A Work Project, presented as part of the requirements for the Award of a Master's degree in Economics from the Nova School of Business and Economics

The General Theory of Employment at 86: Some Empirical Evidence

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32268

Work project carried out under the supervision of:

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December 17, 2021

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Abstract:

In this paper we develop an empirically testable version of the General Theory of Employment. We model it using a simultaneous system of equations, and estimate this system with three-stage least-squares (3SLS). Our results indicate that present income is the main driver of consumption, the transaction motive dominates in the liquidity preference, the major determinant of investment is the state of long-term expectations, and employment is principally pushed by private investment spending.

JEL Classification: E00; E24; D80; E22

Keywords: Macroeconomics, Employment, Uncertainty, Investment

*I am grateful for the supportive guidance from Professor Paulo Rodrigues. I would like to thank Tiago Bernardino, João Quelhas, Diogo Costa, João Santos, Francisco Campos, Maria Beatriz Miranda, Cristiano Marques, Helena Santos, and Ana Rasinhas for the innumerable and invaluable discussions, debates, comments, suggestions, and patience in general. I also wish to mention Sofia Faria, Ricardo Queirós, and Rodolfo Sanches for the unconditional encouragement, and all my friends from Nova and from Porto for the years of priceless friendship. The unparalleled support of my parents, my grandparents, my godmother, my uncle, my other aunts & uncles has been indispensable every step of the way. Last, but not least, I want to thank Joana Carolina for always being there for me.

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"The difficulty lies, not in the new ideas, but in escaping from the old ones, which ramify, for those brought up as most of us have been, into every corner of our minds." (Keynes, 1973b, p.xvii)

1 Introduction

In 1936, John Maynard Keynes published *The General Theory of Employment, Interest, and Money*. This book revolutionized economic theory, pioneering the study of the macro-economy, and introducing radically new concepts, such as the *investment multiplier*, the *liquidity preference*, or the *principle of effective demand*, to explain the volume of employment for the economy as a whole. The purpose of the present work, 86 years later, is not only to lay-out of what we perceive to be the core theoretical model presented in the General Theory, without disregarding the tenants upon which it rests, in a form that is empirically testable, but also to then attempt to carry out this practical analysis, employing as much rigour as one can manage.[1] In this paper we make use of two main sources: Keynes (1973b, 1937b).

Our research objective is then to evaluate empirically the principal arguments of the General Theory. We will abstain from any policy discussions. From a purely theoretical standpoint, we find that employment is determined at the point of effective demand, that is, where aggregate supply equals aggregate demand. Hence, employment is explained by the aggregate market for commodities, and not the aggregate labour market. Changes to the conditions in the former are expected to make employment fluctuate, meaning that employment cycles are driven by fluctuations in the determinants of the output market equilibrium. The most prominent are the cyclical changes in private investment, mostly coming from entrepreneurs' forecasts about future performance, uncertain by nature, depending disproportionately on the present context, but also on conventions and group psychology.

Our econometric framework will consist in treating the General Theory of Employment as a

[1] The accusation that we are merely bastardizing the work of a long deceased economist is to be expected, and can certainly have some substance and semblance of validity to itself. However, we contend that our efforts carry no more of such vice than previous constructions that purport to carry forward the content of Keynes (1973b).

system of simultaneous equations, and estimate it using three-stage least-squares. The results we obtained appear to indicate that our theoretical model finds some support in the quarterly data for the United States between 1960 and 2019, namely that: investment is the main driver of employment, and it mostly depends on agents' expectations.

The rest of this paper is then organized in the following manner: Section 2 outlines the fundamental theoretical relationships of Keynes' macro-economic model, and reviews some of the literature for other explanations of employment/unemployment; Section 3 presents the econometric modelling of the entire General Theory system; Section 4 concludes. The reader can find the meaning of all symbols used in Appendix 1 - Notation. The rest of the Appendix includes theoretical derivations, data sources, figures, statistical tests, and details about the construction of certain data series.

2 Theoretical Foundations

2.1 The General Theory of Employment

The general framework that guides us is the following: our monetary economy is composed of two distinct sectors, each producing one type of goods that we consider as fundamentally different in nature. Our system is closed to international trade, our time scope is the Marshallian short-period[2], where the physical stock of equipment is fixed, and the state of the technique (i.e. the technology used in the production process) and agents' preferences are given. This means that supply can be expanded up to the maximum capacity of the fixed equipment stock. There is a credit sector financing consumption and investment, a central bank providing liquidity to commercial banks, and the public sector is assumed to not intervene in the economic system.

In a *monetary economy*, by contrast with a *real-exchange* one, money has three functions: medium of exchange; unit of account; store of value. The latter has a disproportionate importance,

[2]C.f. Marshall (1920) pages 274-275 & chapter 5 of book V, and Whitaker (1982).

creating a preference for liquidity, as money does not pay interest, but is the direct means for any transaction, without the need for the intermediation of a market (Keynes, 1937b; Dillard, 1948, chap.1). Furthermore, money affects directly the choices made by economic agents, creating a form of indirect exchange, where we have a time-lapse between actions (Chick, 1984, p.5).

The first sector of our simplified model is the one for *consumption goods*. These are characterized by the fact that they bring no monetary return over time, only the utility derived from their consumption. It stems directly from this that these are not affected by uncertainty, only risk.[3] The second sector is concerned with the production of *investment goods*. These commodities are purchased precisely because of the monetary returns they provide during their life-span. These yields, however, must be estimated by the entrepreneur when he or she decides to order this type of output, and these predictions are uncertain by nature. Despite being blind-sighted by uncertainty, agents are propelled to action through conventions and group psychology, which are inexorably prone to violent and unexpected fluctuations when the "general mood" of the agents participating in the economy changes. This is highlighted in both Keynes (1973b) and Keynes (1937b).

Aggregate Output Market

In the market for output as a whole, one finds an *aggregate demand* schedule (*ADF*), and an *aggregate supply* function (*ASF*).[4]

$$Z = \phi(N) = \Pi(N) + wN \textbf{ Aggregate Supply Function} \tag{1}$$

$$D = f(N) = PO^D - U(N) \textbf{ Aggregate Demand Function} \tag{2}$$

The demand for consumption is called the *propensity to consume*, while its investment counterpart is known as the *inducement to invest*. The supply side comes from the standard profit maximization done by firm-owners. Supply and demand are in equilibrium at the point of effective demand, where income and employment are determined. Using the aggregate production function,

[3] See Appendix 2 - Risk and Uncertainty for the distinction between the two.

[4] Their micro-foundations can be found in Appendix 3 - Micro-foundations (Keynes 1973b and Koenig 1980).

one obtains the locus of all points of effective demand: the aggregate supply curve.[5]

$$O = \Psi(N) \textbf{ Aggregate Production Function} \tag{3}$$

$$P = \frac{Z^* + U}{O} \textbf{ Aggregate Supply Curve} \tag{4}$$

The employment function, following chapter 20 of Keynes (1973b), is the main focus of our endeavour, and is simply the inverse of the aggregate supply curve:[6]

$$Z = D \Leftrightarrow \phi(N) = D^E \Leftrightarrow N = \phi^{-1}(D^E) \Leftrightarrow N = F(D^E) \tag{5}$$

The equilibrium volume of employment cannot exceed the full usage of the stock of capital equipment, but nothing guarantees that the resting point attained by the economy will be the one with full employment. In fact, at any point in time, multiple equilibria can be reached, with the one corresponding to the full usage of production capacity being but one among many. This is so because for each state of expectations, we have a specific pair of equations (1) & (2), with a unique point of effective demand, thus giving us a particular equilibrium volume of employment.[7]

Aggregate Labour Market

The labour market is the subject of chapter 2 of Keynes (1973b), where it is synthesized in two fundamental postulates: *real wages equal the marginal productivity of labour*, in equilibrium, such that we are on the labour demand schedule; *real wages equal the marginal disutility of labour*, in equilibrium, such that we are on the labour supply schedule. The acceptance of these propositions implies that the equilibrium in this market, and by extension, the macro-economic equilibrium writ large, is not compatible with involuntary unemployment, for we are necessarily on the supply curve, where no such phenomena is possible, by definition. Thus, by rejecting the second postulate, Keynes allows for macro-economic equilibrium to exist in the presence of involuntary unemployment. In such a situation, the labour market is in disequilibrium, despite the overall economy being in equilibrium, and not on the labour supply schedule, hence, with unemployment of involuntary

[5] C.f. Appendix 4 - Aggregate Supply Curve.

[6] More details about the mathematical properties of the employment function can be found in Appendix 4 - Aggregate Supply Curve.

[7] This is further discussed in Appendix 4 - Aggregate Supply Curve & Appendix 5 - Multiple Equilibria.

nature. This disequilibrium is forced on it by the aggregate market for commodities, and it does not, in any way, arise because of any imperfection of the market for labour. This point is highlighted in Brady (1996).

Determinants of Employment

The determinants of employment are then the catalysts of equations (1) and (2). Since investment commodities are subject to uncertainty, they will fluctuate more than consumption goods. They are then the primary causal factor of employment, and the source of its cyclical behaviour. This is stressed in Smith and Zoega (2008) and in Smith and Zoega (2009). The supply side is not the main focus of our endeavour, and we will only control for it.

$$N_t = F(D_t^E) \Leftrightarrow N_t = F\{D_t = f[C_t = \underset{+}{\chi}(Y_t;\zeta_t); I_t = \underset{+}{\Theta}(MEK_t;i_t)]; \underset{+}{Z_t}; \underset{\pm}{\Gamma_t}\} \tag{6}$$

2.2 Review of the Literature

Grand Synthesis

Hicks (1937) provides the most influential attempt at presenting the content of the General Theory in a mathematical form. The IS-LM model has income and the rate of interest being concurrently determined. Modigliani (1944) expands it to include a labour market. The level of employment is now determined in the latter, giving us a *"(...) classical model in modern dress (...)"* (Minsky, 1975, p.44). The inability of real wages to fall was the cause of unemployment in the classical/neoclassical world, something that Modigliani appears to be oblivious to when he concludes that, given his distinctly "Keynesian" IS-LM, paired with a neoclassical aggregate labour market, "Keynesian results" are only possible with sticky money-wages.[8] This is a mere triviality, however, for if the neoclassical labour market determines employment, then full employment is necessarily implied, by definition, when the market clears[9], and thus only a disequilibrium, provoked by the real wage being above its market clearing value, can yield involuntary unemployment. Unemployment shifted from an output market phenomenon, back to a labour market concept, caused by

[8] This is discussed in Appendix 6 - The Money-Wage Rate.

[9] Modigliani does acknowledge this though.

market imperfections and rigidities.

NRU & NAIRU

The monetarists proposed the concept of a "Natural Rate of Unemployment" (NRU)[10] to explain employment fluctuations. The NRU is the rate that would prevail in the absence of trade cycles, and thus depends on frictional unemployment, reflecting the time spent searching for a new job, and on structural unemployment, reflecting the plethora of labour supply and labour demand mismatches. The NRU assumes perfect competition, and cannot be influenced by monetary policy, while the cyclical rate can. This further emphasized the role of the labour market. The generalization of the NRU was proposed in Modigliani and Papademos (1975) as the "Non-Accelerating Inflation Rate of Unemployment" (NAIRU). It allows for imperfect markets, and reflects the rate of unemployment below which inflation would start increasing.

Search Unemployment

Diamond (1981) *coined* the concept of search unemployment, which is caused by imperfect information about the labour market, leading workers to find it more attractive when there is unemployment, since with more vacancies, job offerings are better, on average. This results in a non-efficient steady-state, where unemployment benefits will improve the society-wide welfare. More recently, Blanchard and Galí (2010) extended the new-Keynesian model to include a labour market with search and matching unemployment. In their framework, real wage rigidities make productivity shocks expand unemployment. Also, with staggered Calvo-pricing, the central bank has a trade-off between unemployment and inflation, akin to the old Phillips curve.

Efficiency Wages

Shapiro and Stiglitz (1984) argued that involuntary unemployment arises from the failure of wages to decrease. This happens because firms will pay their workers an "efficiency wage", that is, a

[10]This concept was initially presented in Friedman (1968) & Phelps (1968).

wage rate that is above the market equilibrium rate, in order to induce effort. At the market level, all firms are incentivized to do the same, resulting in a new equilibrium with underemployment, where the wage rate is above the full employment level. Hoon and Phelps (1992) expanded the framework by making the micro-economic wage-setting depend on an inter-temporal optimization problem. At the macro-economic level, the volume of employment is affected the most by real interest rate changes, such that the authors derive a rather surprising result: an expansion in consumption demand increases unemployment. There are other explanations for wage rates above the full employment level: in Lindbeck and Snower (1989), entrenched workers keep wages high even after a downturn, making the unemployed unable to get their jobs back; Bean and Dreze (1990) contended that the inability of real wages to fall results from the adjustment downwards of profits, which decreases the capital stock, ultimately increasing the NAIRU.

Labour Market Characteristics

King (1990) presented a labour market with two particular characteristics: spatial separation ("island economy") and markov production shocks. In equilibrium, two types of unemployment emerge - "frictional" and "long-term" - with their distribution depending on the economy's recent history of shocks. Among the parameters affecting the equilibrium position, moving costs have a disparate effect on the two types of unemployment, as they increase long-term, but decrease frictional. This differs from the search theory due to its inclusion of unemployment caused by production contractions, the long-term type, and not just sectorial-change unemployment.

Sticky Wages and the New-Keynesian Framework

Galí et al. (2012) introduced imperfect competition into the labour market, with unions setting nominal wages through Calvo-pricing, such that their market power results in wage markups. Hence, involuntary unemployment arises. In Casares et al. (2014), wage-setting was done through an inter-temporal condition. Capital is not fixed, with labour-capital allocation entering firms' decision-

making process. Endogenous unemployment fluctuations are achieved, and are determined by wage-push disturbances, demand shifts, and monetary policy shocks. Instead of imposing wage-stickiness, Christiano et al. (2016) derived it from the firm-worker negotiation process, yielding search & matching unemployment.

WS-PS Model

The WS-PS model is built on the aggregation of a set of micro-economic models, and describes the aggregate labour market with endogenously rigid real wages. Piluso and Colletis (2021) developed a new version of this framework, incorporating the insights about the fundamental asymmetry between employers and employees found in chapter 2 of Keynes (1973b). "Keynesian" and "Classical" unemployment can both be accounted for, and the full employment position is but one of the many equilibria possible.

Unemployment and Investment

Phelps (1994) made the NRU depend on the level of investment in the capital stock, among other things. In their empirical work, Fitoussi et al. (2000) found that low unemployment coexists with low investment, as was proposed in Keynes (1973b). However, the main determinants of unemployment are the domestic institutions, and not investment.

3 Empirical Estimation

3.1 Notes on the Econometric Methodology

Our theoretical construction has many links between the different markets, warranting its treatment as a system of simultaneous equations.[11] Estimating each of these individually, with OLS, or any other method for single equations, would not only be a great disservice to the theory we are trying to find empirical evidence for, but also violate the underlying assumption of no correlation between the regressors and the error terms. Furthermore, we are interested in the "structural" parameters, eliminating the option of using a reduced form specification. Thus, we are forced to resort to a

[11] A sequential framework, where each market clears in succession, would also be a compelling alternative.

method that is both suited to exploit the inner-connections present in our system, and to correct for endogeneity with instrumental variables. We use the *3-stage least squares* (*3SLS*) approach. The derivation of the 3SLS estimator and its properties can be found in Zellner and Theil (1962), while the description of the estimation method and its assumptions are in Appendix 8 - 3SLS. For non-stationary series, we apply the natural logarithm where necessary, and use first differences. The unit root tests we considered were the regular *augmented Dickey-Fuller* test (ADF), and its *generalized least-squares* (GLS) specification.[12] To correct for possible heteroskedastik errors, we make use of *robust* standard errors, and add lags of the dependant variable where we find serial correlation.[13] Our estimation sample goes from the first quarter of 1960 until the final trimester of 2019. The data sources can be found in Appendix 7 - Data Sources, the time series plots in Appendix 13 - Time Series Plots, and the correlograms in Appendix 14 - Correlograms.

Despite using a system-wide estimation method, the *ceteris paribus* analysis of linear regression coefficients is not entirely adequate to the nature of our theoretical model, even if we will carry it nonetheless. Assuming idiosyncratically that *everything else is equal* does not actually make it so. This is a point raised in (Keynes, 1973b, p.297-298). There are many interrelations between the "exogenous" variables mentioned in the General Theory, that matter for the theoretical inner-workings of the model, but that we have not included, for it was not obvious how to do so, and it would greatly complicate the econometric methodology. These can also be seen as "general equilibrium effects". Hence, we should be tentative about the actual value of the coefficients we estimate, focusing instead on their sign, and thus whether they vary in the direction indicated by the theory, or not. We should take exception to this for the more direct relationships, like the investment multiplier, or the marginal propensity to consume, for example.

[12] C.f. Appendix 15 - Unit Root Tests

[13] The results of the autocorrelation tests are in Table 23.

3.2 Propensity to Consume

The micro-economic consumer in Keynes (1973b) is an inter-temporal utility-maximizer. Keynes was aware, and implicitly accepted both the framework, and the results found in Ramsey (1928). The "subjective factors" presented in chapter 9 of Keynes (1973b) can be thought of as being the determinants of agents' preferences and their utility functions, while the "objective factors", introduced in chapter 8, are what enters the inter-temporal budget constraint. This view is developed in Ferguson (2013b). The aggregation of the different optimization problems would then yield the result that *aggregate consumption* (Figures 7 & 34) is a function of contemporaneous *aggregate income* (Figures 9 & 36):

$$C_t = \chi(Y_t) \tag{7}$$

This relationship is taken to be stable and positive in the short-period, with Keynes' "psychological law" stating that an increase in income will expand consumption, but by a lesser degree: $0 < \frac{dC}{dY} < 1$. It is important to note that this is an aggregate relationship, and the preconization of its stability does not purport to the individual or household levels, only to the economy as a whole. The inability to consider this point made early critics discard "Keynes' law", based on different studies on the consumption patterns of diverse households, see, for example, Gilboy (1939). There were also disparate results found for "long-run" data and in cross-sectional studies. This was a "paradox", indicating a schism between individual and aggregate behaviour. In Bunting (1989) & Bunting (2001), it is argued that this paradox was due to the statistical methods used, and the improper distinction of consumption units between cross-sectional and time series data.

To ensure that our results have some robustness, and side-step the above mentioned issues, we will control for some of the micro-level determinants of consumption, namely: *windfall changes to wealth* (Figures 10 & 37); *income distribution changes* (Figures 11 & 38); *real interest rate on consumption credit* (Figures 13 & 39); *availability of consumer credit* (Figures 15 & 41); *consumer sentiment* (Figures 16 & 42).[14] Hence, we have a "*generalized*" propensity to consume:

[14] A detailed discussion about their significance and relevance can be found in Appendix 9 - Notes on the Propensity to Consume.

$$C_t = \underset{+}{\chi}(\underset{+}{Y_t}; \underset{\pm}{\zeta_t}) \tag{8}$$

Our regression equation is:[15]

$$\begin{aligned} C_t = \beta_1 Y_t + \beta_2 Windfall_t + \beta_3 IncomeDistribution_t + \beta_4 LoanRate_t \\ + \beta_5 CreditConsumerConditions_t + \beta_6 ConsumerSentiment_t + \epsilon_t \end{aligned} \tag{9}$$

Income is clearly endogenous, for it is the summation of consumption and investment. To fix this issue, we use the first difference of the *industrial production index* (Figures 6 & 33) as an instrument.

$$\begin{gathered} Dependant\ Variable: C_t \\ Instruments: IndustrialProduction_t; Windfall_t; IncomeDistribution_t; \\ LoanRate_t; CreditConsumerConditions_t; ConsumerSentiment_t \end{gathered}$$

	Coefficient	Std. Error
Y_t	0.5560***	0.0305
$Windfall_t$	0.1199***	0.0416
$IncomeDistribution_t$	0.1121***	0.0151
$LoanRate_t$	−0.0944***	0.0151
$CreditConditionsConsumer_t$	0.0608***	0.0104
$ConsumerSentiment_t$	0.0008***	0.0002

*** p<0.01, ** p<0.05, * p<0.1

Table 1: Propensity to Consume

As we can see, real aggregate income appears as the most relevant determinant of aggregate consumption, in terms of coefficient magnitude, vindicating the hypothesis put forward in Keynes (1973b). We find a marginal propensity to consume (mpc) of 0.556, which, from a purely theoretical viewpoint, is not unreasonable, as it implies an investment multiplier of 2.252,[16] in accordance with the observations found in chapter 18 of Keynes (1973b): a multiplier exceeding the unit, but not particularly large, ensures the relative stability of the economic system.[17] Within a permanent income hypothesis model, Carroll et al. (2017), mention that mpc estimates in the literature range from 0.2 to 0.6. Despite employing a considerably different theoretical edifice, our results do not appear as radically distant from those found by other authors.

