
Hansen J-statistic p-value		0.101
N	54	54

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$ Standard errors in parentheses

purposes, however, the negative effect of U.S. labor cost competitiveness z on imports is more important, since—along with the positive effect of z on exports found above—it implies an overall positive impact of z on net exports. However, the z-elasticity of import demand is small and insignificant in the GMM estimates, and only weakly significant (10% level) in the OLS estimates. According to these estimates, then, the impact of U.S. labor cost competitiveness is stronger on exports than on imports, but still positive for net exports overall.

5.3 Marginal effects of distributional shifts

Because the econometric equations are all specified in log differences, the estimated coefficients can be interpreted as elasticities. In order to add up the effects of distributional variables on total private demand, therefore, it is necessary to weight these elasticities appropriately in order to transform them into the corresponding marginal effects, following the method used in previous structural studies such as Onaran and Galanis (2012) and Stockhammer and Wildauer (2016). However, this paper differs from previous studies because it treats the wage share as endogenous, in which case we have to consider exogenous shifts in the underlying determinants of the wage share rather than the wage share itself—and different drivers of changes in the wage share could have different effects on aggregate demand. In this draft, we consider only exogenous changes in labor cost competitiveness (z); future drafts will consider also changes in other determinants of the wage share such as indicators of firms' monopoly power (μ). This distinction is important because, as discussed in the theoretical section earlier, changes in z are likely to generate more profit-led (or less wage-led) outcomes than changes in μ. This means that the present set of estimates is, if anything, biased in favor of finding profit-led demand (or weaker wage-led demand).

As noted earlier, changes in labor cost competitiveness (z) affect private domestic demand (consumption and the two types of investment) indirectly via their impact on the wage share (ψ) or total wage and profit income (W and R). Hence, we start by calculating the marginal effect of an increase in z on ψ:

$$\frac{\partial \psi}{\partial z} = \gamma_{\psi,z} \frac{\psi}{z} \tag{23}$$

where $\gamma_{\psi,z}$ represents the estimated long-run elasticity of the wage share with respect to z from Table 1. Recalling that, in that set of estimates, we had to decompose the z ratio into its numerator (EP_f) and denominator (ULC) to get a good equation fit, we use the estimated long-run elasticity with respect to ULC in order to focus on a change in domestic labor costs rather than a change in foreign prices or the exchange rate.[33] This elasticity is

[33]In a future draft, we will report results for the effects of a dollar devaluation, that is, a rise in EP_f.

multiplied by the sample mean of ψ/z (sample means for all variables and ratios used in these calculations are given in Table A.3 in the Appendix) to convert from an elasticity to a marginal effect. Since ψ is a percentage while the z index was constructed as the ratio of two indexes with arbitrary units, we normalize the ratio ψ/z to have a sample mean of unity, so in effect we assume that the marginal effect equals the elasticity in equation (23): $\partial\psi/\partial z = \gamma_{\psi,z}$. This procedure yields marginal effects of -0.175 for both the OLS and GMM estimates for the full sample period.

The marginal effects of a one percentage point increase in the wage share on the consumption-GDP ratio C/Y are calculated by

$$\frac{\partial(C/Y)}{\partial\psi} = \gamma_{C,W}\frac{C}{W} - \gamma_{C,R}\frac{C}{R} = c_W - c_R \tag{24}$$

where $\gamma_{C,W}$ and $\gamma_{C,R}$ are the estimated long-run elasticities of consumption with respect to total wages and profits, respectively, from Table 3, and c_W and c_R are the marginal propensities to consume out of wages and profits from equation (10) in the theoretical model. Based on the OLS estimates, the two estimated marginal propensities are $c_W = 0.59$ and $c_R = 0.34$, with a difference of 0.26 (rounded separately). Using the GMM estimates, the same propensities are $c_W = 0.63$ and $c_R = 0.31$, with a somewhat larger difference of 0.32.

The marginal effects of a one percentage point increase in the wage share on residential and nonresidential investment, also expressed as ratios to GDP, are calculated by the following expressions:

$$\frac{\partial(I_{res}/Y)}{\partial\psi} = \gamma_{Ires,\psi}\frac{I_{res}}{W} \tag{25}$$

$$\frac{\partial(I_{nr}/Y)}{\partial\psi} = \gamma_{Inr,\psi}\frac{I_{nr}}{W} \tag{26}$$

where $\gamma_{Ires,\psi}$ and $\gamma_{Inr,\psi}$ are the estimated long-run elasticities of residential and nonresidential investment with respect to the wage share from Tables 4 and 5, and the weighting factors I_{res}/W and I_{nr}/W are measured at their sample means. For residential investment, the marginal effects are 0.38 using OLS and 0.55 using GMM. For nonresidential investment, these effects are −0.21 using OLS and −0.16 using GMM. Thus, GMM finds a stronger distributional effect on residential investment but a slightly weaker effect on nonresidential investment, compared to OLS.