[15] C_t, Y_t & $LoanRate_t$ are in first differences, $IncomeDistribution_t$ & $CreditConditionsConsumer_t$ are in percentage changes.

[16] In the following sub-section we present our estimated multiplier, which is only 0.053 smaller than the one implied by our mcp.

[17] A multiplier considerably larger than the unit (5, for example) results is very small changes to private investment causing large fluctuations to income and employment.

The coefficient of the distribution of income is also positive, but rather small when compared with the marginal propensity to consume. It is in line with Drescher et al. (2020) & Carroll et al. (2017), as they find that depending on the income/wealth level, consumers will behave differently.

The windfall wealth effect exhibits a coefficient of a similar magnitude (0.1199). The earlier empirical estimates provided by Modigliani (1971) had an increase in $1\$$ of wealth only expanding consumption by $5\ cents$. Lettau and Ludvigson (2004) also found small effects, while Case et al. (2011) had rather large estimates, particularly for "housing-wealth". For the Euro Area, Sousa (2010) found almost no "housing-wealth-effects", but significant financial ones.

The variable for credit availability exhibits a small coefficient, but in line with the theoretical discussion, as does the proxy for credit price and discounting of future income.

The consumer sentiment index is highly statistically significant, but has a negligible effect in terms of magnitude, "confirming" our theoretical intuition that consumer goods are not liable to uncertainty. In the literature, one finds support for this view. For example, Dees and Brinca (2013) find some evidence to support the claim that consumer confidence can be a good predictor of consumption patters, in some contexts, even uncovering an "international confidence channel" between the United States and the Euro Area.

The Investment Multiplier

In order to link the two sectors of our economy, we will also estimate the investment multiplier equation. Mathematically, the multiplier is obtained in the following manner:

$$Y = C + I \Leftrightarrow Y = \chi(Y) + I \Leftrightarrow Y = I\frac{1}{1 - \frac{\partial C}{\partial Y}} \Leftrightarrow Y = kI \tag{10}$$

$$Y_t = \beta_1 I_t + \epsilon_t \text{[18]} \tag{11}$$

Since *investment spending* (Figures 8 & 35) is endogenous, we again use the first difference of the *industrial production index* (Figures 6 & 33) as an instrument.[19]

[18] Both variables are in first differences.

[19] Simultaneity coming from the fact that $Y \equiv C + I$.

$Dependant\ Variable : Y_t$
$Instruments : Industrial Production_t$

	Coefficient	Std. Error
I_t	2.1985***	0.0908

*** p<0.01, ** p<0.05, * p<0.1

Table 2: Investment Multiplier

We find a multiplier exceeding the unit, but clearly not very large (2.199). The marginal propensity to consume implied by an investment multiplier of this magnitude would be 0.545, only 0.011 below the one we actually found in our propensity to consume. In contrast, Fisher et al. (2020) estimated multipliers in the range of $1.083 - 1.105$, highlighting the much larger role investment has in our framework.

3.3 Inducement to Invest

In Keynes (1973b), investment demand depends on two distinct components: the marginal efficiency of capital, which is the return on investment, and the rate of interest, measuring both the cost of externally financing such an investment project and the return on lending, the alternative to the purchase of a capital good (Chick (1984) & Crocco (2016)). Hence, we can write:

$$I_t = \Theta(\underset{+}{MEK_t}; \underset{-}{i_t}) \tag{12}$$

As laid out in Keynes (1937b), the decision to invest is contingent upon two sets of expectations, *prospective yields* and *propensity to hoard*, which are liable to frequent fluctuations, and usually not in an offsetting manner. That is so because the conditions that tend to increase the expected returns from investment also tend to decrease hoarding, unambiguously expanding investment, and vice-versa.[20]

Marginal Efficiency of Capital

The discussion about the marginal efficiency of capital (MEK) can be found in chapters 11 and 12 of Keynes (1973b). The MEK is conceptualized as the discount rate that equals the expected

[20]It would be interesting to evaluate whether they are driven by common factors.

returns of the output produced with the newly acquired investment good(s) to the "supply-price" of a capital good, here seen as a "replacement cost", and not a market price (Keynes, 1973b, p.135). As highlighted in Crocco (2016), the MEK is not a marginal productivity schedule, and does not purport to measuring the actual physical output of the capital good. Instead, it is a function linking the present with the future, through the entrepreneurs expectational state, as it measures how much monetary return one is prospected to receive from the goods produced by the investment commodity that one is considering on purchasing. The firm-owner is not interested in the actual productivity of the capital asset, only the *"money"* it can generate in the future, and the two can potential vary independently (Keynes, 1973b, p.213-215).

Mathematically, we have:[21]

$$MEK_t \equiv \frac{E(\Pi_t)}{P_{K,t}} \tag{13}$$

Empirically, we will model the MEK as follows, and introduce its determinants directly into the investment function:

$$MEK_t = \Xi(\underset{+}{Forecasts_t}; \underset{+}{Surprise_t}; \underset{-}{P^I_{K,t}}) \tag{14}$$

The first two variables intend to capture the essence of the stream of expected profits, and are built following Harvey (2021).[22] *Forecasts* give us the direction expected by entrepreneurs of the general state of the economy: if its value is larger than zero, then they believe that the overall mood of the system will improve, if it is zero, then they expect it to maintain its present state, while if it is below zero, general conditions ought to get worse, as per agents' perspectives. *Surprise*, on the other hand, compares the actually realized profits with their forecasts, as a measure of disappointment or fulfilment of expectations. This is relevant because, in an environment characterized by uncertainty, the deviation of results from their prospects can create states of euphoria or panic (Harvey, 2021, p.8). Together, *Forecasts* & *Surprise* (Figures 29 & 55) can be seen as a proxy for the "state of long-term expectations", the main determinant of the nominator in equation (13), discussed in great detail in chapter 12 of Keynes (1973b). As for the denominator in equation (13),

[21] The derivation of this expression is in Appendix 10 - Notes on the Marginal Efficiency of Capital.
[22] This procedure is outlined in Appendix 16 - Prospective Yields (Harvey 2021).

we will use the first difference of the natural logarithm of the four-and-a-half years moving average of the percentage growth in *capital prices* (Figures 21 & 47) in our econometric estimation. This was constructed this way because what matters to entrepreneurs is not the regular variations in the prices of capital commodities, but rather their longer trend, when evaluating investment decisions.[23]

Liquidity Preference

In Keynes (1973b, 1937b), money is seen as a special asset, as it can be used directly to make any payment that is required, unlike the other assets in the economy, which must necessarily be sold first. This becomes particularly important in a monetary economy, where money-contracts dominate, and where uncertainty makes holding cash the safest option to honour commitments, as is emphasized in (Minsky, 1975, p.73-76). Thus, liquidity is simply to have money now, rather than latter, making the interest rate the price for liquidity (Chick, 1984, p.174).[24]

Agents will hold money for the following purposes:[25] *transaction motive*, which can be seen as the "Cambridge equation", or in a generic form, such as $M_1^D = L_1(Y)$; *speculative motive*, in order to profit from investing in interest-bearing assets, making it depend on both the nominal rate of interest, which is the price of financial assets, and the price of capital goods, $M_2^D = L_2(i; P_k)$; *precautionary motive*, which is the propensity to hoard, being related to an agent's uncertainty about the future in terms of its outstanding private financial commitments, $M_3^D = L_3(F)$[26]; *finance motive*, which is the money demanded to finance planned investment projects, and it integrates L_3 through the outstanding financial commitments, as these increase along with investment plans. Hence, our liquidity preference function is:

$$M^D = M_1^D + M_2^D + M_3^D = L_1(Y) + L_2(i; P_k) + L_3(F) = L(Y; i; P_k; F) \tag{15}$$

[23] It is worth noting that neither the first difference nor the percentage growth of capital prices are stationary.

[24] An interesting discussion of the meaning of "*liquidity*" in *liquidity preference* can be found in Culham (2020). In Appendix 11 - Notes on the Liquidity Preference, one can find a discussion about the differences between a *liquidity preference* and a *money demand* schedule.

[25] C.f. Keynes (1973b), chapters 13 & 15, Keynes (1937b), Keynes (1937a), and Minsky (1975), pages 73-76.

[26] In Minsky (1975), it is noted that "near-money" assets also enter the precautionary motive.

The theoretical framework in which we have been operating implicitly assumes that the central bank controls the supply of money, which in conjunction with the liquidity preference determines the rate of interest. However, this is an outdated perspective[27], for modern central banks use *interest rate targetting*, and they actually have power over the rate of interest. Hence, we will instead consider that the central bank sets the policy rate of interest, which then, along with the other relevant variables, determines the liquidity preference. The latter, in conjunction with the policy rate, affects commercial banks' interest rate on investment projects, which is ultimately what enters the investment decisions of firms. This embodies the view that the central bank cannot directly control the rates set by commercial banks, and the idea that the liquidity preference will always offset some of the direct effect of monetary policy. Another alternative that would warrant consideration is having the preference for liquidity set the prices of capital goods, with the rate of interest being given, that is, set by the central bank and/or commercial banks. This is outlined in Minsky (1975).

Empirically, we will model money as the *M1 money supply* (Figures 17 & 43), which includes physical currency, demand deposits, negotiable order withdrawal accounts, travellers' checks, and other types of checkable deposits. This is so because this series is more easily made stationary[28], and because it more closely fits our theoretical concept.[29] The transaction motive is captured with *nominal income*[30] (Figures 23 & 49), and the *velocity of M1* (Figures 24 & 50). The policy rate is the *federal funds rate* (Figures 18 & 44). The speculative motive also includes the *New York stock exchange composite index*[31] (Figures 22 & 48), and the one-and-a-half-years moving average of the percentage growth in the *price of investment commodities*[32] (Figures 20 & 46). Our precautionary motive includes two confidence variables, the *business confidence index* (Figures 26 & 52), and

[27] The author is well aware that imposing such a framework in a sample beginning 30 years before the 1990s is, at best, dubious as an approach, and, at worse, a grave mistake that could render our estimates meaningless. The simplifying assumption we will make is that the direct management of the money supply of the post-war era was asymptotically equivalent to modern monetary policy conduct, in as much as the goal was the same: decrease the rate of interest when the economy is in a downturn, and increase it when it nears full capacity.

[28] *M2* was found to be an I(2) series.

[29] *M1* only considers the most liquid forms of money.

[30] $Y_{nominal} \equiv C_{nominal} + I_{nominal}$

[31] An increase in this index reflects the fact that *"more money"* is being made in the stock market

[32] In this decision environment short term trends are what matters.

business confidence uncertainty[33] (Figures 27 & 53), and the stock of *total nominal credit* (Figures 25 & 51), which also satisfies the finance motive. In order for this variable to be a proxy for outstanding financial commitments, we need to assume that credit gets created at a faster pace than it gets repaid, which may not be true at all times. The liquidity preference regression is:[34]

$$\begin{aligned} M_t^D = \beta_1 FederalFundsRate_t + \beta_2 P_{K,t}^S + \beta_3 NYSEIndex_t + \beta_4 Y_{nominal,t} \\ + \beta_5 M1V_t + \beta_6 Credit_t + \beta_7 BCI_t + \beta_8 Uncertainty_{BCI,t} + \epsilon_t \end{aligned} \tag{16}$$

$$Dependant\ Variable: M_t^D$$
$$Instruments: FederalFundsRate_t; P_{K,t}^S; Y_{nominal,t}; M1V_t; Credit_t; BCI_t; Uncertainty_{BCI,t}$$

	Coefficient	Std. Error
$FederalFundsRate_t$	−0.0045***	0.0011
$P_{K,t}^S$	0.0032**	0.0013
$NYSEIndex_t$	0.0071***	0.0024
$Y_{nominal,t}$	0.8032***	0.0201
$M1V_t$	−0.9753***	0.0139
$Credit_t$	0.1165***	0.0175
BCI_t	−0.0512*	0.0272
$Uncertainty_{BCI,t}$	0.0047***	0.0014

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Liquidity Preference

The federal funds rate has a negative effect on the preference for liquidity, as expected. Its magnitude is much smaller than what we find in the literature, even if different frameworks are used.[35] This can be mostly attributed to our choice of variables for the money supply and the interest rate. The other two variables composing the speculative motive exhibit similarly small coefficients, something that is consistent with the theoretical intuition that agents will not shift their liquidity preference in considerable ways to very modest changes in the *"speculative"* price of capital goods and the stock market index - $1\ unit$ & 1%, respectively, for example.

The elasticity of the preference for liquidity to nominal income is quite high (0.8032), something that is plausible, given that we have a large sample, that captures some long-run dynamics.

[33] This series was constructed using a GARCH(1;1) model, c.f. Appendix 17 - BCI Uncertainty (Grier and Perry 1998).

[34] All variables are the first difference of the natural logarithm, expect for $P_{K,t}^S$, which is only in first difference.

[35] C.f. Hetzel (1984), Mankiw and Summers (1986), Lucas (1988), Stock and Watson (1993), Ball (2001), Bae and De Jong (2007), or Ball (2012), for example.

With nominal money balances as the determined variable and real income per capita as the regressor, Hetzel (1984) found an estimate close to ours (0.88), as do Stock and Watson (1993), using real net national product and the M1 stock, for some of their co-integrating relationships. On the other hand, Mankiw and Summers (1986) estimate elasticities in the range of $0.43 - 1.83$ for the M2 stock, depending on the scalar variable, while Lucas (1988) has the elasticity of real money relative to income very close to one. Ball (2001) and Ball (2012) found smaller coefficients than ours. The velocity of the M1 stock has an estimated coefficient close to unit, highlighting its relevance and magnitude, particularly in the longer run. The elasticity of the credit variable is 0.1165, emphasizing the importance of the finance motive[36], and of outstanding financial commitments. The precautionary motive is complemented by rather small estimates for the business confidence index and business confidence uncertainty.

As a proxy for the rate charged on financing investment purchases, we use the second difference of the *immediate interbank rate of interest* (Figures 28 & 54).[37] The regression equation and its estimates are as follows:[38]

$$i_t = \beta_1 M_t^D + \beta_2 FederalFundsRate_t + \beta_3 i_{t-1} + \beta_4 i_{t-2} + \beta_5 i_{t-3} + \beta_6 i_{t-4} + \epsilon_t \tag{17}$$

$Dependant\ Variable : i_t$
$Instruments : M_t^D; FederalFundsRate_t; i_{t-1}; i_{t-2}; i_{t-3}; i_{t-4}$

	Coefficient	Std. Error
M_t^D	11.7551***	3.4577
$FederalFundsRate_t$	1.9734***	0.3413
i_{t-1}	−0.9295***	0.0508
i_{t-2}	−0.9042***	0.0641
i_{t-3}	−0.4830***	0.0638
i_{t-4}	−0.3546***	0.0492

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Interbank Immediate Rate

[36] Smith (1979) also found the finance motive to be relevant, albeit in a distinct context.

[37] *Investment* reacts to changes in the *interest rate*, such that the first difference of *private investment* is sensible to the second difference of the *interbank rate*. For this to be a valid proxy, one needs to assume that commercial banks change their interbank rates, and their investment loan rates in the same direction.

[38] M_t^D & $FederalFundsRate_t$ are the first differences of the natural logarithm, i_t is the second difference. The lags are used to control for serial correlation.

As we predicted in our theoretical discussion, the interbank rate responds positively to fluctuations in the liquidity preference, and to changes in the federal reserve funds rate. Our intuition that an increase (decrease) in the policy rate will make the rates charged by commercial banks curve upwards (downwards), but that the direct effect is damped by the change to the preference for liquidity schedule was warranted.[39]

Investment Function

The investment function includes the determinants of the MEK, and the rate of interest:[40]

$$I_t = \beta_1 Forecasts_t + \beta_2 Surprise_t + \beta_3 P^I_{K,t} + \beta_4 i_t + \beta_5 I_{t-2} + \epsilon_t \tag{18}$$

$Dependant\ Variable : I_t$
$Instruments : Forecasts_t; Surprise_t; P^I_{K,t}; i_t; I_{t-2}$

	Coefficient	Std. Error
$Forecasts_t$	0.2620***	0.0239
$Surprise_t$	0.1001***	0.0257
$P^I_{K,t}$	−0.3512*	0.1967
i_t	−0.0499***	0.0137
I_{t-2}	0.1424***	0.0467

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Investment Function

As we can see above, the two expectational variables have sizeable coefficients: 0.262 & 0.1001, respectively. This gives credibility to points raised in Keynes (1973b, 1937b), where the role of expectations and confidence is emphasized. Our estimates are larger than the ones found by Harvey (2021), but smaller than those in Heim (2008).[41] The price of capital goods and the rate of interest exhibit negative effects, as expected. Their "small" coefficients are in line with the discussion in (Keynes, 1973b, p.315). Both Fazzari and Mott (1986) and Heim (2008) found a much larger effect for the rate of interest[42], while Harvey (2021) found a smaller one, in addition to a non-significant positive coefficient for the capital price variable.

[39] For example, an increase in the federal funds rate of 1% will have an overall effect on the curvature of the interbank rate of: $0.019734 - 0.000529 = 0.019205 = 1.9205\%$. The direct effect would have been 1.9734%.

[40] I_t is the first difference, $P^I_{K,t}$ is the first difference of the natural logarithm, and i_t is the second difference. We add the second lag of the dependant variable to avoid having serial correlation.

[41] In Harvey (2021), the dependant variable is the rate of change of investment. Heim (2008) measures expectations using the accelerator principle.

[42] "Interest expenses" for Fazzari and Mott (1986).

3.4 The Employment Function

We are now ready to examine the fundamental relationship of our economic model: the employment function. We know from our earlier discussion that employment depends positively on both the aggregate demand function, and the aggregate supply schedule, such that we can write:

$$N_t = F(\underset{+}{D_t}; \underset{+}{Z_t}; \underset{\pm}{\Gamma_t}) \tag{19}$$

The determinants of aggregate demand have already been outlied. We will compute the ASF (Figures 3 & 31) using the following expression, derived in Appendix 4 - Aggregate Supply Curve:[43]

$$Z(N) = \frac{\Psi(N)}{\Psi'(N)} w \tag{20}$$

Instead of using the volume of employment, we opt for the *employment rate* (Figures 2 & 30), as the computed coefficients will have a more straightforward interpretation. Also, we are unable to isolate the employment rate for the private non-exporting sector, which would be the metric consistent with our theoretical model. Hence, we make use of the overall employment rate, taking it as a proxy for its private counterpart.[44] We control for the existence of non-utilized capital stock with the *percentage of production capacity used in the manufacturing sector* (Figures 4 & 32).[45]

We know that both consumption spending and the aggregate supply function are endogenous, due to simultaneity.[46] Thus, in order to avoid any complications due to instrument interactions, and exploiting the fact that we are using a simultaneous system estimator, we will have two regression equations for the employment rate: one for the demand side, and one for the supply side. The instrument chosen for *private consumption* is the percentage change in *consumer credit* (Figures 14 & 40), and the one selected for the *ASF* is the first difference of the natural logarithm of the *industrial production index* (Figures 6 & 33). We include the lag of the dependant variable to

[43] We are ignoring user costs. Output is measured as the *index of total production*, the marginal product of labour as the *hourly output index*, and the wage rate as the *hourly compensation of all employees*. All of these purport to the *business sector* and are deflated with the *implicit gdp deflator*.

[44] For this to be a suitable proxy, we need to assume that the employment rate for the economy as a whole and the employment rate for the private non-exporting sector move in the same direction, something that seems plausible, from an intuitive standpoint.