In contrast to domestic demand, export and imports are specified here as direct functions of labor cost competitiveness (rather than the wage share, as in many previous studies). The marginal effects of an increase in z on X/Y and M/Y are found using the following equations:

$$\frac{\partial(X/Y)}{\partial z} = \gamma_{X,z}\frac{X/Y}{z} \tag{27}$$

$$\frac{\partial(M/Y)}{\partial z} = \gamma_{M,z}\frac{M/Y}{z} \tag{28}$$

where $\gamma_{X,z}$ and $\gamma_{M,z}$ are the estimated long-run elasticities of exports and imports (respectively) with respect to the z ratio[34] from Tables 6 and 7. X/Y, M/Y, and z are all evaluated at their sample means (z was multiplied by 100 for scaling reasons). Based on these calculations, the marginal effects on exports are 0.05 using OLS and 0.04 using GMM, while the marginal effects on imports are weaker at about −0.01 using either OLS or GMM.

Finally, the marginal effects of an increase in z on private aggregate demand (Y^{PD}), measured in proportion to total GDP (Y, which also includes government spending and

[34] Recall from equations (15) and (16) that these elasticities with respect to z are estimates of the following expressions from the theoretical model: $\gamma_{X,z} = \varepsilon_X/(1+\theta)$ and $\gamma_{M,z} = \varepsilon_M/(1+\theta)$.

inventory accumulation, which we have not modeled here), are added up as follows:

$$\left(\frac{\partial Y^{PD}}{\partial z}\right)\frac{1}{Y} = \left(\frac{\partial(C/Y)}{\partial \psi} + \frac{\partial(I_{res}/Y)}{\partial \psi} + \frac{\partial(I_{nr}/Y)}{\partial \psi}\right)\frac{\partial \psi}{\partial z} + \frac{\partial(X/Y)}{\partial z} - \frac{\partial(M/Y)}{\partial z} \tag{29}$$

The term in the large parentheses on the right-hand side is the sum of the marginal effects of the wage share on consumption and the two types of investment from equations (24)–(26). Applying the chain rule, this sum is multiplied by the marginal effect of z on ψ from equation (23) to obtain the marginal effects of z on C/Y, I_{res}/Y, and I_{nr}/Y. The last two terms on the right-hand side of equation (29) represent the marginal effects of z on net exports, calculated as the difference between the effects on exports and imports from equations (27) and (28), to arrive at the total (or net) marginal effect of changes in ULC on private demand shown in Table 8.

Note that, since a rise in z induces a decrease in the wage share ψ (as shown in the first row of Table 8), negative signs in the other rows indicate wage-led effects while positive signs indicate profit-led effects. The total (net) marginal effect is found to be negative, indicating wage-led demand overall in response to changes in z, in the OLS estimates, and turns out to be even more negative, indicating more strongly wage-led demand, in the GMM estimates. Specifically, the sum of the marginal effects is -0.015 for the OLS estimates and -0.077 in the GMM estimates.[35] These results suggest that any bias caused by use of the "single equation" (separate estimation) approach may lead to underestimates of wage-led demand effects, rather than overestimates, as critics of this approach have usually presumed.

[35] Some authors do not include insignificant marginal effects, i.e., ones based on insignificant estimated coefficients (elasticities), in the total or net marginal effect. We did not follow that practice in Table 8 because of our use of GMM, in which all the equations are simultaneously estimated, so it does not seem to make sense to drop individual effects that aren't significant. Nevertheless, if we do omit the insignificant effects (for residential investment in OLS, imports in GMM, and nonresidential investment in both methods), that is, treat those effects as zero, the total (net) effects are 0.016 for the OLS estimates (indicating slightly profit-led demand) and -0.113 for the GMM estimates (indicating wage-led demand). Thus, our qualitative conclusion that the GMM results are more wage-led than the OLS results still holds.

Table 8: Marginal Effects of an Increase in Labor Cost Competitiveness z on Private Demand, Whole Sample Period 1963–2016

	OLS	**GMM**
ψ	−0.175	−0.175
C/Y	−0.045	−0.056
I_{res}/Y	−0.067	−0.096
I_{nr}/Y	0.036	0.028
M/Y	−0.011	−0.008
X/Y	0.050	0.038
Domestic	−0.076	−0.123
Net exports	0.061	0.046
Total Y^{PD}/Y	−0.015	−0.077

Table 8 also decomposes the marginal effects into the domestic and net export components. Both the OLS and GMM estimates show that private domestic demand ($C+I_{res}+I_{nr}$) is wage-led, while net exports ($X - M$) are profit-led but not by enough to fully offset the wage-led effects of a rise in z on domestic demand. Interestingly, the GMM estimates show that domestic demand is more strongly wage-led, but net exports are less strongly profit-led, compared with the OLS estimates.

It remains to be seen *why* we find that the bias in the OLS estimates is, if anything, toward finding *less* wage-led demand rather than toward finding stronger wage-led effects. Simply in terms of the numbers shown in Table 8, the GMM estimates find greater negative effects of z on household expenditures (consumption and residential investment) and weaker positive effects on nonresidential investment and net exports, compared with the OLS estimates. One possible explanation could be that the dynamic interactions between the components of private aggregate demand—including multiplier and accelerator effects—lead, on net, to stronger wage-led demand effects that are not captured by OLS estimation of individual equations. Therefore, the single equation approach may underestimate the degree of wage-led demand by not fully capturing these dynamic interactions. Or, it may simply be that controlling for both simultaneity (the endogeneity of all the distributional and income variables) and common shocks leads to more wage-led results.

In the end, it is important to take these particular results with considerable caution. In the first place, all such estimates of the total (net) marginal effects are clearly sensitive to many aspects of the specification of a structural model, including not only whether distribution and income variables are treated as exogenous or endogenous, but also the precise specifications of the various underlying functions for consumption, investment, and net exports—and also for the wage share and unit labor costs, if these are endogenized. Second, these estimates have been made only for exogenous shifts in labor cost competitiveness; effects of other causes of distributional shifts, such as a rise in monopoly power of firms, are likely to differ (and could be even more wage-led in nature). And third, although income distribution clearly has important effects on the various components of private aggregate demand, the net effects are relatively small because the effects on those components tend to offset each other. Specifically, the negative effects of greater labor cost competitiveness on household expenditures (consumption plus residential investment) are offset by the positive effects on net exports and, to a lesser extent, nonresidential investment spending, with the exact balance depending on the weights of the different types of demand in the economy. As a result, it is likely that other factors, such as financial instability or monetary policies, may be more important drivers of short-run changes in output in the U.S. economy and other countries (as found, for example, by Stockhammer and Wildauer (2016)).

6 Conclusions

This paper introduces a new method for estimating structural models of demand and distribution. While previous structural studies have drawn criticism for failing to account for simultaneity bias and the systemic dimension of the models, these issues can ameliorated by estimating a structural model as a system of equations using GMM, in which the wage share and other income or output variables are endogenously determined by a set of exogenous or predetermined instruments. In addition to introducing this methodology into the literature, the paper also includes several new features in a structural model, including the disaggregation of fixed investment into its residential and nonresidential components, modeling the wage share as a function of unit labor costs, and re-specifying export and import demand as functions of labor cost competitiveness in line with the underlying theory.

Although critics of the structural approach argue that its typical finding of wage-led, rather than profit-led, demand is driven by bias stemming from its failure to address the endogeneity of the wage share and other variables, or the systemic character of the model (for example, common shocks), no evidence is found to support this hypothesis. On the contrary, the GMM results show that demand is more wage-led than the results for the same set of equations estimated separately by OLS. This suggests that any simultaneity bias or other specification error in the separate estimation of the equations actually leads to findings of *less* wage-led demand—not more, as critics of this approach have suggested. Furthermore, the analysis in this paper also suggests a rethinking of how the relationship between income distribution and aggregate demand (or total output) should be modeled. Once the wage share is endogenized, instead of calculating the effects of exogenous shifts in the wage share itself, we have to analyze the effects of exogenous shifts in the underlying determinants of the wage share such as labor costs or monopoly power. In the preliminary results presented in this paper, the U.S. economy is found to have wage-led demand in response to shocks to labor cost competitiveness (and more strongly so in the GMM estimates), but results could vary for other types of distributional shocks or other countries (or if structural breaks in some of the coefficients are found). Thus, one should be cautious about characterizing the U.S. economy as having uniquely wage-led or profit-led demand, as the results could vary depending on the source of a distributional shift or which time period is considered.

Naturally, the analysis in this paper still has a number of limitations that call for additional research. Given the limited number of observations (54) and large number of parameters (45) that were estimated in the GMM systems model, the Hansen J-test for overidentifying restrictions is only barely satisfied at the 10% level. Experiments showed that this problem is not well addressed by simply adding more instruments (for example, including government spending as an additional instrument did not improve this statistic). Hence, an important direction for future efforts in this research project will be to use simpler models that can allow us to (a) estimate less parameters and (b) extend the sample period. A second limitation is that we have only considered here the effects of a shock to labor cost competitiveness; future work will have to consider shocks to other determinants of distributive shares. A third limitation is that the method of adding up the marginal effects to determine the total or net impact of a distributional shift does not necessarily capture all of the dynamic interactions of the variables, for example, multiplier-accelerator links between output and investment. To address this, it would be necessary to use simulation methods to trace out the dynamic effects of a distributional shock on the whole system of equations over time. Furthermore, the results obtained here (as in previous studies) are clearly sensitive to the particular functional forms assumed for the various components of aggregate demand, so trying alternative specifications for the estimation of consumption, investment, and net exports would be an important sensitivity test. Alternative measures for some of the variables (for example, unit labor costs for nonfinancial corporations only instead of for the whole economy) could also be considered.[36] And of course, the analysis here has been conducted solely for the U.S. economy; similar efforts need to be made for other countries either individually or using panel data.