[45] A high value would indicate that the economy is close to full employment.

[46] $C = \chi(N)$ & $Z = \phi(N)$.

control for autocorrelation. Our regressions are:[47]

$$\begin{cases} N_t = \beta_1 I_t + \beta_2 C_t + \beta_3 N_{t-1} + \epsilon_t \\ N_t = \beta_1 ASF_t + \beta_2 CapacityUtilization_t + \beta_3 N_{t-1} + \epsilon_t \end{cases} \tag{21}$$

Overall, we have an over-identified system, consisting of 7 equations - (16), (17), (18), (11), (9), (21) - and 6 determined variables - M_t^D, i_t, I_t, Y_t, C_t, N_t. Estimating the entire system[48] yields the following results for the employment function.

$Dependant\ Variable : N_t$
$Instruments : I_t; CreditConsumer_t; N_{t-1}$

	Coefficient	Std. Error
I_t	0.2623***	0.0169
C_t	0.0584**	0.0242
N_{t-1}	0.4613***	0.0396

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Employment Function - Demand Side

An increase of private investment in 1 billion real U.S. dollars is predicted to directly stimulate the employment rate by 0.262%, on average, *ceteris paribus*. Kahn (1931), where the idea of a multiplier relationship between investment and employment was first proposed, discussed multipliers in the range of $0.56 - 0.94$. However, these were expansions of employment in the sector for consumption goods driven by an increase in investment spending, thus different from what we are presently looking at. By contrast, a similar increase in consumption expenditure is only estimated to have an impact of 0.058%. This appears to give some validation to the hypothesis that **private investment** is the main driver of employment.

$Dependant\ Variable : N_t$
$Instruments : IndustrialProduction_t; CapacityUtilization_t; N_{t-1}$

	Coefficient	Std. Error
ASF_t	2.9458***	1.0991
$CapacityUtilization_t$	0.0905***	0.0067
N_{t-1}	0.4758***	0.0344

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Employment Function - Supply Side

[47] All variables are in first differences, except for ASF_t, which is the first difference of the natural logarithm.
[48] C.f. Appendix 18 - Complete System.

A 1% expansion of the aggregate supply function is expected to improve the percentage of those employed by 0.0295%, as long as there are no other changes. An increase in the utilization of the available capacity also expands the employment rate. The dynamics that come purely from the supply side appear to matter, but not as much as the main driver of employment in a monetary economy: **private investment demand**.

3.5 Short-comings & Extensions

A prominent weak-link of our estimation procedure is that we have not accounted for the "Lucas critique".[49] While on the one hand we have no direct obligation to do so, for we are disregarding policy discussions, on the other, we can still be accused of estimating *ad-hoc* aggregate relationships, without taking into consideration the micro-economics underlying them.[50]

Forby, disregarding the government and the international sector has probably caused our estimates to exhibit some form of bias. Even if we are only looking at private consumption and investment, there are certainly points of contact with the public sector and the rest-of-the-world that we are not taking into consideration. As expansionary fiscal policies seem to be on the rise again, due to the *Covid-19* pandemic, Keynes' General Theory re-emerges as a relevant tool for policy-makers, and thus the inclusion of fiscal considerations and the international market ought to be a worthwhile endeavour.

There is also no explicit place for inflation neither in our theoretical model, nor in our empirical estimation. Given that it is an important macro-economic phenomenon, it surely affects the variables we are concerned with, in some way or another. This could be solved by combining chapter 21 of Keynes (1973b) with Keynes (1972b), and with "external" sources. That would further allow us to make the inducement to invest depend on the real interest rate, and not the nominal one, with an additional equation connecting the two.

[49] Lucas (1976).

[50] A discussion of the *Lucas critique* can be found in Appendix 12 - Notes on the *Lucas critique* (Lucas 1976).

Another point of possible contention is that our model has no type of dynamics, as we are not accounting for the adjustment towards an equilibrium position, nor the potential shift towards a new one once the former is reached. The only thing we can say is that expectations fluctuate, and that the central bank can change its policy variable. It is thus completely outside of our domain why investment actually creates cycles, even if we can speculate that it is because investment fluctuates that we see cyclical changes in employment.

Furthermore, we have made use of a "long-run" sample, spanning 59 years, to estimate a "short-period" model. Even if the first-differencing has eliminated some of the long-term behaviour, one can never fully escape it with a time series sample this big. Moreover, the fact that we discarded the effects of changes in the capital stock by assuming that it was fixed has certainly had an impact in our coefficients.

It would be interesting to attempt an estimation of the elasticities present in chapters 20 & 21 of Keynes (1973b), employing a framework similar to ours. One would need to estimate other relationships that we did not empirically model for, like the production function, for example, and probably transform all variables into their natural logarithms. Additionally, even though we drew from Minsky (1975), a lot of the aspects of the "minskyan" financial instability hypothesis fell outside of the scope of our present work. It would, however, be a compelling way of further developing this research. Besides, instead of following Harvey (2021), one could attempt to estimate profit expectations using a *Kalman Filter*.

"If the simple basic ideas can become familiar and acceptable, time and experience and the collaboration of a number of minds will discover the best way of expressing them." (Keynes, 1937b, p.212)

4 Conclusion

We have presented an empirically testable version of the theoretical model of Keynes' General Theory, using Keynes (1973b, 1937b) as our main sources, but also expanding the *canon* to "in-

terpreters" and to external "influences". The General Theory of Employment allows for multiple equilibrium positions, among which we find the one corresponding to full employment, thus making it relevant to study a plethora of economic phenomena. Its main conclusion can be summarized in the following simple manner: in a monetary economy, where time is a relevant variable, employment is chiefly determined by agents' expectations & uncertainty about future outcomes (Keynes, 1973b, p. xvi). In this sense, we find ourselves in alignment with the current stream of research that emphasizes the importance of various types of uncertainty in influencing the real economy, such as Bloom (2014), Gieseck and Largent (2016), or Castelnuovo and Pellegrino (2018), for example, despite our "heterodox" approach to the subject matter.

Our empirical exercise appears to provide some validation to the main tenets present in Keynes (1973b). Contemporaneous income appears to be the main driver of current consumption and the investment multiplier exceeds the unit, but is not very large. The preference for liquidity seems to incorporate all the "keynesian" motives, even if the transaction one dominates, in terms of coefficient magnitude, while private investment emerges as mostly liable to fluctuations in the expectational components of the marginal efficiency of capital. Finally, investment demand is estimated to be the main determinant of employment.

Inspired by the quote above, we should move ahead by attempting to further forward the development of these *"simple basic ideas"*. The continued exploration of the rather simplistic framework we employed ought to be like *"fishing in a virgin lake: a whopper at every cast, but so many lovely new specimens that the palate never cloyed"* (Samuelson, 1983). Given the present economic context, a return to full-employment macro-economics, with solid and sound foundations, is as prescient as ever. Hopefully this work can be but one among the many.

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Appendix 1 - Notation

ij: representative firm *i*, operating in market *j*.

w: exogenous and uniform money-wage rate.

n_{ij}: number of workers employed by firm *i*, operating in market *j*.

o_{ij}: output produced by the *i-th* firm operating in the *j-th* market.

p_{ij}: the price of firm *i*'s output in market *j*.

π_{ij}: profits made by firm *i* in market *j*.

u_{ij}: user costs of the *i-th* firm operating in the *j-th* market.

K_{ij}:value of the equipment of firm *i* in market *j* at the end of the production period.

$\bar{K}_{ij}$: value of the equipment of firm *i* in market *j* at the beginning of the production period.

A^I_{ij}:purchases of intermediate investment goods of firm *i* in market *j*.

A^C_{ij}: purchases of intermediate consumption goods of firm *i* in market *j*.

A_{ij}: purchases of intermediate commodities of firm *i* in market *j*.

a_{ij}: appreciation of the equipment of firm *i* in market *j*.

d_{ij}: depreciation of the equipment of firm *i* in market *j*.

D_{ij}: net depreciation of the equipment of firm *i* in market *j*.

K'_{ij}: value of the equipment of firm *i* in market *j*, without production, at the end of the production period.

A'_{ij}: intermediate purchases strictly related with maintenance for the *i-th* firm, in the *j-th* market.

D'_{ij}: net depreciation of the equipment of firm *i* in market *j*, without production.

j: representative market *j*.

u_j: user costs incurred by the production in market *j*.

A^C_j: intermediate purchases of consumption goods in the *j-th* market.

o_j: output produced in market *j*.

p_j: price of market *j*'s production.

m_j: number of firms operating in the *j-th* market.

n_j: volume of employment in market *j*.

c: representative market for consumption goods.

k: representative market for investment goods.

o_c^D: demand for consumption goods in the *c-th* market.

o_c: output produced in market c.

p_c: price of the output produced in market c.

ac: representative agent *a* in market c.

o_{ac}^D: demand of agent *a* in the *c-th* market.

h_c: number of demand agents in the *c-th* market.

y_c: income in market c.

n_c: volume of employment in market c.

n_k: volume of employment in market *k*.

p_k: price of output in the *k-th* market.

o_k: output produced in the *k-th* market.

z_j: supply price in market *j*.

π_j: profits in market *j*.

z_c: supply price in the *c-th* market for consumption goods.

z_k: supply price in the *k-th* market for investment goods.

$r = \{1; 2\}$: sectors in our economy, sector *1* is for consumption, while *2* is for investment.

N_r: aggregate employment in sector *r*.

D_r: aggregate demand in sector *r*.

$P_r O_r^D$: aggregate monetary value of the quantity demanded in sector *r*.

U: aggregate user costs.

Z_r: aggregate supply price in sector *k*.

Π_r: aggregate profits in sector *r*.

O: aggregate output.

$Z = D \Leftrightarrow D^E \Leftrightarrow Z^*$: point of effective demand.

C: aggregate consumption.

I: aggregate investment.

MEK: marginal efficiency of capital.

i: nominal interest rate.

r: real interest rate.

ζ: aggregate consumption controls.

Γ: aggregate employment controls.

k: investment multiplier.

V_0: present value of the stream of expected profits.

$E[\Pi]$: prospective yields.

P_K: price of a unit of capital goods.

P_K^I: price of capital goods used in the investment regression.

P_K^S: price of investment commodities used in the liquidity preference regression.

M^D: money demand.

α: proportion of income kept for transaction motives.

F: outstanding financial commitments.

Appendix 2 - Risk and Uncertainty

Following Samuelson (2004), risk and uncertainty are defined using state-space set theory. We can think of risk as referring to a situation where the economic agent is aware of all possible states in the economy, and is also able to assign the correct probability to them, while under uncertainty, the agent cannot assign probabilities anymore, even if he correctly identifies each state.

One can also employ the framework used in Keynes (1973a): with an uncertain environment, the weight-of-evidence-coefficient is necessarily below the unit, such that we are unable to identify the relevant probability distribution, as there is insufficient information, while under a risky environment, the weight-of-evidence-coefficient is exactly equal to one, and the applicable probability distribution can be known with certainty (Brady, 1996, p.143).

Classical/neoclassical economics, as argued in Keynes (1937b), reduced expectations to computable assertions about the future states of the economy, through the calculus of probabilities. In this framework, we only have risk, and uncertainty is very much similar to certainty. In sharp contrast, Keynes contends that economic agents are in an environment chronically plagued by the dense fog of uncertainty, which is not computable through any scientific method, and are propelled to decision-making by the sheer necessity of action, while still being perfectly aware that their almost complete ignorance of the future blinds them profoundly to the actual consequences of their decisions. Economic agents mitigate this conundrum with the use of 3 "techniques": the present (and the past) is an accurate representation of what will happen in the future; current prices and outputs are correct perspectives about what lies ahead[51]; an individual's own judgment is taken to be worthless, thus, we resort to conventions, the group psychology of agents that make decisions by copying each-other. These foundations are unstable, resulting in the general state of expectations being prone to sudden and violent fluctuations.

[51] This is similar to the "hayekian" conception of prices as vector transmitting information through the economy (Hayek, 1945).

Appendix 3 - Micro-foundations (Keynes 1973b and Koenig 1980)

We begin by building Keynes' General Theory of Employment from the ground-up, looking first at the behaviour of individual entrepreneurs in a given market, then extrapolating to obtain the dynamics of that market as a whole, before aggregating across markets to finally arrive at the macro-economic relationships that we aim to study. In each sector, there is a given number of markets, in which operate a given number of economic agents, that span from whole firms, to consumers and investors. Making decisions for these firms are entrepreneurs, which also play the role of investors when they decide to embark on investment projects with their respective firms.

Unless otherwise stated, we are working with real values in their standard conception, and ignoring Keynes' method of deflating nominal values with the money-wage rate.

The General Theory's theoretical architecture is based on the behaviour of entrepreneurs, and their expectations of production costs and the demand to which they sell. This aspect of Keynes (1973b) is often overlooked, or outright ignored. Our exposition of Keynes' micro-foundations follows closely the one presented in Koenig (1980), with differences in the notation employed.

The Supply Side in an Individual Market

The supply side is identical in both the consumption and capital goods sectors, hence we simplify our notation by excluding this distinction, for the time being. Producing firm i operates in market j, characterized by pure/free competition, in a Marshallian sense[52], and profit optimization. As such, its supply depends on its marginal cost, which is divided into two distinct components in Keynes (1973b): factor costs; user costs.

Since we have placed ourselves in the Marshallian short period, the only factor costs we deal

[52] "Thus we assume that the forces of demand and supply have free play; that there is no close combination among dealers on either side, but each acts for himself, and there is much free competition; that is, buyers generally compete freely with buyers, and sellers compete freely with sellers. But though everyone acts for himself, his knowledge of what others are doing is supposed to be generally sufficient to prevent him from taking a lower or paying a higher price than others are doing." Marshall (1920), page 284.

with are those that originate from the employment of labour units. User costs purport to the cost of using the equipment owned by the company, instead of not doing so. It is an opportunity cost that links the present with the future, as the producer is foregoing future profits by using its equipment in the present. It is worth highlighting that in the General Theory, the term "equipment" refers to the fixed capital stock and the stocks of inventory.

Factor costs are: $$FactorCosts_{ij} = wn_{ij}(o_{ij})$$

To arrive at the user cost formulation, we begin by looking at the sources of changes in the value of the equipment during the production period:

$$K_{ij} \equiv \bar{K}_{ij} + A^I_{ij} + A^C_{ij} + a_{ij} - d_{ij} \Leftrightarrow a_{ij} - d_{ij} \equiv K_{ij} - \bar{K}_{ij} - A^I_{ij} - A^C_{ij}$$

$$\Leftrightarrow D_{ij} \equiv \bar{K}_{ij} + A_{ij} - K_{ij}$$[53]

We isolate the part of net depreciation that does not depend on production in the following manner: $$K'_{ij} \equiv \bar{K}_{ij} + A'_{ij} - D'_{ij} \Leftrightarrow D'_{ij} \equiv \bar{K}_{ij} + A'_{ij} - K'_{ij}$$[54]

Thus, one arrives at the user costs for company *i*, participating in market *j*, by subtracting the net depreciation in the absence of production from the one incurred when production occurs:

$$UserCosts_{ij} \equiv u_{ij} \equiv D_{ij} - D'_{ij} \equiv A_{ij} - K_{ij} - (K'_{ij} - A'_{ij})$$[55]

Summing both components gives us the total cost function:

$$TotalCosts_{ij} \equiv FactorCosts_{ij}(o_{ij}) + UserCosts_{ij}(o_{ij})$$

$$\equiv [wn_{ij}(o_{ij})] + [A_{ij} - K_{ij} - (K'_{ij} - A'_{ij})]$$

Firm *i*'s profit function is composed by its revenues (i.e. the monetary value of the output it expects to sell) and the costs we have just derived: $\pi_{ij} = p_{ij}o_{ij} - wn_{ij}(o_{ij}) - u_{ij}(o_{ij})$. It aims to

[53](Koenig, 1980, p.433)
[54](Koenig, 1980, p.434)
[55](Koenig, 1980, pg.434). This is also the result presented in (Keynes, 1973b, p.53). The differences in notation are the following: our A'_{ij} corresponds to Keynes' B', K'_{ij} to G', K_{ij} to G, and A_{ij} to A_1.

maximize it with respect to the amount of physical output it will produce:[56,57]

$$Max_{\{o_{ij}\}}\pi_{ij} \Leftrightarrow Max_{\{o_{ij}\}}p_{ij}o_{ij} - wn_{ij}(o_{ij}) - u_{ij}(o_{ij})$$

$$F.O.C.: \frac{d\pi_{ij}}{do_{ij}} = 0 \Leftrightarrow p_{ij} = w\frac{dn_{ij}}{do_{ij}} + \frac{du_{ij}}{do_{ij}} \Leftrightarrow MR_{ij} = MC_{ij}$$

$$S.O.C.: \frac{d^2\pi_{ij}}{do_{ij}^2} < 0 \Leftrightarrow -w\frac{d^2n_{ij}}{do_{ij}^2} - \frac{d^2u_{ij}}{do_{ij}^2} < 0$$

These are indeed the usual micro-economic results, with the particularity of the inclusion of user costs. The individual supply function for company *i* will have to be such that the combination $\{p_{ij}o_{ij}\}$ satisfies the optimization condition. Aggregating across individual firms, we obtain the supply function for market *j*:[58]

$$o_j = \sum_{i=1}^{m_j}(o_{ij}(p_j) = o_j(o_j)), where\frac{do_j}{dp_j} > 0$$

Furthermore, if we ignore user costs and re-arrange the equation, we obtain what Keynes called the "first classical postulate": $\frac{w}{p_{ij}} = \frac{do_{ij}}{dn_{ij}}$.[59,60]

The Demand Side in an Individual Market

At this stage, we have derived the supply function of a given market *j*. Be it either in the consumption or investment commodities sector, producers set the combination $\{o_jp_j\}$[61] that satisfies the first order condition of their maximization problem, or, in other words, they choose the monetary revenue that optimizes their economic profits. This is then confronted with the entrepreneurs anticipations of the demand facing their firms to establish the equilibrium position in the market.

[56]The money-wage rate is exogenously determined, and homogenous across markets and sectors in our model. A discussion of the nominal wage's place in the General Theory apparatus is presented in Appendix 6 - The Money-Wage Rate.

[57]The individual firm's production function takes the following form: $o_{ij} = \varphi_{ij}(n_{ij}$, meaning that the relationship between output and the units of labour employed is: $n_{ij} = \varphi^{-1}(o_{ij})$.

[58](Koenig, 1980, p.435)

[59]Keynes' discussion of the classical postulates is found in Chapter 2 of the General Theory.

[60]This formula is rearranged by Minsky to make the price level be equal to the ratio between the money-wage and the marginal productivity of labour, such that in the presence of decreasing returns to labour, the price level must increase when the employment level expands, given the money-wage rate. Minsky (1975), page 40.

[61]Firms choose directly the output level, the price corresponding to it is exogenous to them. However, they think in monetary terms, that is, they care about the revenue generated by the level of output, and not that quantity itself.

Keynes assumes that supply agents do not make mistakes in their anticipations (such that short-run expectations are always fulfilled), thus these will coincide with actual demand.[62]

This is the point where we need to reintroduce the distinction between the two sectors in our economy, for the behaviour of investors is distinctly different from that of consumers in both Keynes (1973b) and Keynes (1937b).

In the *c-th* market for consumption goods, our representative agent has a Marshallian Demand[63], such the quantity he or she demands of consumable commodities depends primarily on income. For the sake of simplicity[64] we exclude profit earners from consumption considerations, such that workers are the only consumers, and that labour is the only source of income. This assumption allows us to make the market demand depend on the volume of employment in market c:

$$o_c^D = \sum_{a=1}^{h_c} o_{ac}^D \Leftrightarrow o_c^D = o_c^D(n_c), \frac{\partial y_c}{\partial n_c} > 0 \Rightarrow \frac{do_c^D}{dn_c} > 0$$

Koenig (1980) goes one step further, and makes the demand in each consumption market depend on the aggregate volume of employment in the economy, using the following assumptions: the markets in the economy are linked in such a manner that an increase in production in market c will induce an overall increase in output (and thus volume of employment as well); when overall production expands (with the respective increase in the volume of employed men and women), the workers in the *c-th* market for consumer spending are able to increase the labour services they sell, such that their income varies in the same direction as aggregate income in the economy. Thus we have:[65]

$$o_c^D = o_c^D(N), \frac{do_c^D}{dN} > 0$$[66]

[62] This is discussed in Appendix 5 - Multiple Equilibria.