In spite of these limitations, the present (admittedly preliminary) findings do have some tentative policy implications. The results suggest that redistributing income toward workers via increased real wages (which are in the denominator of our measure of labor cost competitiveness) would have only a modest positive effect in stimulating the U.S. economy, even according to the GMM estimates, but a modest positive effect is better than a negative

[36] Based on some preliminary experiments we have done (not reported here), we expect that using this alternative measure of unit labor costs to construct the z ratio would yield similar results for exports and imports, but using the wage share for that sector might yield stronger distributional effects on nonresidential investment than we have found here using the wage share for the entire economy.

one. In addition, a redistribution of income toward labor would make the economy more equitable by raising the wage share, and would also have important effects on the composition of aggregate demand—mainly by boosting consumption and housing construction, while dampening exports (with smaller effects on business investment and imports). Furthermore, although we have yet to do the calculations, redistributing income toward labor by other means, such as by reducing the monopoly power of firms, could have a more univocally positive impact on U.S. private sector demand, assuming that they would not have the same offsetting impact on net exports as would occur in the case of higher labor costs. Thus, one tentative policy conclusion is the importance of efforts to revive anti-trust enforcement, reduce excessive intellectual property protection, and break up large monopolistic firms, all of which could result in improved macroeconomic performance along with greater distributional equity. Such efforts should go hand-in-hand with efforts to raise wages through more direct means, such as by increasing the minimum wage rate or strengthening labor unions and workers' bargaining rights.

References

Autor, David, David Dorn, Lawrence F. Katz, Christina Patterson, and John Van Reenen (2017, May). "The rise of market power and the macroeconomic implications." Working Paper 23396, National Bureau of Economic Research.

Barbosa-Filho, Nelson H. and Lance Taylor (2006). "Distributive and demand cycles in the US economy—a structuralist Goodwin model." *Metroeconomica* 57(3), 389–411.

Barrales, Jose and Rudiger von Arnim (2017). "Longer run distributive cycles: Wavelet decompositions for the US, 1948-2011." *Review of Keynesian Economics* 5(2), 196–217.

Basu, Susanto (2019). "Are price-cost markups rising in the United States? A discussion of the evidence." *Journal of Economic Perspectives* 33(3), 3–22.

Bhaduri, Amit and Stephen A. Marglin (1990). "Unemployment and the real wage: The economic basis for contesting political ideologies." *Cambridge Journal of Economics* 14(4), 375–393.

Blecker, Robert A. (1989). "International competition, income distribution and economic growth." *Cambridge Journal of Economics* 13(3), 395–412.

Blecker, Robert A. (1996). "The trade deficit and U.S. competitiveness." In Robert A. Blecker, ed., *U.S. Trade Policy and Global Growth: New Directions in the International Economy*, pp. 179–214. Armonk, NY: M.E. Sharpe, Economic Policy Institute Series.

Blecker, Robert A. (1998). "International competition, relative wages, and the balance-of-payments constraint." *Journal of Post Keynesian Economics* 20(4), 495–526.

Blecker, Robert A. (1999). "Kaleckian macro models for open economies." In Johan Deprez and John T. Harvey, eds., *Foundations of International Economics: Post Keynesian Perspectives*, pp. 116–149. London and New York: Routledge.

Blecker, Robert A. (2002). "Demand, distribution, and growth in neo-Kaleckian macro models." In Mark Setterfield, ed., *The Economics of Demand-Led Growth: Challenging the Supply-Side Vision of the Long Run*, pp. 129–152. Cheltenham: Edward Elgar.

Blecker, Robert A. (2011). "Open economy models of growth and distribution." In Eckhard Hein and Engelbert Stockhammer, eds., *A Modern Guide to Keynesian Macroeconomics and Economic Policies*, pp. 215–239. Cheltenham, UK, and Northampton, MA, USA: Edward Elgar.

Blecker, Robert A. (2016a). "The US economy since the crisis: slow recovery and secular stagnation." *European Journal of Economics and Economic Policies: Intervention* 13(2), 203–214.

Blecker, Robert A. (2016b). “Wage-led versus profit-led demand regimes: The long and the short of it.” *Review of Keynesian Economics* 4(4), 373–390.

Blecker, Robert A. and Mark Setterfield (2019). *Heterodox Macroeconomics: Models of Demand, Distribution and Growth*. Cheltenham, UK: Edward Elgar.

Bowles, Samuel and Robert Boyer (1995). “Wages, aggregate demand, and employment in an open economy: An empirical investigation.” In Gerald Epstein and Herbert Gintis, eds., *Macroeconomic Policy After the Conservative Era*, pp. 143–171. Cambridge, UK: Cambridge University Press.

Carvalho, Laura and Armon Rezai (2016). “Personal income inequality and aggregate demand.” *Cambridge Journal of Economics* 40(2), 491–505.

Cauvel, Michael (2018). *Three Essays on the Empirical Estimation of Wage-Led and Profit-Led Demand Regimes*. Unpublished Ph.D. dissertation, American University, Washington, DC.

Cauvel, Michael (2019). “The neo-goodwinian model reconsidered.” Technical Report PKES Working Paper 1915, Post-Keynesian Economic Society.

Charpe, Matthieu, Slim Bridji, and Peter McAdam (2019). “Labor share and growth in the long run.” Working Paper 2251, European Central Bank.

Cynamon, Barry Z. and Steven M. Fazzari (2017). “Secular demand stagnation in the 21st century U.S. economy.” Paper Presented at INET Secular Stagnation Conference, December.

Darvas, Zsolt (2012). “Real effective exchange rates for 178 countries: a new database.” Working Paper 2012/06, Bruegel. http://bruegel.org/2012/03/real-effective-exchange-rates-for-178-countries-a-new-database/.

De Loecker, Jan, Jan Eeckhout, and Gabriel Unger (2018). “The rise of market power and the macroeconomic implications.” Working paper, KU Leuven, November.

Dutt, Amitava Krishna (1984). “Stagnation, income distribution and monopoly power.” *Cambridge Journal of Economics* 8(1), 25–40.

Elsby, Michael W. L., Bart Hobijn, and Ayşegül Şahin (2013). “The decline of the U.S. labor share.” *Brookings Papers on Economic Activity* 2013(Fall), 1–52.

Fernandez, Juan V. (2005). *Income Distribution and Aggregate Demand in the U.S. Economy: An Empirical Investigation*. Unpublished Ph.D. dissertation, American University, Washington, D.C.

Furceri, Davide and Prakash Loungani (2018). “The distributional effects of capital account liberalization.” *Journal of Development Economics* 130(January), 127–144.

Gordon, David M. (1995). "Growth, distribution, and the rules of the game: Social structuralist macro foundations for a democratic economic policy." In Gerald Epstein and Herbert Gintis, eds., *Macroeconomic Policy After the Conservative Era*, pp. 335–383. Cambridge, UK: Cambridge University Press.

Greene, William H. (2011). *Econometric Analysis* (7 ed.). Boston: Pearson.

Hein, Eckhard (2014). *Distribution and Growth After Keynes*. Cheltenham, UK: Edward Elgar.

Hein, Eckhard and Lena Vogel (2008). "Distribution and growth reconsidered: Empirical results for six OECD countries." *Cambridge Journal of Economics* 32(3), 479–511.

Jayadev, Arjun (2007). "Capital account openness and the labour share of income." *Cambridge Journal of Economics* 31(3), 423–443.

Kalecki, Michal (1954). *Theory of Economic Dynamics*. London: Unwin.

Karabarbounis, Loukas and Brent Neiman (2014). "The global decline of the labor share." *Quarterly Journal of Economics* 129(1), 61–103.

Karabarbounis, Loukas and Brent Neiman (2018). "Accounting for factorless income." *NBER Macroeconomics Annual* 33, 167–228.

Kiefer, David and Codrina Rada (2015). "Profit maximising goes global: The race to the bottom." *Cambridge Journal of Economics* 39(5), 1333–1350.

Kohler, Karsten, Alexander Guschanski, and Engelbert Stockhammer (2019). "The impact of financialisation on the wage share: a theoretical clarification and empirical test." *Cambridge Journal of Economics* 43(4), 937–974.

Lavoie, Marc (2014). *Post-Keynesian Economics: New Foundations*. Cheltenham, UK; Northampton, MA: Edward Elgar.

Lavoie, Marc (2017). "The origins and evolution of the debate on wage-led and profit-led regimes." *European Journal of Economics and Economic Policies: Intervention* 14(2), 200–221.

Loretan, Mico (2005). "Indexes of the foreign exchange value of the dollar." Technical report, Federal Reserve Bulletin, Winter.

Marglin, Stephen A. and Amit Bhaduri (1990). "Profit squeeze and Keynesian theory." In Stephen A. Marglin and Juliet B. Schor, eds., *The Golden Age of Capitalism*, pp. 153–186. Oxford, UK: Oxford University Press.

Naastepad, C.W.M. and Servaas Storm (2006). "OECD demand regimes (1960-2000)." *Journal of Post Keynesian Economics* 29(2), 211–246.

Ng, Serena and Pierre Perron (2001). "Lag length selection and the construction of unit root tests with good size and power." *Econometrica* 69(6), 1519–1554.

Nikiforos, Michalis and Duncan K. Foley (2012). "Distribution and capacity utilization: Conceptual issues and empirical evidence." *Metroeconomica* 63(1), 200–229.

Obst, Thomas, Özlem Onaran, and Maria Nikolaidi (2017). "The effect of income distribution and fiscal policy on growth, investment, and budget balance: the case of Europe." Working Paper GPERC 43, Greenwich Political Economy Research Centre.

Onaran, Özlem and Giorgos Galanis (2012). "Is aggregate demand wage-led or profit-led? National and global effects." Working paper, International Labour Organization. http://econpapers.repec.org/paper/iloilowps/994786233402676.htm.

Onaran, Özlem and Thomas Obst (2016). "Wage-led growth in the EU15 member-states: the effects of income distribution on growth, investment, trade balance and inflation." *Cambridge Journal of Economics* 40(6), 1517–1551.