[63] We are employing this term in its usual micro-economic use. In Marshall (1920), individual demand is first introduced in chapter 3 of book III.

[64] Income distribution is not a primary concern of the present study, even if it enters our scheme at another stage.

[65] The employment level for the economy as a whole is divided between the sector for consumables, and the sector for investment, in this simple manner: $N = \sum N_r = N_1 + N_2 = \sum n_c + \sum n_k$. This aggregation comes from Keynes (1973b), page 282.

[66] (Koenig, 1980, p.437)

Equilibrium in an Individual Market

The adjustment towards equilibrium in the *c-th* market for consumption goods can be summarized in the following fashion. Producers go through their optimization process such that they decide to supply the combination $\{p_c o_c\}$[67], which maximizes their profits, provided that $o_c^D = o_c$ for p_c. If this is not the case, then they will alter the monetary output they supply, until they find an output level with a price for which $o_c^D = o_c$. The dynamics of the process are also rather straightforward, for if demand exceeds supply, entrepreneurs have an incentive to expand the latter, but if the opposite is true, then they have the strictly inverse urge.[68] This is the adjustment mechanism presented in Keynes (1973b), where stocks vary, instead of windfall profits, which was the adjustment process present in Keynes (1972a). The overall mechanism in the *k-th* market for capital goods is similar to the one we just described, with the difference being on the behaviour of the demand side, which is much more unstable according to Keynes (1973b) and Keynes (1937b).

Aggregate Demand

Having reached this point in our reasoning, we are now able to aggregate across markets in each sector, to obtain the aggregate demand function for consumption and investment commodities.

$$D_1 = \sum p_c o_c^D(N) = P_1 O_1^D(N) = C = \chi(N)^{69}$$

$$D_2 = \sum p_k o_k^D = P_2 O_2^D = I$$

In the analysis we will carry at a later point, we will be in need of the aggregate demand function for output as whole, which can simply be defined as the summation of the consumption and investment functions, net of user costs, to avoid any double counting.

$$D = f(N) = D_1 + D_2 - U(N) = P_1 O_1^D + P_2 O_2^D - U(N) = P O^D - U(N)$$

[67] It is worth noting that this is the monetary value of production, for output is measured in physical quantities.

[68] This requires some qualifications, however: we are assuming that for each value of monetary supply in the *c-th* market for consumption output, there is a corresponding monetary value of supply in both sectors, such that we have a specific aggregate income and aggregate employment level (otherwise, there is no basis to assume that the quantity demanded will change, as we made it depend on the number of labour units employed in the economy as a whole).

[69] (Koenig, 1980, p.443)

Macro-level user costs are obtained by aggregating their micro-economic counterparts, with the subtraction of intermediary consumption spending (which is null in the aggregate, as is pointed out in Millar (1972)):

$$U \equiv \sum_{j=1}^{m_j} u_j - A_j^C$$ [70]

This is indeed Keynes' conception of aggregate demand, as we can see in the following quote from Keynes (1973b): "*(...) let D be the proceeds which entrepreneurs expect to receive from the employment of N men (...)*" (page 25).

Aggregate Supply

Keynes does not believe that one can add heterogenous physical quantities of output. Hence, he switches to the use of units of labour, which are homogenous from the point of view of suppliers. The distinction between sectors is irrelevant for the time being, so we can make use of our generic *j-th* market again. We turn now to the General Theory, where one can find the following quote: "*(. . .) when we are looking at it from the entrepreneur's standpoint, to call the aggregate income (i.e. factor cost plus profit) resulting from a given amount of employment the proceeds of that employment. (. . .) the aggregate supply price of the output of a given amount of employment is the expectation of proceeds which will just make it worth the while of the entrepreneurs to give that employment.*" (Keynes (1973b), (page 24). There's also a footnote in the same page highlighting that this supply price is measured in terms of employment units, and not output units. Thus, we can write the supply price for market *j* as:[71,72,73]

$$z_j = \pi_j + wn_j = o_j p_j - u_j <=> z_j(n_j) = o_j(n_j)p_j(o_j(n_j)) - u_j(o_j(n_j))$$

[70](Koenig, 1980, p.441).

[71](Koenig, 1980, p.440-442).

[72]As we remarked before, output and employment are related through the production function, but now for the market as a whole: $o_j = \varphi(n_j)$.

[73]There's a vast literature discussing Keynes' conception of the supply function. One can find a rather extensive list of this literature in both Heller (2010) and Heller et al. (2011). Koenig (1980) correctly defines Keynes' supply function as the sum of (expected) profits with factor costs. This is also the result obtained by Arthmar and Brady (2009) (the same goes for de Jong (1954), who started the initial back-and-forth, Weintraub (1957), Roberts (1978), Dos Santos Ferreira and Michel (1988), Dos Santos Ferreira and Michel (1991) and Hayes (2007)) when integrating the elasticities presented in the General Theory.

We know that output is an increasing function of employment, and that prices increase with production. Also, from the optimization first order condition, we also know that the price must exceed the first derivative of the user costs. Hence, the supply price will be a positive function of the level of employment: $\frac{dz_j}{dn_j} > 0$.[74]

Since we want to first aggregate across markets within each sector, we will reintroduce their distinction. (Koenig, 1980, p.442) considers that the number of units of labour employed in the *c-th* and *k-th* markets is related with the overall number of units in the entire sector, such that one can write:

$$z_c = G_c(N_1), \frac{dz_c}{dN_1} > 0$$

$$z_k = G_k(N_2), \frac{dz_k}{dN_2} > 0$$

Finally, we simply aggregate as we did before for the demand side:

$$Z_1 = \sum z_c(N_1) = \phi(N_1) = \Pi_1(N_1) + wN_1, \frac{dZ_1}{dN_1} > 0$$

$$Z_2 = \sum z_k(N_2) = \phi(N_2) = \Pi_2(N_2) + wN_2, \frac{dZ_2}{dN_2} > 0$$

$$Z = \phi(N) = Z_1 + Z_2 = (\Pi_1(N_1) + wN_1) + (\Pi_2(N_2) + wN_2) = \Pi(N) + wN, \frac{dZ}{dN} > 0$$

[74](Koenig, 1980, p.442).

Appendix 4 - Aggregate Supply Curve

The ASC is first introduced in (Keynes, 1973b, p.44), and then is explored in depth in chapter 20, albeit in its inverse form. Keynes lays out that the usual supply relationship of relating prices with quantities can still be achieved with his apparatus, and without invoking the aggregation of non-homogenous physical output quantities. Here, it is worth remembering that the General Theory's theoretical pyramid is constructed from the perspective of firms, such that the supply curve will be the locus of all feasible production points, that is, where aggregate demand and aggregate supply meet. Thus, this curve is actually the function describing all effective demand points. It is derived by equalling Z and D:[75]

$$Z = D \Leftrightarrow Z = PO^D - U \Leftrightarrow PO^D = Z + U \Leftrightarrow P = \frac{Z+U}{O^D} \Leftrightarrow P = \frac{Z+U}{O}$$

$$\Leftrightarrow P = \frac{\phi(N) + U(N)}{\Psi(N)}$$

We will find it useful to adopt the notation proposed by Heller et al. (2011), since it conveys the message in a clearer way:[76]

$$P = \frac{Z^* + U}{O} \tag{22}$$

In the footnote present in pages 55 & 56 of Keynes (1973b), it is stated incorrectly stated that the aggregate supply function is linear, with a slope equal to the inverse of the money-wage rate. As noted in Dos Santos Ferreira and Michel (1991) & Heller et al. (2011), this is a slip of the pen, for he is referring to the employment function, and not the aggregate supply function. We will use this space to prove that the point of effective demand is indeed the point where producers maximize their profits, and to present the slope and curvature of the aggregate supply function.

Beginning with the aggregate supply function:

[75] By definition, in equilibrium we must have: $O^D = O$.

[76] Z^* refers to the point of effective demand, and this what we are concerned with in the aggregate supply curve, for it is the locus of all effective demand points. As such, Keynes' notation would induce us into the error of believing that we are dealing with the aggregate supply function as whole in that formula, when we are not, we are looking at the points of intersection between the aggregate demand function and its supply counterpart. We will also use D^E & $Z = D$.

$$Z(N) = \Pi(N) + wN = PO(N) - wN - U(N) + wN = PO(N) - U(N)$$

The *F.O.C.* from the profit maximization ensures that:

$$P = w\frac{dN}{dO} + \frac{dU}{dO}$$

Inserting this into the ASF:[77]

$$Z^*(N) = (w\frac{dN}{dO} + \frac{dU}{dO})O(N) - U(N)$$

Plugging the ASF into our ASC, we get:

$$P = \frac{((w\frac{dN}{dO} + \frac{dU}{dO})O(N) - U(N)) + U(N)}{O(N)} \Leftrightarrow P = w\frac{dN}{dO} + \frac{dU}{dO}$$

This is the first-order-condition for the profit maximization, proving that this principles underlies Keynes' entire theoretical edifice.

The first and second derivatives of the ASF are the following:[78,79]

$$\frac{dZ^*}{dN} = w[1 - \frac{\Psi(N)\Psi''(N)}{(\Psi'(N))^2}]$$

$$\frac{d^2Z^*}{dN^2} = w\frac{2\Psi(N)(\Psi''(N))^2}{(\Psi'(N))^3} - w\frac{\Psi'(N)\Psi''(N) + \Psi(N)\Psi'''(N)}{(\Psi'(N))^2}$$

We will assume that the ASF is linear, with a positive slope. This implies the following for the second and third derivatives of the production function, for all levels of employment:

$$\Psi''(N) < \frac{(\Psi'(N))^2}{\Psi(N)}$$

$$\Psi'''(N) = \Psi''(N)[\frac{2\Psi''(N)}{\Psi'(N)} - \frac{\Psi'(N)}{\Psi(N)}]$$

[77] This specification of the ASF has the "built-in" assumption that we are in equilibrium.
[78] (Heller, 2010, p.889).
[79] The aggregate production function takes the following form: $O = \Psi(N)$.

Appendix 5 - Multiple Equilibria

One of the most important results that a Z-D model of the sorts we have built must yield is the possibility of multiple equilibria. By this we mean that the economy can reach a multitude of "resting points", the one corresponding with full employment being but one among them. It is in this sense that Keynes considers his theory as general, with the classical/neoclassical results only valid in one of the equilibrium positions, corresponding to the full employment of all production factors supplied in the market at the ongoing return rate. Keynes' criticism goes one layer deeper, he does not simply contend that the classical model can only yield a full employment equilibrium, he actually proposes that full employment is an *a priori* assumption, such that without it, the system is undetermined. This is the same criticism that was levied at the theoretical construct presented in Keynes (1972a). Recently, Akerlof (2019) has highlighted the importance of considering the multiplicity of equilibrium positions.

The full employment equilibrium is defined by Keynes as the point for which $\varepsilon_O = 0$, that is, when output supply is perfectly inelastic to effective demand changes. Alternatively, one can think in terms of production possibilities frontier, where full employment implies that we find ourselves at its boundary. In this scenario, we are unable to increase consumption spending without decreasing investment, and vice-versa, for resources are fully allocated. This is where the neoclassical theory comes into play, as it is able to explain the distribution of output between sectors when all resources are applied. However, in any other situation, the output of one of the goods can be expanded without the contraction of the output of the other good, and Keynes argues that the relationship between investment expenditure and consumption spending will actually be positive in the presence of underemployment.[80]

The idea that the models in Keynes (1973b) and Keynes (1937b) can yield underemployment

[80]This line of reasoning is found in Brady (1996).

and full employment equilibria is widely accepted. Its most famous formulation is perhaps the *"Keynesian-cross"*, as depicted in Samuelson (1948), Dillard (1948), and Hansen (1953). These formulations ignore the supply side, and simply make the different levels of national income depend on different levels of aggregate demand, thought of as the summation of consumption spending, exogenous investment expenditure, and government purchases. The state of expectations plays no role. Implicitly, it is assumed that not every level of national income corresponds to a full employment situation. Most discussions of the multiplier effect employ this framework.

Another possibility is to consider that Keynes works with expected prices and expected quantities, such that for each combination of expected proceeds, one has a pair of aggregate demand and aggregate supply functions, resulting in a particular volume of employment. Then, actual spending is distinct from expected proceeds, and follows the dynamics espoused in Keynes (1937b). This would, at least on the surface, be coherent with the verbal discussion in chapter 3 of Keynes (1973b). This is the route taken by Dos Santos Ferreira and Michel (1988), Dos Santos Ferreira and Michel (1991), Brady (1996)[81]. The main problem with this framework, is that, in Keynes (1973b), there is no discussion whatsoever of what happens when actual spending and entrepreneurs' expected proceeds do not coincide. Does the equilibrium position move to the actual spending level, and if so, what is the dynamic of this shift?[82] Furthermore, how are the expectations of firms formed[83], and what is their relation to the behaviour of actual consumers and investors? As is correctly pointed out by Casarosa (1981), at the micro-economic level, one cannot assume that the expected demand function is simply entrepreneur's expectations of actual expenditures, since that

[81]The conception presented in Brady (1996) is peculiar, and worth pondering over for a brief moment. Brady considers that since consumption goods only concern risky behaviour, they correspond to the short-term expectations of firms, while investment goods, on the other hand, correspond to the long-term expectations, as they are uncertain. Thus, it would be the frequent disappointment of long-term expectations that would be responsible for involuntary unemployment, that is, actual investment spending being shy of expected investment proceeds.

[82]There are examples in the literature of such dynamics, see Koenig (1980), or Casarosa (1981).

[83]This point is emphasized in (Chick, 1984, p.64).

would violate the atomicity postulate. It appears then, that it is sensible to accept that Keynes tacitly assumed that firms' estimates of the demand side are correct, and thus that the aggregate demand function would correspond to the actual expenditure patterns of consumers and investors.[84]

Last, but not least, one can also consider that for each money-wage level, there is a pair of aggregate demand and aggregate supply functions, and thus a specific equilibrium volume of employment. Both Koenig (1980), and Chick (1984) explore this approach.

Our first contention then is that for each state of expectations, we will have an equilibrium level of both output and employment, with a particular pair of aggregate demand and aggregate supply functions. It is easy to see why a change in the determinants of investment will shift the demand function, for they are not dependant on employment. As for the supply side, we make use of the fact that it is firms that purchase investment goods, in order to expand their production capacity. It is only logical then that an increase in investment spending would also induce firms to shift upwards their supply curve. Our second contention is that for each money-wage rate, we also encounter a different pair of aggregate demand and aggregate supply schedules, implying thus a particular volume of employment. The supply function depends on the profit maximization condition, which includes the money-wage rate. This relationship is simple, a decrease in the money will depress the supply side. As stressed in Koenig (1980), page 446, the relationship between aggregate demand and nominal wages is not straightforward, but in any case, we will see a shift in the schedule if wages change.

[84]This interpretation is corroborated by a passage in Keynes (1973c): *"I now feel that if I were writing the book again I should begin by setting forth my theory on the assumption that short-period expectations were always fulfilled; and then have a subsequent chapter showing what difference it makes when short-period expectations are disappointed."* (page 181). This assumption is also present in (Chick, 1984, p.67).

Full Employment Equilibrium

The derivations presented in this section follow Heller and Dessotti (2007). The elasticity of supply relative to effective demand is the following:[85]

$$\varepsilon_O = \frac{D_w^E}{O}\frac{\Delta O}{\Delta D_w^E} \Leftrightarrow \frac{D_w^E}{O}\Delta O = \varepsilon_O \Delta D_w^E$$

We know that in equilibrium:

$$P_w O = D_w^E \Leftrightarrow P_w = \frac{D_w^E}{O}$$

Furthermore, changes in effective demand will be spread between output and prices:

$$\Delta D_w^E = \Delta P_w O + \Delta O P_w \Leftrightarrow \Delta D_w^E = \Delta P_w O + \Delta O \frac{D_w^E}{O} \Leftrightarrow \Delta D_w^E = \Delta P_w O + \varepsilon_O \Delta D_w^E$$

$$\Delta D_w^E (1 - \varepsilon_O) = \Delta P_w O \Leftrightarrow \Delta D_w^E = \frac{\Delta P_w O}{1 - \varepsilon_O} \Leftrightarrow \Delta D_w^E = \frac{1}{1 - \varepsilon_O}\Delta \Pi$$

In the full employment equilibrium, when output does not react to changes in effective demand, all variations in the former are absorbed by profit increases, coming from rising prices. This is what Keynes calls "*true inflation*".[86]

Departing again from the point of effective demand, we have that:

$$D_w^E - P_w O = 0$$

Taking the derivative with respect to effective demand, we get:

$$1 - [P_w \frac{dO}{dD_w^E} + O\frac{dP_w}{dD_w^E}] = 0 \Leftrightarrow 1 - P_w \frac{dO}{dD_w^E} - O\frac{dP_w}{dD_w^E} = 0$$

We know that: $P_w = \frac{D_w^E}{O}$ Λ $O = \frac{D_w^E}{P_w}$. Inserting them in the previous expression:

$$1 - \frac{D_w^E}{O}\frac{dO}{dD_w^E} - \frac{D_w^E}{P_w}\frac{dP_w}{dD_w^E} = 0 \Leftrightarrow 1 - \varepsilon_O - \frac{D_w^E}{P_w}\frac{dP_w}{dD_w^E} = 0 \Leftrightarrow 1 - \varepsilon_O = \frac{D_w^E}{P_w}\frac{dP_w}{dD_w^E}$$

Multiplying and dividing the right hand side by $\frac{N}{dN}$:[87]

$$1 - \varepsilon_O = (\frac{D_w^E}{N}\frac{dN}{dD_w^E})(\frac{dP_w}{P_w}\frac{N}{dN}) \Leftrightarrow \frac{1 - \varepsilon_O}{\varepsilon_N} = \frac{dP_w}{dN}\frac{N}{P_w}$$

[85] Here we are using wage-units, which is Keynes' way of measuring real values.

[86] Keynes (1973b), page 303.

[87] $\varepsilon_N = \frac{D_w^E}{N}\frac{dN}{dD_w^E}$

From the FOC of the profit maximization, we know that:

$$P_w = \frac{P}{w} = \frac{1}{\Psi'(N)} \Leftrightarrow \frac{dP_w}{dN} = -\frac{\Psi''(N)}{(\Psi'(N))^2}$$

We arrive then at the following expression:

$$\frac{1-\varepsilon_O}{\varepsilon_N} = -\frac{\Psi''(N)}{(\Psi'(N))^2}\frac{N}{P_w}$$

Hence, when the elasticity of output is perfectly elastic, we have constant returns to scale, but when it is perfectly inelastic, the previous equality is undefined, for the elasticity of employment is also equal to 0.

In Heller (2010), the slope of the employment function is derived as:

$$\frac{dN}{dD_w^E} = \frac{dO}{dD_w^E}\frac{D_w^E}{O} = \varepsilon_O$$

In the presence of constant returns, any change to effective demand will result in equally proportional variations of employment & output, and prices remain constant. This is the setting of the *Keynesian-cross*. When we are at full employment, the employment function is an horizontal line (slope equal to 0), while its inverse, the aggregate supply curve, is vertical (slope undefined).

Graphical Representation

We can plot our *Z-D* model in the $PO, PO^D - N$ space, where the ASC is vertical at the full employment equilibrium, here corresponding to the pair $ASF''' - ADF'''$. As stated in Appendix 4 - Aggregate Supply Curve, we are assuming a linear aggregate supply function. The non-linearity in the aggregate demand function comes from the propensity to consume, that we are taking as concave, for that fits the theoretical discussion in Keynes (1973b). However, we will estimate it as a linear regression, in order to avoid econometric complications.