Onaran, Özlem, Engelbert Stockhammer, and Lucas Grafl (2011). "Financialisation, income distribution and aggregate demand in the USA." *Cambridge Journal of Economics* 35(4), 637–661.

Pacitti, Aaron (2015). "Bargaining power, labor market institutions, and the Great Moderation." *Eastern Economic Journal* 41, 160–182.

Pariboni, Riccardo and Pasquale Tridico (2019). "Labour share decline, financialisation and structural change." *Cambridge Journal of Economics* 43, 1073–1102. Advance access publication June 7, 2019.

Razmi, Arslan (2016). "Growth and distribution in low-income economies: modifying post-keynesian analysis in light of theory and history." *Review of Keynesian Economics* 4(4), 429–449.

Razmi, Arslan (2018). "Does the demand regime matter over the medium run? revisiting distributional issues in a portfolio framework under different exchange rate regimes." *Metroeconomica* 69(4), 708–736.

Ros, Jaime (2016). "Can growth be wage-led in small open developing economies?" *Review of Keynesian Economics* 4(4), 450–457.

Setterfield, Mark and Yun K. Kim (2017). "Household borrowing and the possibility of 'consumption-driven, profit-led growth'." *Review of Keynesian Economics* 5(1), 43–60.

StataCorp (2017). "Stata statistical software: Release 15." Technical report, StataCorp LLC, College Station, TX. https://www.stata.com/manuals13/rgmm.pdf.

Stockhammer, Engelbert (2017a). "Determinants of the wage share: A panel analysis of advanced and developing economies." *British Journal of Industrial Relations* 55(1), 3–33.

Stockhammer, Engelbert (2017b). "Wage-led versus profit-led demand: what have we learned? A Kaleckian-Minskyan view." *Review of Keynesian Economics* 5(1), 25–42.

Stockhammer, Engelbert, Eckhard Hein, and Lucas Grafl (2011). "Globalization and the effects of changes in functional income distribution on aggregate demand in Germany." *International Review of Applied Economics* 25(1), 1–23.

Stockhammer, Engelbert and Jo Michell (2016). "Pseudo-Goodwin cycles in a Minsky model." *Cambridge Journal of Economics* 41(1), 105–125.

Stockhammer, Engelbert, Özlem Onaran, and Stefan Ederer (2009). "Functional income distribution and aggregate demand in the euro area." *Cambridge Journal of Economics* 33(1), 139–159.

Stockhammer, Engelbert, Joel Rabinovich, and Niall Reddy (2018). "Distribution, wealth and demand regimes in historical perspective. USA, UK, France and Germany, 1855-2010." Working Paper 1805, Post-Keynesian Economics Society.

Stockhammer, Engelbert and Robert Stehrer (2011). "Goodwin or Kalecki in demand? Functional income distribution and aggregate demand in the short run." *Review of Radical Political Economics* 43(4), 506–522.

Stockhammer, Engelbert and Rafael Wildauer (2016). "Debt-driven growth? Wealth, distribution and demand in OECD countries." *Cambridge Journal of Economics* 40(6), 1609–1634.

Summers, Lawrence H. (2015). "Demand side secular stagnation." *American Economic Review: Papers and Proceedings* 105(5), 60–65.

Taylor, Lance (1983). *Structuralist Macroeconomics: Applicable Models for the Third World.* New York: Basic Books.

A Appendix: Data sources, instrument list, and sample means

This paper uses annual U.S. data, with a sample period of 1963–2016 for the econometric estimation and earlier values of many variables for lags that are included in the equations or instruments. Data on GDP, consumption, investment, exports, and imports all come from the BEA national income accounts, and all are measured in chained 2009 dollars. Residential and nonresidential investment are based on the BEA's measures of total private, fixed residential and nonresidential investment and are converted to real values with corresponding price indexes. W is measured as total compensation paid to employees, including wages and salaries and supplements to wages and salaries. R is measured as the gross operating surplus, constructed as the sum of net operating surplus and private consumption of fixed capital. Nominal series for both W and R come from the BEA's NIPA accounts and are converted to real series with the GDP deflator. The wage share is constructed by taking the ratio of the nominal labor compensation series to the BEA's nominal GDP series and rescaling it by multiplying by 100.[37] Nominal unit labor costs (ULC) are calculated as the product of the wage share and the domestic price level, the latter of which is measured using the BEA's implicit price deflator for GDP.

Nominal series on household debt, corporate debt, wealth, and net worth come from the Federal Reserve and are converted to percentages of GDP by dividing by nominal GDP. The real exchange rate series comes from the Darvas (2012) database, which has been updated online to include more recent years. Theis measure is preferred over the Federal

[37] Note that the sum of W and R is equal to gross domestic income, which is equivalent to GDP in theory, but not in practice. Therefore, measuring the wage share in this way results in an implicit profit share that is equal to the sum of R and the statistical discrepancy—or the measured difference between gross domestic income and GDP—divided by GDP. Alternative indexes of the labor share and unit labor costs for the non-financial corporate sector and non-farm business sector from BLS were used in some preliminary estimates (not reported here) as sensitivity tests; results were qualitatively similar to those using the labor (wage) share for the total economy so the latter was used in the estimates reported in the paper for greater comparability with previous studies.