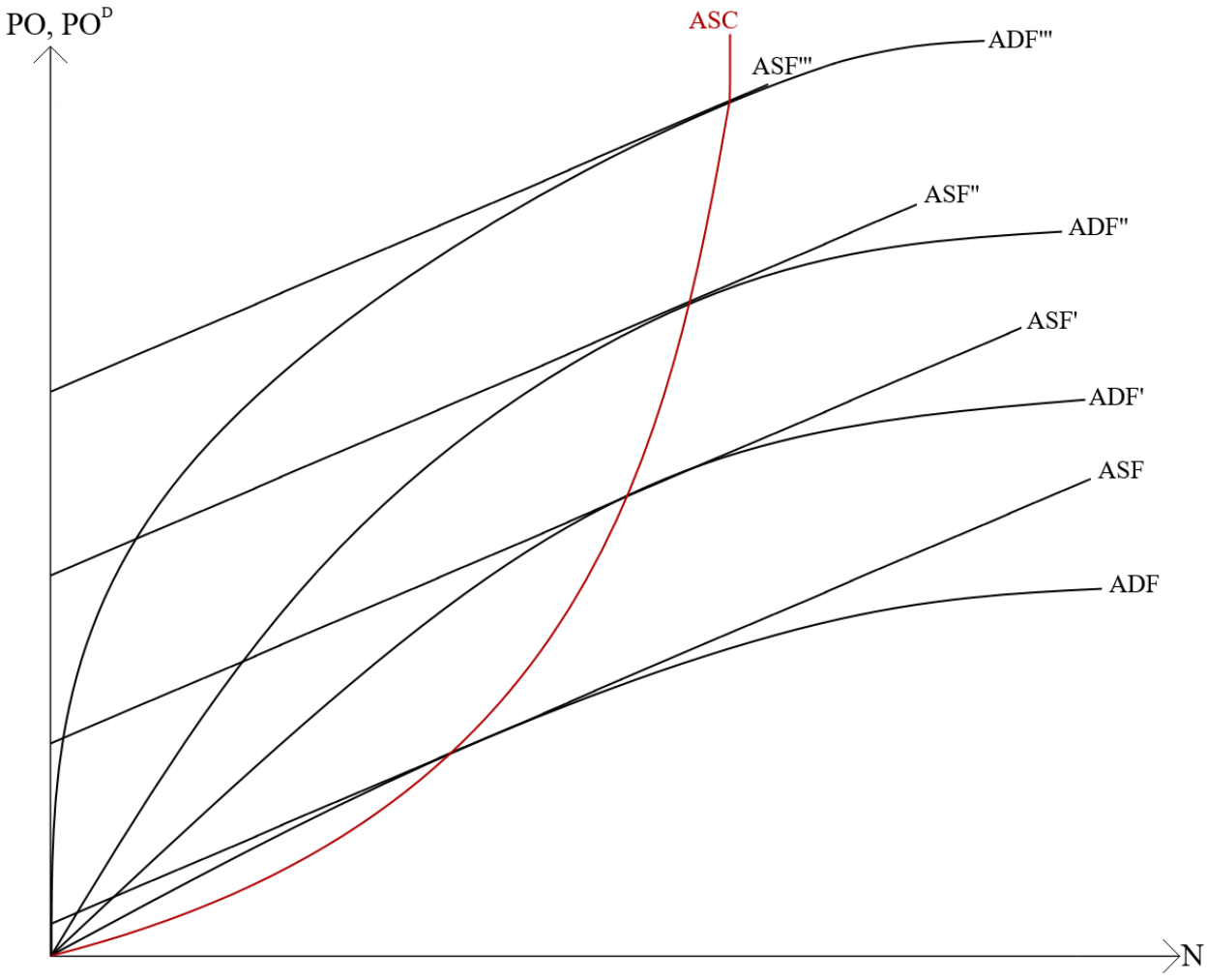


Figure 1: Z-D Model

Appendix 6 - The Money-Wage Rate

The *money-wage rate* is assumed to be fixed for most of Keynes (1973b). This assumption is first introduced in page 27, and is then relaxed in book V. Keynes decides to use the wage rate as his *"deflator"*, in order to avoid complex price-indexes for heterogeneous goods.[88] The wage rate is taken to be homogeneous because, from the point of view of the price-taker producer, workers are perfect substitutes.[89] Thus, employing only labour and wage units will allow for aggregation without any major hurdles. Furthermore, the assumption of fixed money-wages allows Keynes to initially side-step the discussion of inflation, by *"pinning-down"* the system to a given wage rate level. However, the results presented in books I through IV ought not to dependant on nominal wages not varying.

What are then, from a theoretical viewpoint, the effects of a decrease in the money-wage? This is an important question, as it is the usual remedy for unemployment within the neoclassical framework, against which Keynes was setting his own theory. Let us examine two extreme cases: the wage rate decreases, but the price level remains constant, such that real income contracts; nominal wages fall, resulting in an equal decrease in general prices, meaning that income in real terms is unchanged. We will assume that the distribution of income remains static, and that the ASF does not vary, for simplicity's sake.

In the first scenario, we expect the transaction motive to to exert a downward pressure on the liquidity preference. Furthermore, the decrease in real income ought to stimulate the propensity to hoard, for agents are likely to be more uncertain about the future in a downturn. Hence, we are unsure of the ultimate direction the liquidity preference will follow. It could either increase, or decrease, depending on which motive dominates. For the sake of simplicity, we will say that the transaction motive dominates, such that the interest rate drops, but that this change only affects

[88] C.f. Ferguson (2013a).
[89] C.f. (Brady, 1996, p.150).

investment in the following period, as do any fluctuations to the MEK. Since real income decreased, the propensity to consume must follow suit, meaning that, overall, employment contracted in the first period due to the decrease in consumption. In the following period, however, investment will face upward pressure from the rate of interest, and downward pressure from the MEK, as prospective yields are likely to contract, due to the worsening of the economic context. Again, which of the two dominates is unknown. If the interest rate is dominant, then investment increases, also expanding consumption through the multiplier. The volume of employment would increase in the second period, and possibly overall. If the MEK is dominant, which appears to be the view outlined in chapter 19 of Keynes (1973b), then employment further contracts, leading the economy to an even worse situation than it was initially.

In the second scenario, the same considerations apply to the liquidity preference, such that we will again assume that the transaction motive dominates. Since real income remained unchanged, the propensity to consume will not exhibit any fluctuations. Next period, investment is pushed in different directions by the rate of interest and the MEK.[90] If the former dominates, then investment increases, stimulating consumption through the multiplier, thus unambiguously expanding the volume of employment. This is the only scenario where we can make such a claim. If the latter dominates, however, then the initial situation of involuntary unemployment deteriorates even more. Under the framework of the General Theory of Employment, it is not clear what happens when the money-wage falls, much less that it results in a clear positive variation in the volume of employment.

We can also use our empirical model to evaluate this question. Let us assume, in both scenarios, that wages fall by 1%, resulting in an equal decrease in the *BCI*, *forecasts*, *surprise*, and *real/nominal income*, respectively, with *business confidence uncertainty* increasing in the same

[90] We are again considering that investment is not affected contemporaneously, in order to simplify our reasoning.

magnitude. Everything else is taken to be constant. Again, investment is assumed to not respond contemporaneously. Hence, in both scenarios, the liquidity preference, and, consequently, the rate of interest, exhibit the following variations:

$$\Delta M_t^D = -0.8032\% + 0.0512\% + 0.0047\% = -0.007473$$
$$\Delta i_t = -0.0878$$

In the first scenario, the contraction in real income results in the following stimulation of the propensity to consume: $\Delta C_t = -0.00556$

Employment in period t decreases by:

$$\Delta N_t = -0.000325\%$$

The following period, investment reacts in this manner:

$$\Delta I_{t+1} = -0.00262 - 0.001001 + 0.004381 = 0.00076$$

The multiplier stimulates consumption:

$$\Delta C_{t+1} = (0.00076 * 2.1985) * 0.556 = 0.00093$$

Finally, the overall change in the employment rate is:

$$\Delta N_{t+1} = 0.000199 + 0.000054 = 0.00025\%$$
$$\Delta N = 0.00025 - 0.000325 = -0.0000717\%$$

Hence, overall, employment decreases, but not by a relevant margin, such that we can say that in the first scenario, given our assumptions, the change in the money-wage is neutral.

In the second scenario, apart from the variation in the liquidity preference and the rate of interest, nothing else changes in the first period. Once we get to the second one, however, investment, income, and consumption vary in the same magnitude as before. Thus, the overall fluctuation in the employment rate is: $\Delta N = 0.000025\%$

Employment seems to expand, but only slightly, such that we can again consider that the variation in the nominal wage rate is neutral.

We conclude this section by summarizing the main point of chapter 17 of Keynes (1973b), following Lerner (1952): in a monetary economy, wages[91] are sticky due to the liquidity characteristics of money as an asset, making the stability of the entire system depend on the stability of the purchasing power of money. That is, money-wages should not be seen as rigid by assumption, but rather by *"derivation"*, due to the properties of the world we live in.

[91] As well as other prices and costs.

Appendix 7 - Data Sources

All data is quarterly, with the conversion method for non-quarterly data consisting in taking the arithmetical average.

The General Theory of Employment

Employment Level (Q1 1948 - Q4 2019): *The number of individuals employed in the United States, measured in thousands of persons and seasonally adjusted. U.S. Bureau of Labor Statistics, Employment Level [CE16OV], retrieved from FRED, Federal Reserve Bank of St. Louis;* https://fred.stlouisfed.org/series/CE16OV*, October 11, 2021.*

Civilian Labour Force (Q1 1948 - Q4 2019): *The number of individuals aged above 16 actively engaged in the labour force, measured in thousands of persons and seasonally adjusted. U.S. Bureau of Labor Statistics, Civilian Labor Force Level [CLF16OV], retrieved from FRED, Federal Reserve Bank of St. Louis;* https://fred.stlouisfed.org/series/CLF16OV*, November 15, 2021.*

Employment Rate (Q1 1948 - Q4 2019): *Series constructed as the ratio between the employment level and the civilian labour force. Measured as a percentage rate. It will be used as a proxy for the employment rate in the non-exporting private sector.*

Hourly Compensation - Business Sector (Q1 1947 - Q4 2019): *Index of the hourly compensation of all those employed in the business sector, to be used as a proxy for the money-wage rate, and seasonally adjusted. U.S. Bureau of Labor Statistics, Business Sector: Hourly Compensation for All Employed Persons [HCOMPBS], retrieved from FRED, Federal Reserve Bank of St. Louis;* https://fred.stlouisfed.org/series/HCOMPBS*, November 22, 2021.*

Output (Q1 1947 - Q4 2019): *Index measuring the output of all employed in the business sector, to be used as a proxy for the physical quantity of output produced in the economy, and seasonally adjusted. U.S. Bureau of Labor Statistics, Business Sector: Output for All Employed Per-*

sons [OUTBS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/OUTBS, November 23, 2021.

Labour Productivity (Q1 1947 - Q4 2019): *Index measuring the output per hour for all employed in the business sector, to be used as a proxy for the marginal productivity of labour, and seasonally adjusted. U.S. Bureau of Labor Statistics, Business Sector: Labor Productivity (Output per Hour) for All Employed Persons [OPHPBS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/OPHPBS, November 22, 2021.*

Real Aggregate Supply Function (Q1 1947 - Q4 2019): *Series constructed by multiplying the hourly compensation by the ratio of output and labour productivity, deflated with the gross domestic product implicit price deflator.*

Capacity Utilization - Manufacturing (Q1 1948 - Q4 2019): *Percentage of the production capacity used in the manufacturing sector, to be used as a proxy for the capacity of the economy as a whole, and seasonally adjusted. Board of Governors of the Federal Reserve System (US), Capacity Utilization: Manufacturing (SIC) [CAPUTLB00004SQ], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/CAPUTLB00004SQ, November 23, 2021.*

Gross Domestic Product Implicit Price Deflator (Q1 1947 - Q4 2019): *The price deflator of the gross domestic product, using 2012 as the indexed year, and seasonally adjusted. Used to deflate all nominal values. U.S. Bureau of Economic Analysis, Gross Domestic Product: Implicit Price Deflator [GDPDEF], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/GDPDEF, October 22, 2021.*

Real Private Wages (Q1 1947 - Q4 2019): *Amount of the national income paid as wages and salaries, measured as a seasonally adjusted annual rate, in billions of U.S. dollars, and deflated with the gross domestic product implicit price deflator. Retrieved from the Bureau of Economic*

Analysis, National Income by type of Income, https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=2&isuri=1&1921=survey, November 3, 2021.

Real Private Corporate Profits (Q1 1947 - Q4 2019): *Amount of the national income classified as corporate profits, measured as a seasonally adjusted annual rate, in billions of U.S. dollars, with inventory valuation adjustments and capital consumption adjustments and deflated with the gross domestic product implicit price deflator. Retrieved from the Bureau of Economic Analysis, National Income by type of Income, https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=2&isuri=1&1921=survey, November 3, 2021.*

Industrial Production Index (Q1 1947 - Q4 2019): *Measure of the volume of industrial production, indexed on the year of 2017, and seasonally adjusted. Board of Governors of the Federal Reserve System (US), Industrial Production: Total Index [IPB50001SQ], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/IPB50001SQ, October 5, 2021.*

Propensity to Consume

Real Private Personal Consumption Expenditure (Q1 1947 - Q4 2019): *The amount spent by agents on consumption goods, measured as a seasonally adjusted annual rate, in billions of U.S. dollars, and deflated with the gross domestic product implicit price deflator. U.S. Bureau of Economic Analysis, Personal Consumption Expenditures [PCEC], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/PCEC, October 11, 2021.*

Real Gross Domestic Private Investment (Q1 1947 - Q4 2019): *The amount spent on investment goods, measured as a seasonally adjusted annual rate, in billions of U.S. dollars, and deflated with the gross domestic product implicit price deflator. U.S. Bureau of Economic Analysis, Gross Private Domestic Investment [GPDI], retrieved from FRED, Federal Reserve Bank of St. Louis;*

https://fred.stlouisfed.org/series/GPDI, October 11, 2021.

Real Private Income (Q1 1947 - Q4 2019): *Series constructed as the sum of real private personal consumption and real gross domestic private investment. Measured in billions of real U.S. dollars.*

Real U.S. Wealth (Q1 1952 - Q4 2019): *Stock of U.S. wealth for all sectors, measured in billions of dollars, not seasonally adjusted, and deflated with the gross domestic product implicit price deflator. Board of Governors of the Federal Reserve System (US), All Sectors; U.S. Wealth, Level [BOGZ1FL892090005Q], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/BOGZ1FL892090005Q, November 5, 2021.*

Windfall (Q1 1957 - Q4 2019): *Series constructed as the 5-year moving average of the real U.S. wealth quarterly growth. Measured as a percentage rate.*

Income Distribution (Q1 1947 - Q4 2019): *Series constructed as the ratio between real private wages and real private income. Measured as a percentage rate.*

Real Bank Prime Loan Rate (Q1 1949 - Q4 2019): *Average of the rate posted by the top 25 insured chartered commercial banks in the U.S.. It is one of the rates used to price short-term loans. Measured as a percentage rate, and not seasonally adjusted. Deflated using the inflation measure built with the gross domestic product implicit price deflator. Board of Governors of the Federal Reserve System (US), Bank Prime Loan Rate [MPRIME], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MPRIME, October 11, 2021.*

Real Consumer Credit (Q4 1951 - Q4 2019): *Amount of consumer credit provided to households and non-profits, in billions of U.S. dollars, seasonally adjusted, and deflated with the gross domestic product implicit price deflator. Board of Governors of the Federal Reserve System (US), Households and Nonprofit Organizations; Consumer Credit; Liability, Level [HCCSDODNS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/HCCSDODNS, October 11, 2021.*

Consumer Credit Conditions (Q4 1951 - Q4 2019): *Series built as the ratio between the level of real consumer credit and the real private income. Measured as a percentage rate.*

Consumer Sentiment (Q1 1960 - Q4 2019): *Index of consumers' mood. Not seasonally adjusted. Retrieved from the Surveys of Consumers conducted by the University of Michigan, http://www.sca.isr.umich.edu/, November 5, 2021.*

Inducement to Invest

Money Supply (Q1 1959 - Q4 2019): *M1, the measure consisting of the most liquid form of money. Measured in billions of U.S. dollars, and seasonally adjusted. Board of Governors of the Federal Reserve System (US), M1 [M1SL], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/M1SL, November 9, 2021.*

Federal Funds Rate (Q3 1954 - Q4 2019): *Rate at which institutions trade the balances held at the Federal Reserve overnight. It is the central policy rate in the U.S.. Measured as a percentage rate, and not seasonally adjusted. Board of Governors of the Federal Reserve System (US), Federal Funds Effective Rate [FEDFUNDS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/FEDFUNDS, November 2, 2021.*

Producer Price Index - Private Capital Equipment (Q2 1947 - Q4 2019): *Measure of the price of capital goods, indexed on the year of 1982, and seasonally adjusted. U.S. Bureau of Labor Statistics, Producer Price Index by Commodity: Final Demand: Private Capital Equipment [WPSFD41312], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/WPSFD41312, October 5, 2021.*

Capital Price - Stock Market (Q4 1948 - Q4 2019): *Series constructed as the 18-month moving average of the quarterly rate of change in the price of capital goods.*

Capital Price - Investment (Q4 1951 - Q4 2019): *Series constructed as the 18-quarters moving av-*

erage of the rate of change in the price of capital goods.

New York Stock Exchange Composite of Interest Rates and Price Indexes (Q1 1952 - Q4 2019): *Index measuring the activity of the NYSE, in millions of dollars, and not seasonally adjusted. Board of Governors of the Federal Reserve System (US), Interest Rates and Price Indexes; NYSE Composite Index, Level [BOGZ1FL073164003Q], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/BOGZ1FL073164003Q, October 12, 2021.*

Nominal Private Income (Q1 1947 - Q4 2019): *Series built as the sum of nominal private consumption and nominal private investment.*

M1 Velocity (Q1 1959 - Q4 2019): *Velocity of circulation of the M1 money stock, measured as a ratio, and seasonally adjusted. Federal Reserve Bank of St. Louis, Velocity of M1 Money Stock [M1V], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/M1V, November 9, 2021.*

Total Credit (Q1 1947 - Q4 2019): *Total credit provided to the private non financial sector, in billions of U.S. dollars, adjusted for breaks, and not seasonally adjusted. Bank for International Settlements, Total Credit to Private Non-Financial Sector, Adjusted for Breaks, for United States [QUSPAMUSDA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/QUSPAMUSDA, November 8, 2021.*

Business Confidence Index (Q1 1950 - Q4 2019): *Measure of the mood of entrepreneurs and businesses. Retrieved from the OECD database (2021), Business confidence index (BCI) (indicator). doi: 10.1787/3092dc4f-en (Accessed on 11 October 2021).*

BCI Uncertainty (Q2 1953 - Q4 2019): *Series built using a garch model as a measure of the uncertainty in the mood of entrepreneurs and businesses.*

Interbank Rate (Q3 1954 - Q4 2019): *Immediate interbank rate of interest, used as a proxy for*

the interest rate charged investment projects' financing. Measured as a percentage rate, and not seasonally adjusted. Retrieved from Dbnomics, https://db.nomics.world/OECD/MEI/USA.IRSTCI01.ST.Q, on November 10, 2021.

Purchasing Managers' Index (Q1 1948 - Q4 2019): *Index measuring the confidence of purchasing managers, where a value above 50 indicates the belief of a betterment of present conditions, and a value below 50 indicates the opposite. Retrieved from Nasdaq Data, https://data.nasdaq.com/data/ISM/MAN_PMI-pmi-composite-index, November 2, 2021.*

Forecasts (Q1 1948 - Q4 2019): *Series constructed using PMI and corporate profits, following Harvey (2021).*

Surprise (Q2 1948 - Q4 2019): *Series constructed as the difference between forecasts and actual realized profits of the previous period, following Harvey (2021).*

Appendix 8 - 3SLS

Three stage least squares is an estimation method, presented originally in Zellner and Theil (1962), for systems of simultaneous equations. The 3 stages can be summarized as follows: the first computes the standard two-stage least squares coefficients, while the second estimates the residuals making use of the estimated coefficients, in order to determine the existence of correlation across equations, before the final stage employs generalized least squares to re-estimate the parameters, given the information obtained in the second stage. The existence of correlation across equations, materialized in a non-diagonal variance-covariance matrix, where contemporaneous covariances are different from zero for the structural disturbances, confirms that we are indeed in the presence of an interconnected simultaneous system of equations. When this is the case, we gain efficiency by using 3SLS, for it exploits the full information characteristics of our model. If we were not to find a non-diagonal VCV matrix, then the 3SLS estimator would be asymptotically equivalent to its 2-stage counterpart. Apart from stationarity, it requires an homoskedastik error error term, with a zero mean and no serial correlation.

The estimated VCV matrix of correlations above the diagonal for the entire system is:

$$\begin{bmatrix} 0.0000 & (-0.185) & (-0.232) & (0.208) & (0.151) & (-0.094) & (-0.157) \\ -0.0006 & 1.1665 & (0.026) & (-0.125) & (0.042) & (0.333) & (0.220) \\ -0.0003 & 0.0132 & 0.2200 & (-0.578) & (-0.471) & (-0.323) & (0.175) \\ 0.0005 & -0.1048 & -0.2108 & 0.6046 & (0.840) & (0.090) & (-0.130) \\ 0.0001 & 0.0133 & -0.0644 & 0.1907 & 0.0852 & (0.119) & (-0.061) \\ 0.0000 & 0.0745 & -0.0314 & 0.0145 & 0.0072 & 0.0430 & (0.782) \\ 0.0000 & 0.0395 & 0.0136 & -0.0168 & -0.0029 & 0.0269 & 0.0275 \end{bmatrix}$$

Matrix 1: *VCV Matrix*

The *Breusch-Pagan* test for a diagonal VCV matrix has us keeping the alternative hypothesis of a non-diagonal matrix, confirming that the 3SLS estimator is making use of the full information characteristics of the model, and is more efficient than 2SLS, in this context.

Breusch-Pagan test for diagonal covariance matrix:
$\chi^2(21)$ = 579.754 [**0.0000**]

Table 8: Breusch-Pagan Test

Appendix 9 - Notes on the Propensity to Consume

As discussed in Appendix 3 - Micro-foundations (Keynes 1973b and Koenig 1980), at the micro-economic level, an individual's consumption will depend on income, while the market demand is a function of aggregate employment. Once we aggregate across markets, we have that:

$$C = \chi(N)$$

Since we are interested in determining employment, and not income, it is only logical that we make the propensity to consume depend on income, such that we have:

$$C = \chi(Y)$$

It should be noted that a change in consumption as a response to a change in income will be non-proportional, meaning that the short-period average propensity to consume is larger than its marginal counterpart, but in the long-period, these two measures tend to become equal, as highlighted in Alimi (2013).

While we are mainly concerned with the aggregate dynamics governing the demand for consumption commodities, and are working with aggregate data, we will nevertheless control for some of the factors affecting the inter-temporal maximization problem, in order to account for the share of their influence that is not reflected in the simplified relationship presented above. We are also wary of the fact that some of these can change in the course of the trade cycle, making their inclusion all the more important. To ensure stationarity, we make use of the first difference of private personal consumption expenditure. One of the objective factors mentioned in chapter 8 that we will control for is "*windfall changes in capital-values not allowed for in calculating net income*" (Keynes, 1973b, p.92). By this, Keynes means not the usual "wealth-effect"[92], which concerns regular, or predictable, changes in the value of wealth held by agents in the economy, but instead, unpredictable and irregular fluctuations to the value of the stock of wealth. This effect is more important the more wealth-owning individuals there are in the economy. The variable we shall

[92] Kimball (1990) proposes a regular 2-period model that includes wealth effects.

employ was constructed in the following manner: we begin by computing the quarterly logarithmic percentage change in real wealth, before standardizing it and finally creating its five-year moving average. Its interpretation is straightforward: a value of 1 means that wealth grew by one standard deviation more than its medium-term average. This is indeed close to the effect Keynes was alluding to.

Distributional effects are mentioned in chapters 8 & 10 of Keynes (1973b). In the former under the discussion of changes to the wage-unit, as that could alter the income distribution in the economy, while in the latter, Keynes asserts that during a recovery from a recession, income is likely to be redistributed towards groups with lower marginal propensities to consumer, thus decreasing the investment multiplier.[93] Since we are assuming that our economy is only populated by wage-earners and profit-bearers, we will measure the distribution of income as the share of the total real wage bill in real income. We then make use of its percentage change. Since we assume that workers have a higher marginal propensity to consume, we expect a positive coefficient.[94]

Last, but not least, chapter 8 of Keynes (1973b) includes a discussion of the effect of a change in the "*rate of time-discounting*" (Keynes, 1973b, p.93). This refers to a combination of three factors[95]: the real rate of interest; expectations regarding future prices, relative present ones; subjective assessment of one's probability of survival for the near future. All-in-all, this reflects the rate at which an agent can trade present consumption for future consumption. An increase in the rate of interest would decrease the value of future income, such that it would decrease present consumption, in the usual utility maximization framework. On the other hand, an expectation of higher future prices relative to their present counterparts would induce a higher consumption level in the present. A decrease in the probability of survival would probably result in an increase in present

[93] The micro-foundations of this dynamic can be found in Ferguson (2013b), pages 24-26.

[94] García-Lizana and Pérez-Moreno (2012) develop a fully fleshed framework where the distribution of income is an important determinant of consumption.

[95] (Ferguson, 2013b, p.5).

consumption. Empirically, we will model the first factor as the first difference in the real bank prime loan rate, used as a proxy for the rate charged on consumption loans. The second factor is accounted for with the consumer sentiment index developed by the University of Michigan. This index encompasses the overall mood of consumers, and not only their price expectations, such that we expect it to have a positive effect.

As stressed in (Chick, 1984, p.105) and in (Minsky, 1975, p.23-24), since the publication of Keynes (1973b), access to financial institutions, and thus credit, has been considerably "liberalized". This means that we must take consumer credit into account in our propensity to consume function. We do so through the already mentioned real bank prime loan rate, but now an increase in this rate of interest reflects the fact that credit has become more expensive, and also through the variable "consumer credit conditions", which is simply the percentage change in the ratio between the level of real consumer credit and real income, hence measuring how much credit there is available relative to the economy's output.

Appendix 10 - Notes on the Marginal Efficiency of Capital

The decision to invest is made in present, taking into consideration the current level of demand, but only materializes itself in the future, where demand is likely to have changed, thus the producer needs to make predictions about these changes This is why investment demand depends on long-term expectations, and not on present income. The length of time between the planning of the investment project and its actual implementation embeds the decision process with even more uncertainty (Chick, 1984, p.119-120).

The return on investment will be the profits made in the future that can be directly attributed to the investment good(s) purchased in the present. That is, the entrepreneur incurs current costs, in order to collect ensuing returns (Chick, 1984, p.120).

Assuming that returns accrue at the end of each time-period, then the present value of the stream of expected returns can be written as:[96]

$$V_0 = \sum_{t=1}^{n} \frac{E(\Pi_t)}{(1+r_t)^t} \tag{23}$$

Substituting the rate of interest for the discount rate will equate this stream of expected yields to the supply price[97], such that the MEK solves the following equation:

$$P_{K,t} = \sum_{t=1}^{n} \frac{E(\Pi_t)}{(1+MEK_t)^t} \tag{24}$$

Following Meade (1937), Darity and Cottrell (1987) and Rappoport (1992), we define the marginal efficiency of capital as the following identity:[98]

$$MEK_t \equiv \frac{E(\Pi_t)}{P_{K,t}} \tag{25}$$

Producers then compare the MEK with the interest rate, if the former is larger, then they embark on that particular investment project, if the opposite is true, they do not. Aggregating across projects and firms, the equilibrium is found at the margin, where the MEK equals the interest rate.

[96](Chick, 1984, p.120) & (Crocco, 2016, p.285).

[97]This line of reasoning comes from Chick (1984), page 120.

[98]This requires the assumption that prospective profits be an infinite series of constant values (Darity and Cottrell, 1987, p.212).

Appendix 11 - Notes on the Liquidity Preference

The treatment of the liquidity preference present in Keynes (1973b) is profoundly different from what it became in subsequent literature. This is already evident in the most famous "popularization" of the General Theory, Hicks (1937), where the liquidity preference is reduced to an "extension" of the Marshallian "demand-for-money" schedule, with the addition of the negative relationship between money demand and the interest rate.[99] One could think of this simple equation as illustrating Hicks' point:

$$M^D = \frac{\alpha Y}{i}$$

The nominator is the "Cambridge cash-balance equation", and the denominator is introduced to capture the opportunity cost of holding money instead of an interest-bearing asset. In this sense, there is nothing "revolutionary" in the liquidity preference, which is "*hard to distinguish from the revised and qualified Marshallian theories*" (Hicks, 1937, p.153). This is the dominant view in the present consensus, as can be seen in Romer (2019), the most widely used textbook in advanced courses on macro-economics. On page 242, the demand for money is derived from the micro-economic optimization problem, and is simply a regular downward slopping schedule depending positively on output, and negatively on the rate of interest.

This is profoundly different from the conception found in Keynes (1973b, 1937b), where money is the liquid asset used to "fend-off" the inherit uncertainty of a monetary economy. Instead of demanding a medium of exchange, agents have a schedule for their *liquidity preference*, that is, for the amount of their holdings that they wish to keep in a liquid form. This means that expectations and uncertainty about the future play a key role. Money-holdings represent a particular state of expectations about the future.

The theory of the liquidity preference is a departure from classical/neoclassical economics, for it sets the interest rate as a purely monetary phenomenon, instead of being the price that brings into

[99] This line of reasoning is found in Minsky (1975), page 33.

equality savings and investment. As highlighted in Carvalho and Carvalho (2019), the neoclassical loanable funds theory is simply an extension of the underpinnings that neoclassical economics operates on: full employment is an *a priori* assumption, such that we are in a long-run equilibrium where money is neutral, and the nominal economy cannot affect its real counterpart. As such, the rate of interest has to be a real price, for it brings into equality two real variables. The loanable funds market is then nothing but a capital market, where investment is seen as a demand, and savings as a supply, operating in the ordinary manner. Furthermore, money supply fluctuations follow the usual quantity theory of money results: they only affect nominal prices, *ceteris paribus*. As with many other aspects in the General Theory, Keynes relegates this reasoning, and its results, to the special case where the economy is in the long-run full-employment equilibrium. In the "keynesian" construction, it is income (and employment) that ensures the equilibrium between aggregate savings and aggregate investment.[100] The *everything else constant* assumption that the loanable funds theory rests upon is discarded, for when investment increases, it necessarily expands income, which in turn ought to stimulate savings, something not possible in the neoclassical framework, where investment and savings vary independently. The interest rate is then the price of liquidity (Chick, 1984, p.174), found at the point where the preference for liquidity equals the supply, that is, in the money market equilibrium.

[100]The discussion of this idea can be found in pages 180-182 of Keynes (1973b).

Appendix 12 - Notes on the *Lucas critique* (Lucas 1976)

The *Lucas critique* was proposed in Lucas (1976), where the Nobel laureate critiqued large-scale "Keynesian" macro-econometric models for not taking into account the underlying micro-level behavioural patterns. These models would perform well in short-term forecasting by design, but would be useless in policy discussions. This was so because their *structural* relationships were not actually *structural*, and thus would not remain unaltered when one changed policy variables. The "truly" invariant structures were to be found at the individual agent level. Hence, it is not a critique of any particular economic policy, nor is it a direct critique of theoretical models *per say*.

It is true that we have developed the micro-foundations behind the General Theory, but we are not directly taking them into account in most of our econometric modelling. Hence, it could be that we are missing their influence when we assume *ceteris paribus* to interpret the coefficients we obtained. In the same vein, it not obvious how DSGE models deal with this issue, for without the assumption of *rational expectations*, it is not conceivable that agents would not modify their preferences periodically when adjusting for an ever evolving economic context. This is the exact same criticism found in Lucas (1976): one is relying on potentially unrealistic assumptions. The Lucas critique should not be seen, in the opinion of the author, as an "end-all be-all", but rather as an ideal to strive towards, that we are conscience of never actually reaching. By "endogenizing" expectations, and making them depend, among other things, on the policy variable(s), one could find an efficient and effective way of "solving" the *Lucas critique*. This alternative to the rational expectations assumption could turn out to be more viable and less restrictive. Asimakopulos (1971) presents a possible framework:[101]

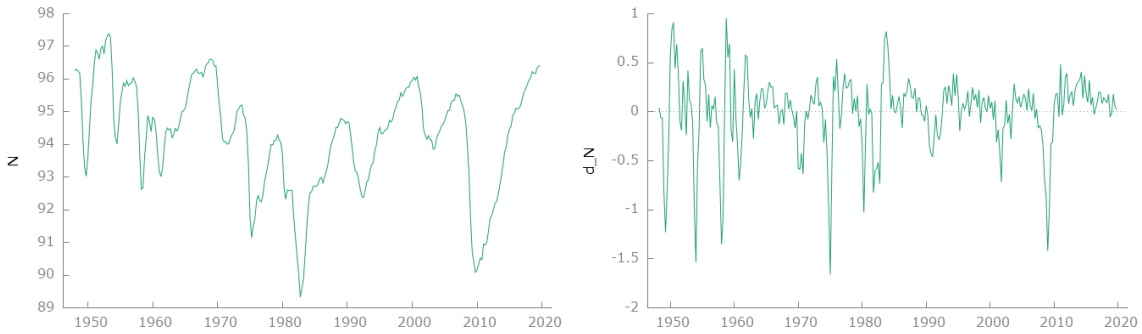
$$\begin{cases} E[\Pi] = g(I) \\ I = h(E[\Pi]) \end{cases}$$

A VAR approach would seem appropriate under this framework.

[101] All other determinants are taken as given.

Appendix 13 - Time Series Plots

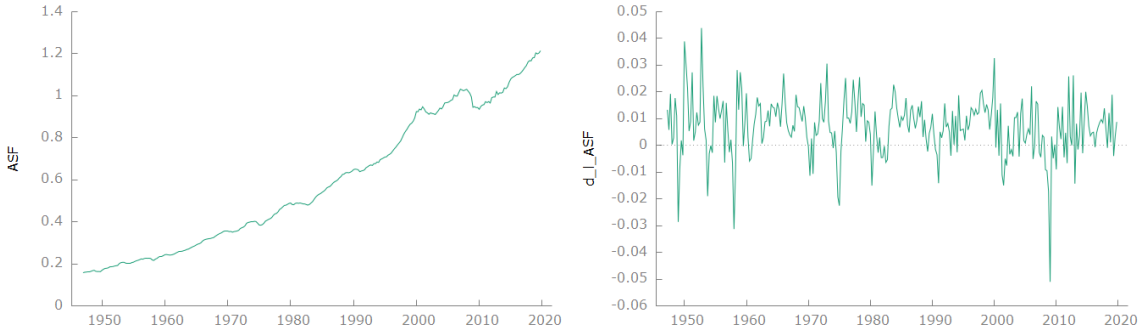
The General Theory of Employment



(a) Employment Rate

(b) First Difference of Employment Rate

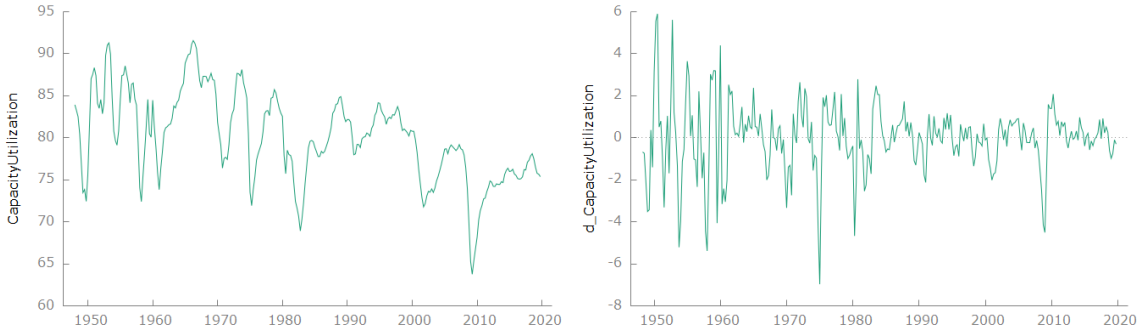
Figure 2: Employment



(a) Aggregate Supply Function

(b) First Difference of the Natural Logarithm of Aggregate Supply Function

Figure 3: Aggregate Supply



(a) Capacity Utilization

(b) First Difference of Capacity Utilization

Figure 4: Capacity - Manufacturing

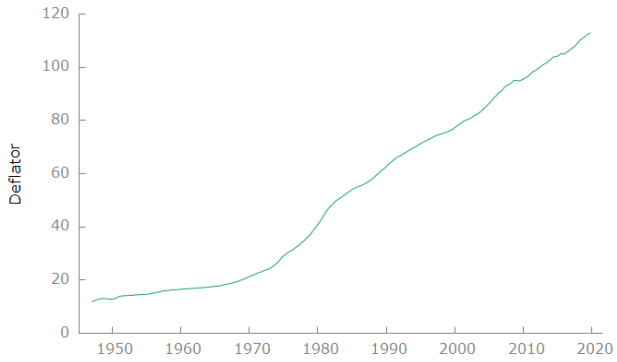
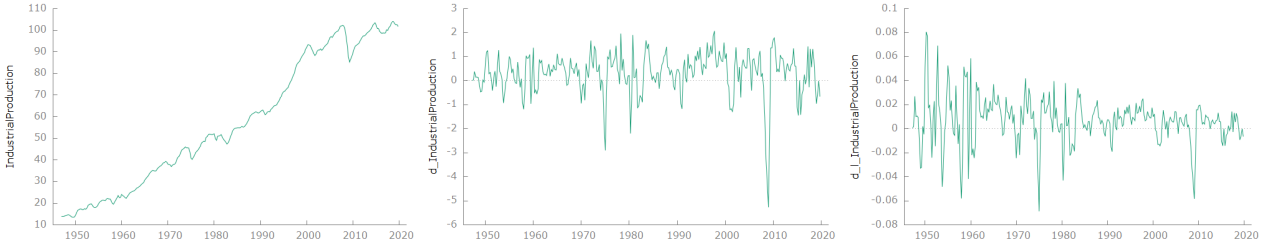