Reserve's trade weighted real broad U.S. dollar index, which is more commonly used, because the Fed series begin in 1973 and using it would substantially reduce the sample size. For the years of overlap, the Fed series is highly correlated with the Darvas (2012) series. For example, for the period 1973–2014, the two real exchange rate series have a correlation coefficient of 0.932.[38] Note that this real exchange rate index is a measure of the real value of the U.S. dollar, and hence is a trade-weighted index of P/EP_f (the reciprocal of the real exchange rate as used in our theoretical model). Therefore, the price of foreign goods expressed in U.S. dollars (EP_f) was calculated by dividing the consumer price index for all urban consumers from BLS, used a a measure of the U.S. price level P, by the Darvas (2012) series for the real value of the dollar (P/EP_f). Then, the z ratio was constructed by taking the ratio $z = EP_f/ULC$.

The real long-term interest rate was measured as the difference between the Federal Reserve's 10-year treasury constant maturity rate and inflation expectations, which are measured as average inflation over the previous 10 years. However, this interest rate variable was not significant when included in either of the investment functions, and hence was not included in the estimates reported in the body of this paper. OECD GDP, excluding the U.S., is used as a proxy for foreign income. This variable is calculated by subtracting the OECD's measure of U.S. GDP from its measure of OECD GDP, both of which are measured in 2010 U.S. dollars. Real home prices were measured by deflating the Bank for International Settlements' index of prices for new one family houses by the GDP deflator. However, this variable was not included in the estimates reported in the paper because of data limitations, as using it would have forced us to start the sample period in 1964 thereby losing one observation.

[38] Both real exchange rate series are based on consumer price indexes. However, there are some differences in the methodologies used to construct the two series. The trade weights used for the Fed indexes vary every year, while those used by Darvas (2012) do not vary. The Fed indexes are based on exchange rates with 26 currencies, while the Darvas (2012) series are based on trade among 67 countries (including the U.S.). For more details, refer to Loretan (2005) and Darvas (2012).

The union activity measure comes from BLS and measures the number of strikes beginning in the period that idled 1,000 or more workers. This had more statistical significance in the ULC equation compared to a simple unionization rate (union membership as a percentage of the labor force). The average markup series comes from De Loecker et al. (2018), in which firm-level data are used to calculate markups for each firm, and the average markup is weighted by firms' market shares.[39] Capital intensity, or the capital-labor ratio, is measured by dividing an estimate of the real capital stock at current PPPs, from the Penn World Tables, by the BLS measure of the civilian labor force. The real oil price was measured by taking the U.S. dollar per barrel price of West Texas Intermediate from the IMF[40] and deflating it by the producer price index for all industrial commodities from BLS. The manufacturing employment share is calculated by taking the ratio of total manufacturing employees to all employees in total private industries, with data for both of these series coming from BLS. Inflation expectations reflect the one-year ahead forecast of CPI-U from the Livingston survey, with the data point for each observation reflecting the inflation expectations from the end of the previous year.[41] Data sources and variable definitions are summarized in Table A.1.

[39]Downloaded in the file DLE_markups_fig_v2.csv, which is available on Jan De Loecker's website, https://sites.google.com/site/deloeckerjan/data-and-code.

[40]This oil price measure was obtained from the IMF's Primary Commodity Price System (PCPS) for the years 1990–2018 and for earlier years from older editions of the IMF's International Financial Statistics. The two series were completely consistent for the years of overlap.

[41]Following the methodology used by Pacitti (2015), adjustments were made because of the fact that observations prior to 1993 reflected 14-month ahead forecasts, rather than 12-month ahead forecasts. The authors would like to thank Aaron Pacitti for sharing his data and answering questions about his methodology.

Table A.1: Variable Definitions and Data Sources

Variable	Definition	Units	Source
Real GDP	Real Gross Domestic Product	Billions of 2009 chained U.S. dollars	BEA*
Consumption	Real personal consumption expenditures	Billions of 2009 chained U.S. dollars	BEA*
Residential investment	Private, fixed residential investment, deflated by price index for private, fixed residential investment	Billions of 2009 U.S. dollars	NIPA tables 5.3.4 and 5.3.5, line 20, authors' calculations
Nonresidential investment	Private, fixed nonresidential investment, deflated by price index for private, fixed nonresidential investment	Billions of 2009 U.S. dollars	NIPA tables 5.3.4 and 5.3.5, line 2, authors' calculations
Investment	Real gross private domestic investment	Billions of 2009 chained U.S. dollars	BEA*
Exports	Real exports of goods and services	Billions of 2009 chained U.S. dollars	BEA*
Imports	Real imports of goods and services	Billions of 2009 chained U.S. dollars	BEA*
Real exchange rate	Real effective exchange rate index (narrow-based)	Index, 2007=100	Darvas (2012), updated online
Real interest rate	10-year constant maturity rate - average inflation (percentage change in CPI) over previous ten years	Percentage	Fed*, BLS, authors' calculations
Corporate debt	Total liabilities and equity of nonfinancial corporate business as a percentage of nominal GDP	Percentage*100	Fed*, authors' calculations
			Continued on next page