Figure 5: Gross Domestic Product Implicit Price Deflator



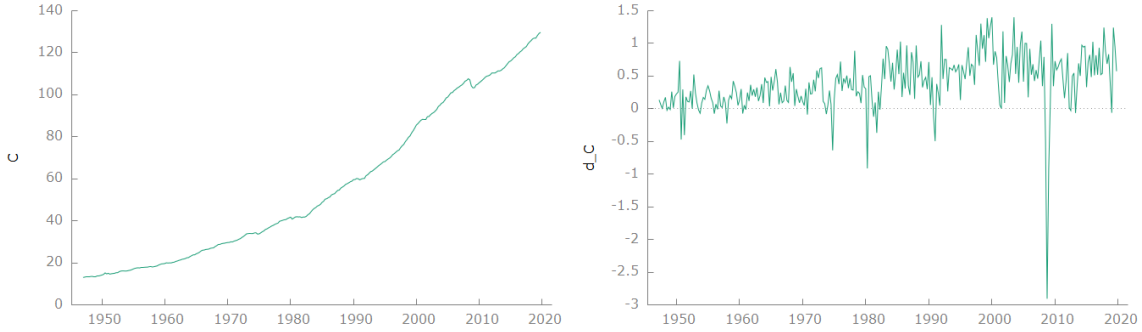
(a) Industrial Production Index

(b) First Difference of Industrial Production

(c) First Difference of the Natural Logarithm of Industrial Production

Figure 6: Industrial Production

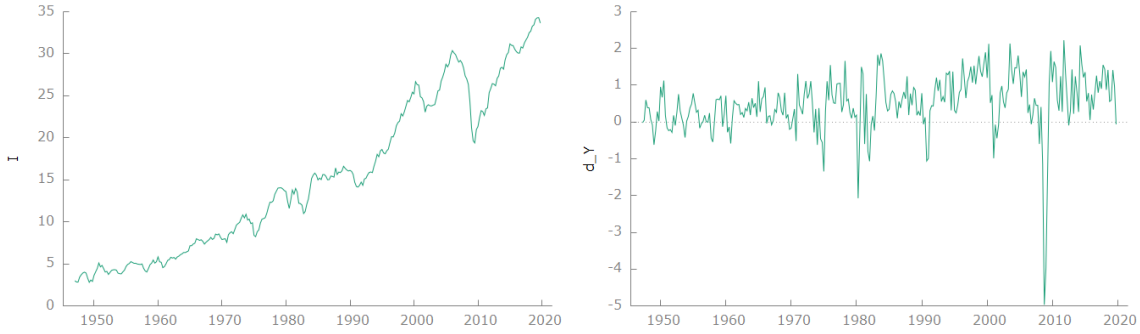
Propensity to Consume



(a) Consumption

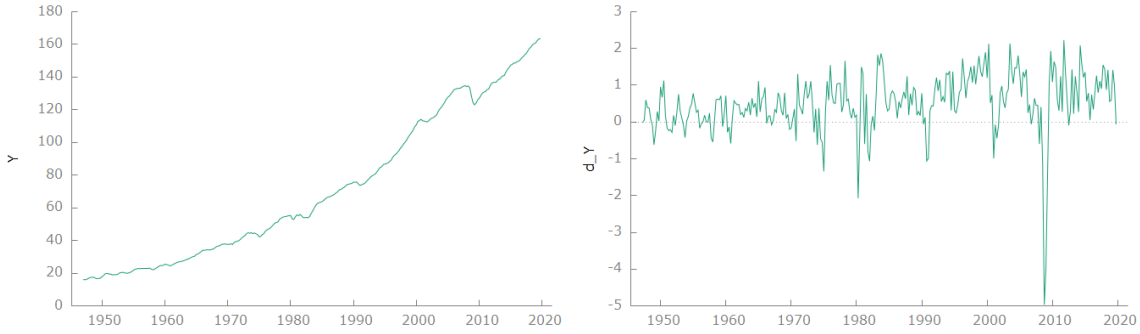
(b) First Difference of Consumption

Figure 7: Private Personal Consumption



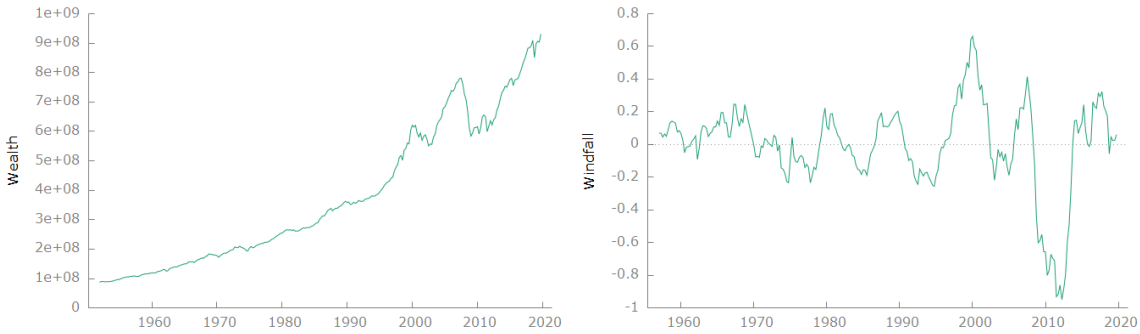
(a) Investment (b) First Difference of Investment

Figure 8: Private Investment



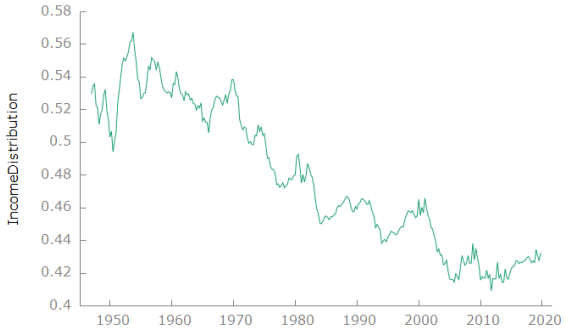
(a) Income (b) First Difference of Income

Figure 9: Private Investment

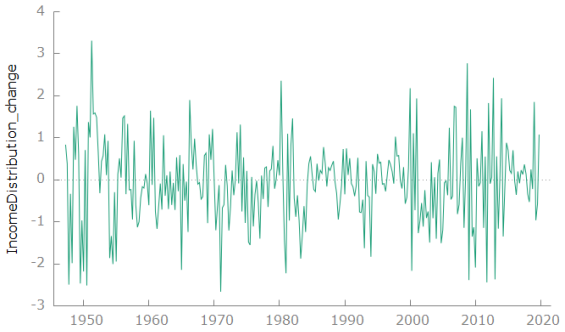


(a) Wealth (b) Windfall

Figure 10: Wealth & Windfall

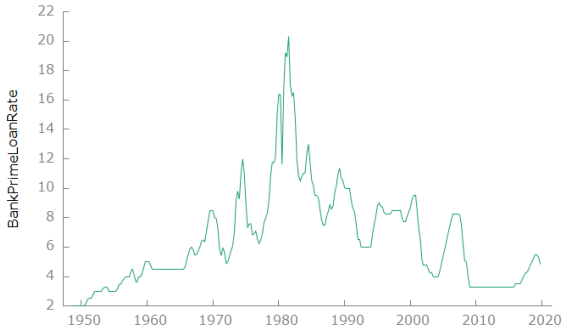


(a) Income Distribution

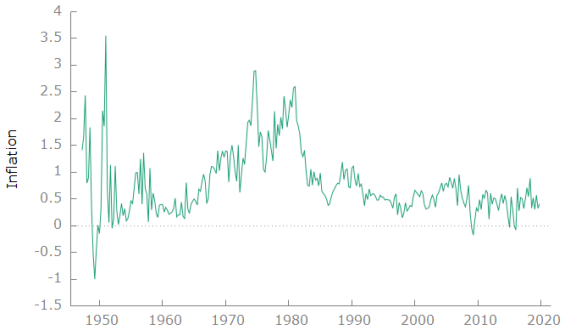


(b) Change in Income Distribution

Figure 11: Private Income Distribution

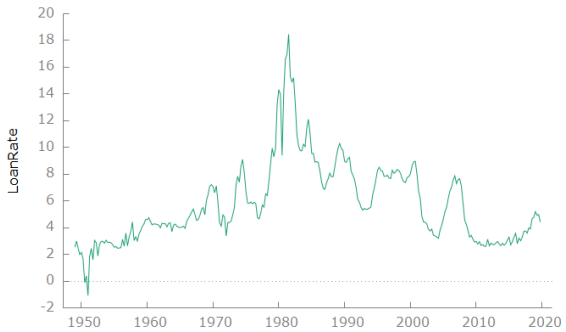


(a) Nominal Bank Prime Loan Rate

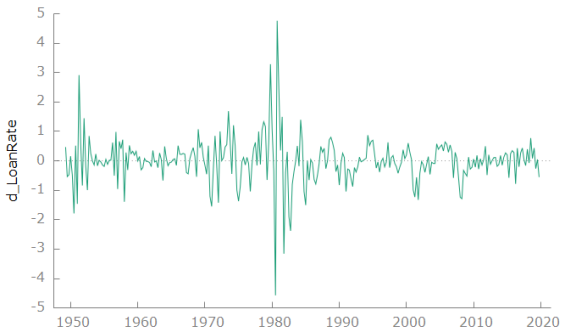


(b) Inflation

Figure 12: Nominal Interest Rate & Inflation

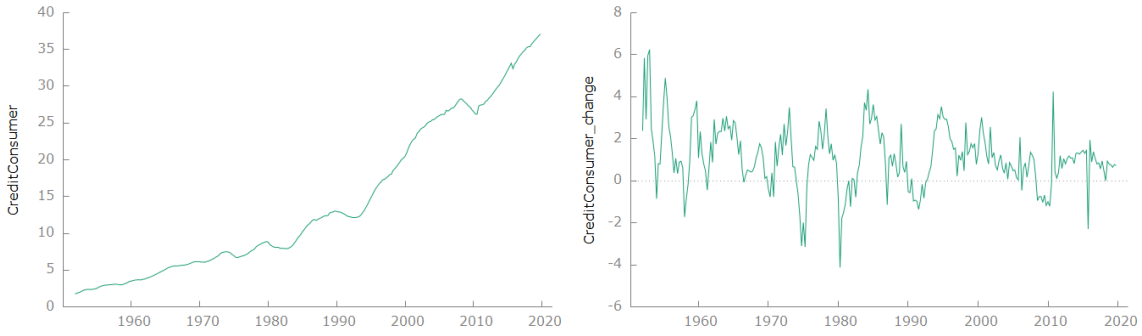


(a) Real Bank Prime Loan Rate



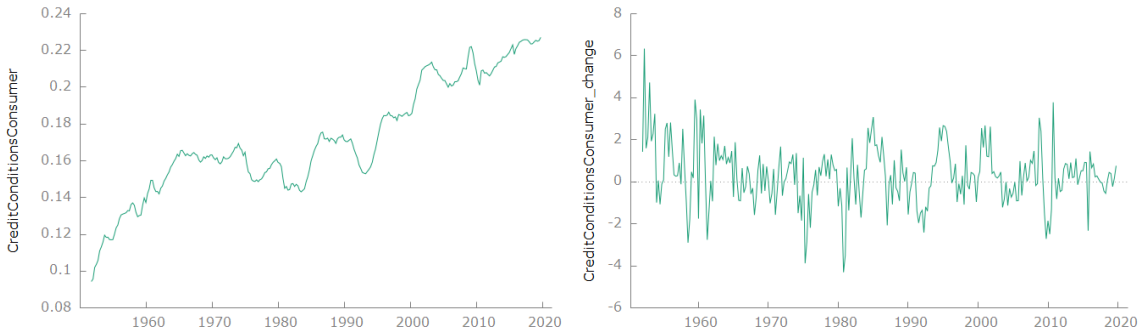
(b) First Difference of Real Bank Prime Loan Rate

Figure 13: Real Interest Rate



(a) Consumer Credit (b) Change in Consumer Credit

Figure 14: Total Consumer Credit



(a) Consumer Credit Conditions (b) Change in Consumer Credit Conditions

Figure 15: Consumer Credit Conditions

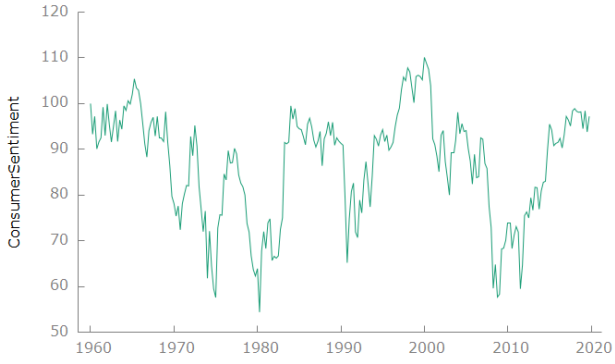
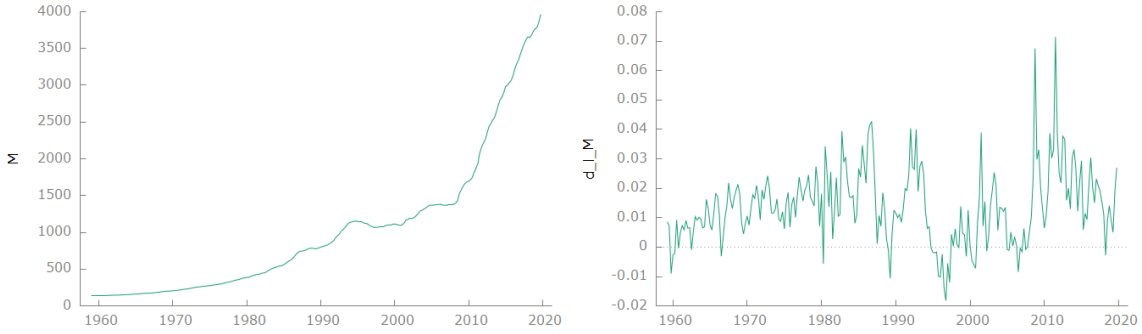


Figure 16: Consumer Sentiment

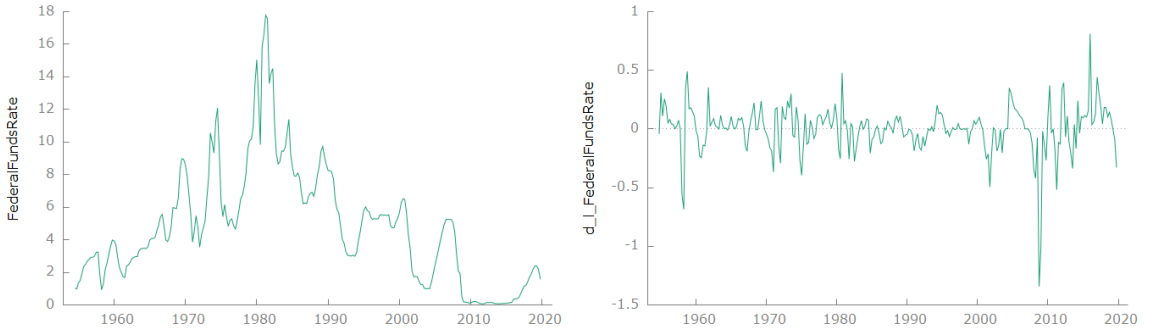
Inducement to Invest



(a) M1

(b) First Difference of the Natural Logarithm of M1

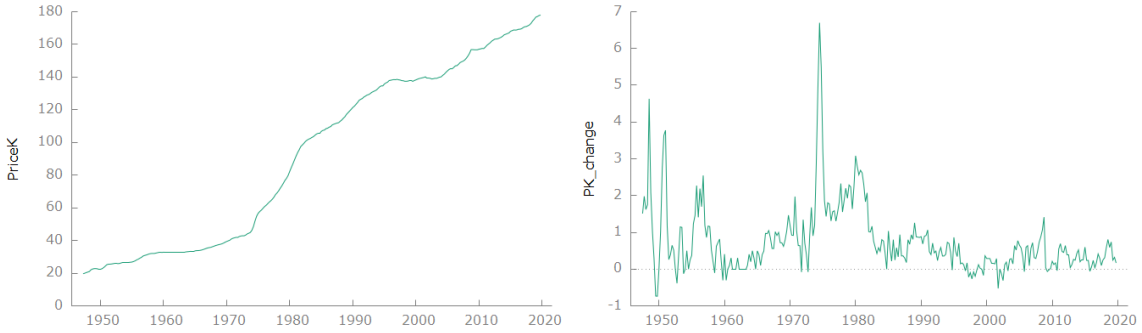
Figure 17: Money Supply



(a) FED Funds

(b) First Difference of the Natural Logarithm of FED Funds

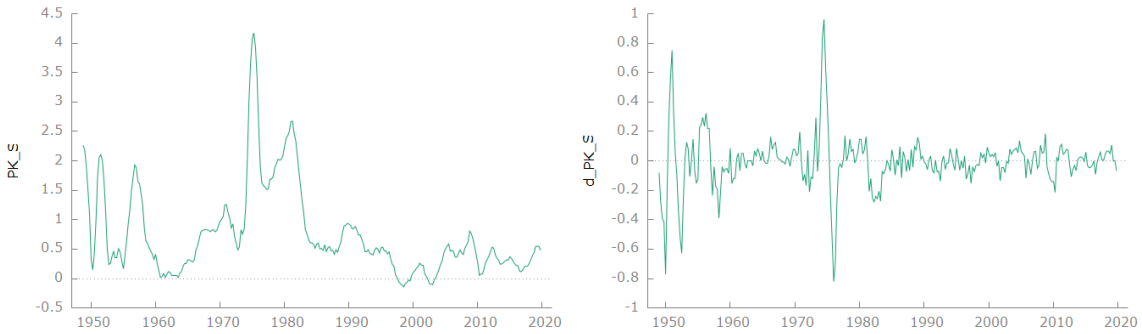
Figure 18: Federal Funds Rate



(a) Capital Price

(b) Change in Capital Price

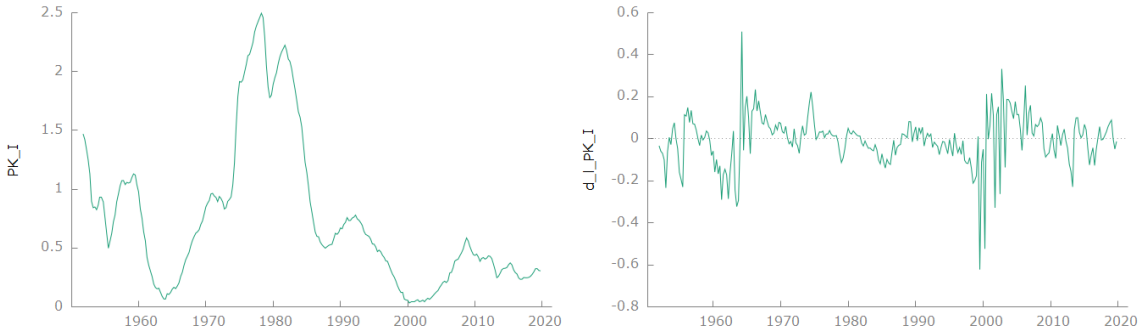
Figure 19: Producer Price Index - Private Capital Equipment