Table A.1 – continued from previous page

Variable	Definition	Units	Source
Household debt	Total liabilities of households and nonprofit organizations as a percentage of nominal GDP	Percentage*100	Fed*, authors' calculations
Net worth	Net worth of households and nonprofit organizations as a percentage of nominal GDP	Percentage*100	Fed*, authors' calculations
Nominal GDP	Gross Domestic Product	Billions of Dollars	BEA*
Wages	Wages and salaries plus supplements to wages and salaries, paid, converted to real values using the GDP deflator	Billions of 2009 U.S. dollars	BEA NIPA Table 1.10, line 2
Wage share	100*wages / nominal GDP	Percentage*100	BEA, authors' calculations
Profits	Gross operating surplus; net operating surplus + private consumption of fixed capital, converted to real values using GDP deflator	Billions of 2009 U.S. dollars	NIPA table 1.10, lines 9 and 22, authors' calculations
Domestic price level	Implicit price deflator for Gross Domestic Product	Index, 2009=100	BEA NIPA 1.1.4, line 1
Nominal unit labor costs	Wage share * domestic price level	Index	BEA, authors' calculations
Foreign income	OECD GDP - U.S. GDP (volume estimates, fixed PPPs), OECD's average of quarterly series	Millions of 2010 U.S. dollars	BEA, authors' calculations
Markup	Average markup, weighted by market share of sales	Percentage	De Loecker et al. (2018)

Continued on next page

Table A.1 – continued from previous page

Variable	Definition	Units	Source
Capital Intensity	(1,000,000*Capital stock at current PPPs) / (1,000*annual average of civilian labor force)	2011 U.S. dollars per person	Penn World Tables, BLS*, authors' calculations
Union activity	Number of strikes idling 1,000 or more workers beginning in the current period	Number of strikes	OECD Statistics
Manufacturing share of employment	100*All manufacturing employees / All employees in total private industries	Percentage*100	BLS*, authors' calculations
Inflation expectations	One-year ahead forecast of inflation rate based on CPI-U from the end of the previous year	Percentage*100	Livingston Survey from Federal Reserve Bank of Philadelphia
Home prices	Residential property price index for new one-family houses, annual average of quarterly series, deflated with GDP deflator	Index, 2005=100 (new scale after deflating)	Bank for International Settlements, authors' calculations
Real oil price	Price of West Texas Intermediate in U.S. dollars per barrel from IMF deflated by U.S. producer price index for all industrial commodities from BLS	1982 dollars per barrel	IMF, BLS, authors' calculations

Continued on next page

Table A.1 – continued from previous page

Variable	Definition	Units	Source
Foreign prices in U.S. dollars (EP_f)	Consumer price index for all urban consumers from BLS divided by real exchange rate index	Index, 2012 = 100	BLS, Darvas (2012) and online updates, authors' calculations
Labor cost competitive-ness ratio (z)	Ratio of foreign prices in U.S. dollars to unit labor costs, $z = EP_f/ULC$	Decimal	Authors' calculations

* indicates series downloaded from the Federal Reserve Bank of St. Louis FRED Database

Table A.2: Instrument Specification for All Equations

Variable	**Lags**
Δ *ln consumption*	1-4
Δ *ln wages*	1-4
Δ *ln profits*	1-4
Δ *ln GDP*	1-4
Δ *ln household debt*	0-4
Δ *ln residential investment*	1-4
Δ *ln wage share*	1-4
Δ *ln net worth*	0-4
Δ *ln nonresidential investment*	1-4
Δ *ln manufacturing share*	0-4
Δ *ln corporate debt*	0-4
Δ *ln imports*	1-4
Δ *ln z*	1-2
Δ *ln exports*	1-4
Δ *ln foreign income*	0-1
Δ *ln ULC*	1-4
Δ *ln* EP_f	0-2
Δ *ln real oil price*	0-2
Δ *ln capital intensity*	0-4
Δ *ln capital intensity* $*$ Δ *ln markup*	0
Δ *ln markup*	0-4
Inflation expectations	0-4
Δ *ln real exchange rate*	0-2
Δ *ln union activity*	0-4
1986 *dummy*	0
Before 1984 *dummy*	0

Note: The statistical software drops some of the instruments from estimation to prevent collinearity.

Table A.3: Sample Means Used to Calculate Marginal Effects

Series	**1963–2016**
C/Y	0.640
C/W	1.156
C/R	1.888
I_{res}/W	0.094
I_{nr}/W	0.198
X/Y	0.075
M/Y	0.095
ψ	55.480
ψ/z	1.000
$100 \times z$	1.397