(a) PK - Stock Market

(b) First Difference of PK - Stock Market

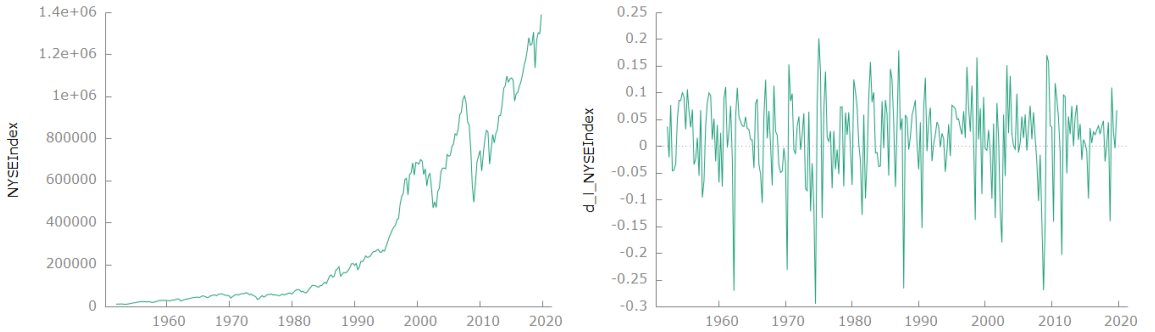
Figure 20: Capital Price - Stock Market



(a) PK - Investment

(b) First Difference of the Natural Logarithm of PK - Investment

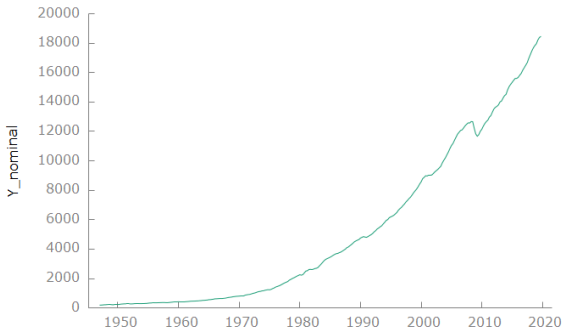
Figure 21: Capital Price - Stock Market



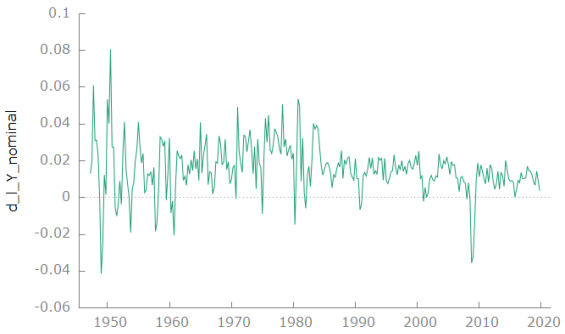
(a) NYSE

(b) First Difference of the Natural Logarithm of NYSE

Figure 22: NYSE Composite Index

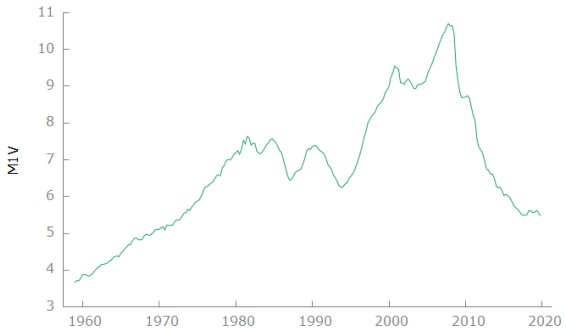


(a) Nominal Income

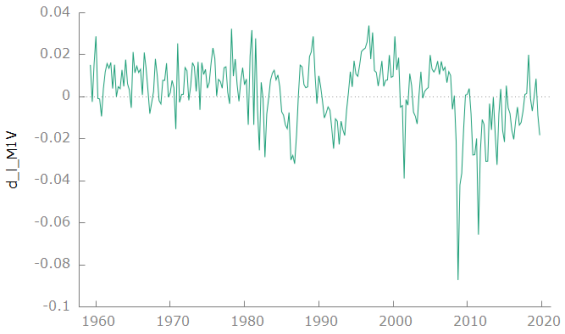


(b) First Difference of the Natural Logarithm of Nominal Income

Figure 23: Nominal Private Investment

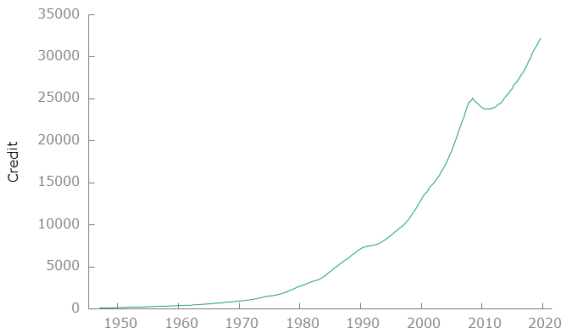


(a) M1V

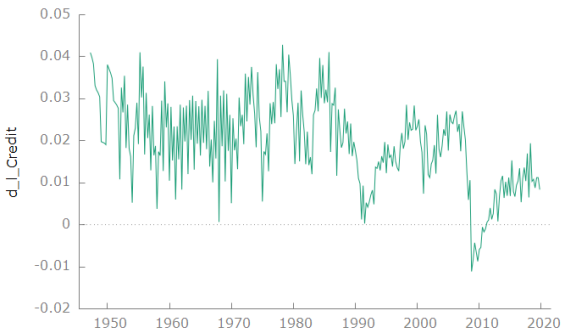


(b) First Difference of the Natural Logarithm of M1V

Figure 24: Velocity of Money Supply

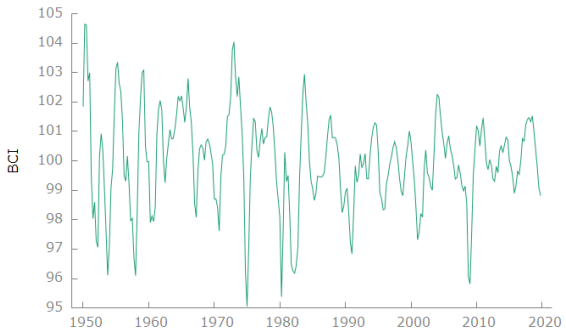


(a) Credit

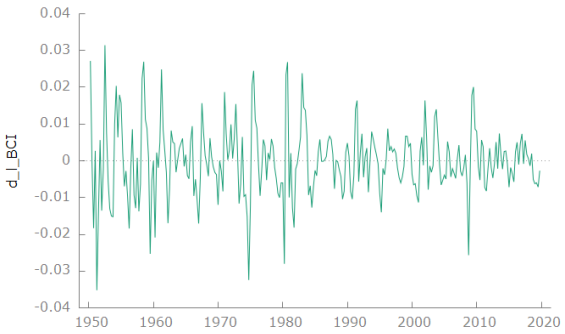


(b) First Difference of the Natural Logarithm of Credit

Figure 25: Total Private Credit

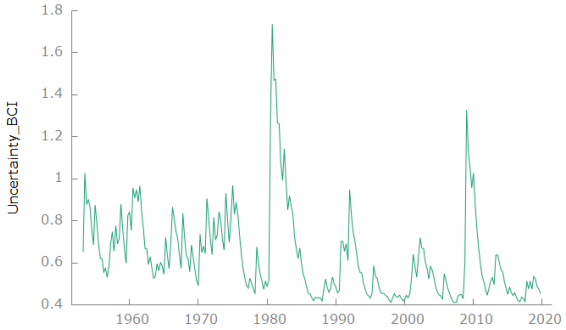


(a) BCI

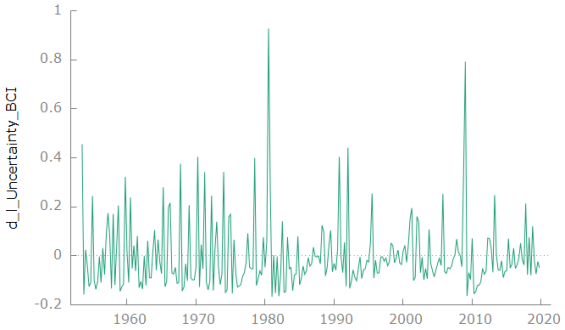


(b) First Difference of the Natural Logarithm of BCI

Figure 26: Business Confidence Index

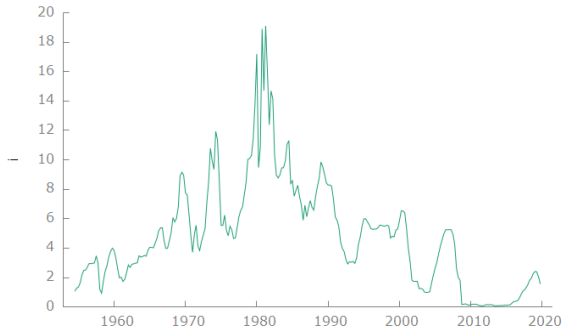


(a) BCI Uncertainty

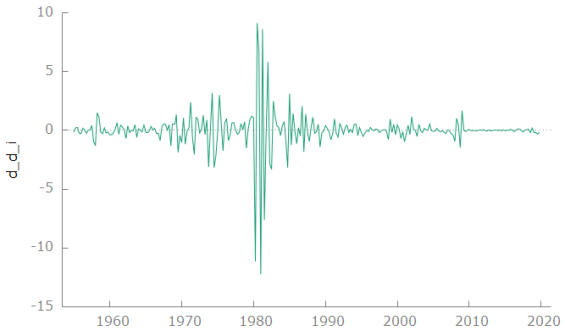


(b) First Difference of the Natural Logarithm of BCI Uncertainty

Figure 27: Business Confidence Index Uncertainty

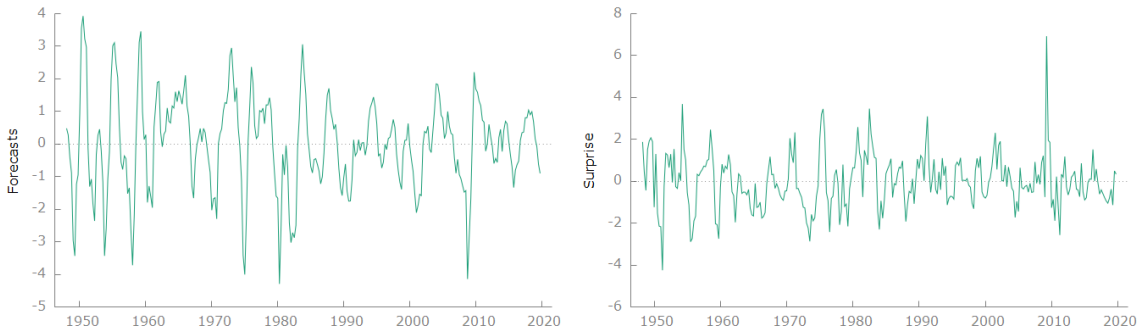


(a) Interbank Rate



(b) Second Difference of Interbank Rate

Figure 28: Immediate Interbank Rate

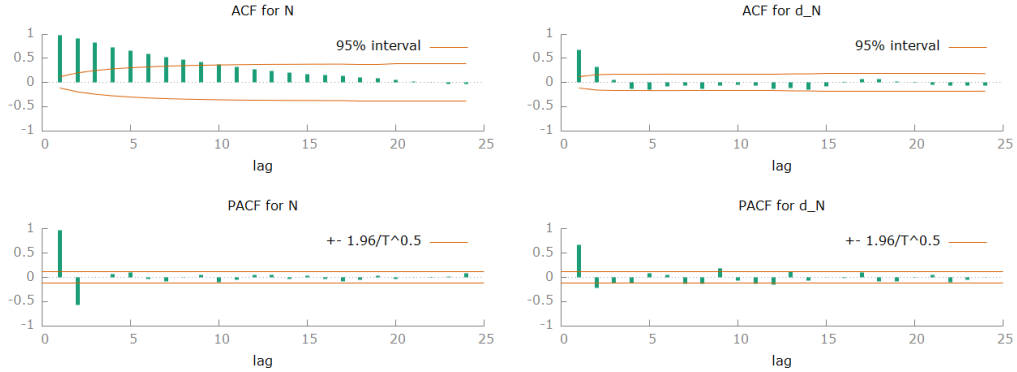


(a) Forecasts (b) Surprise

Figure 29: Prospective Yields

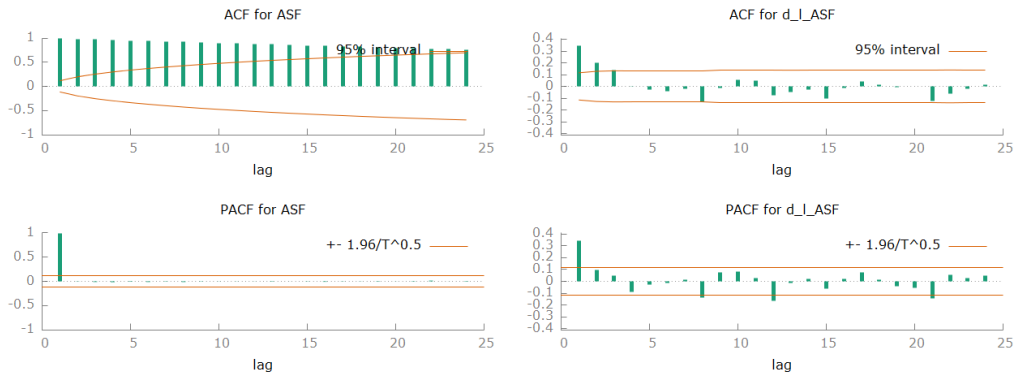
Appendix 14 - Correlograms

The General Theory of Employment



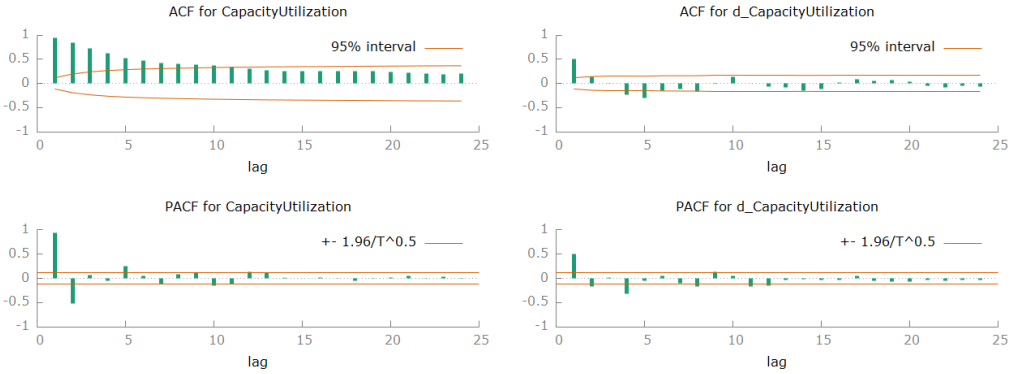
(a) Employment Rate (b) First Difference of Employment Rate

Figure 30: Employment



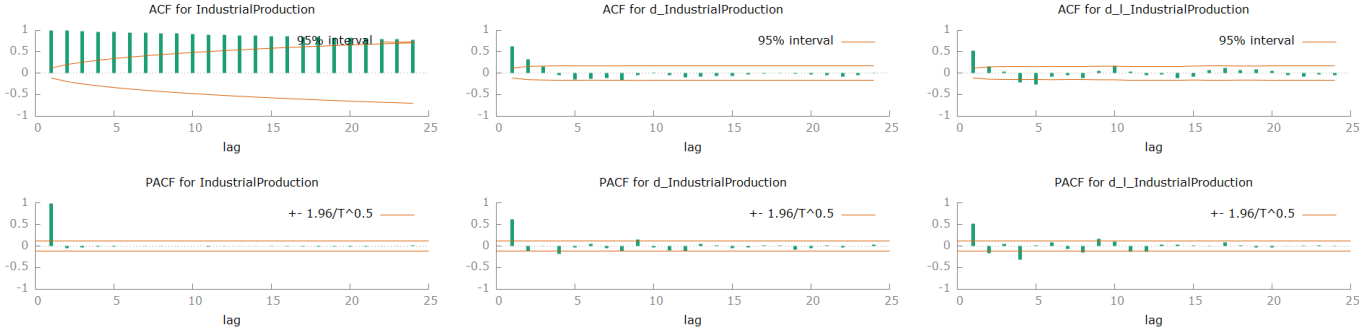
(a) Aggregate Supply Function (b) First Difference of the Natural Logarithm of Aggregate Supply Function

Figure 31: Aggregate Supply



(a) Capacity Utilization (b) First Difference of Capacity Utilization

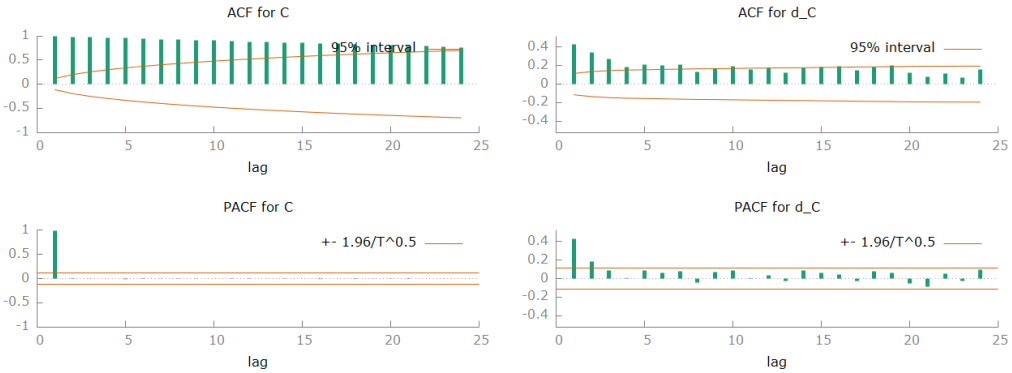
Figure 32: Capacity - Manufacturing



(a) Industrial Production Index (b) First Difference of Industrial Production (c) First Difference of the Natural Logarithm of Industrial Production

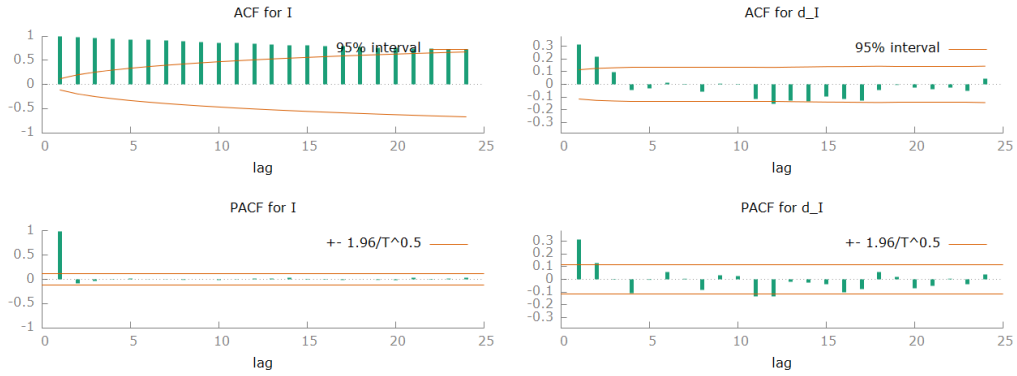
Figure 33: Industrial Production

Propensity to Consume



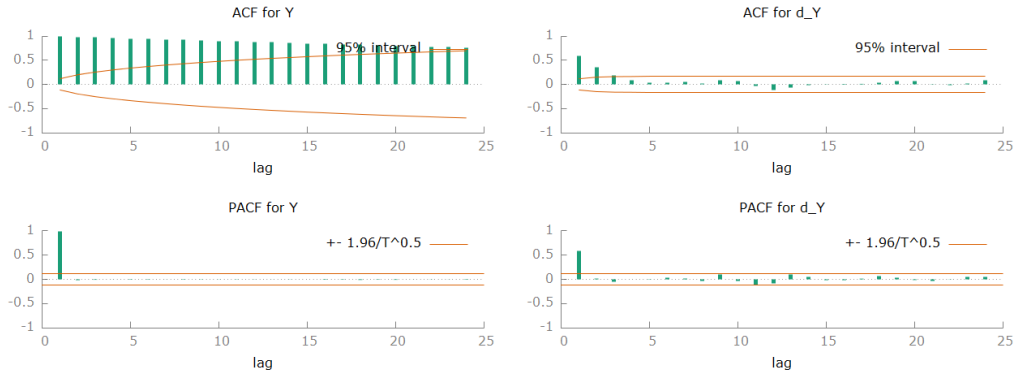
(a) Consumption (b) First Difference of Consumption

Figure 34: Private Personal Consumption



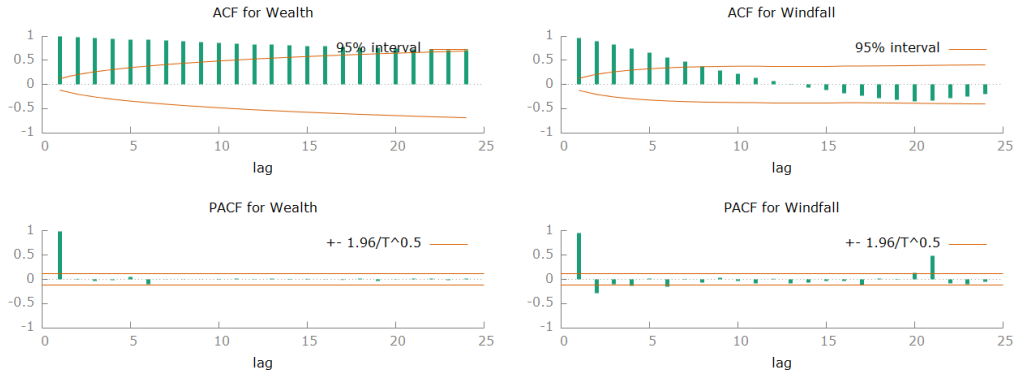
(a) Investment (b) First Difference of Investment

Figure 35: Private Investment



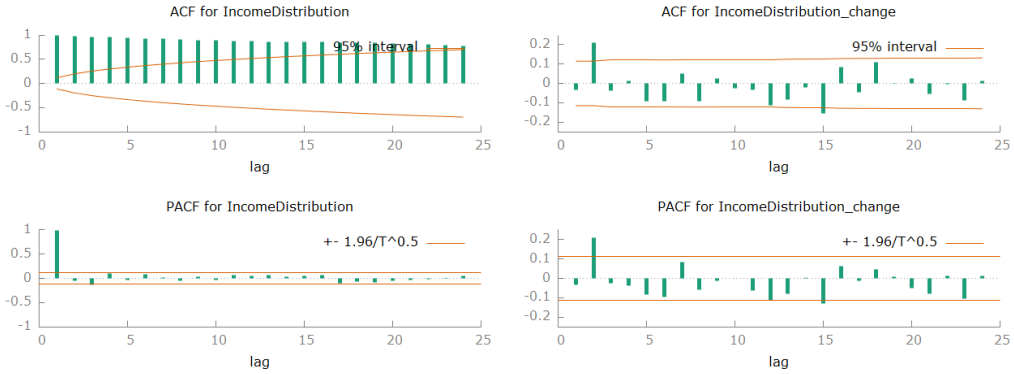
(a) Income (b) First Difference of Income

Figure 36: Private Investment



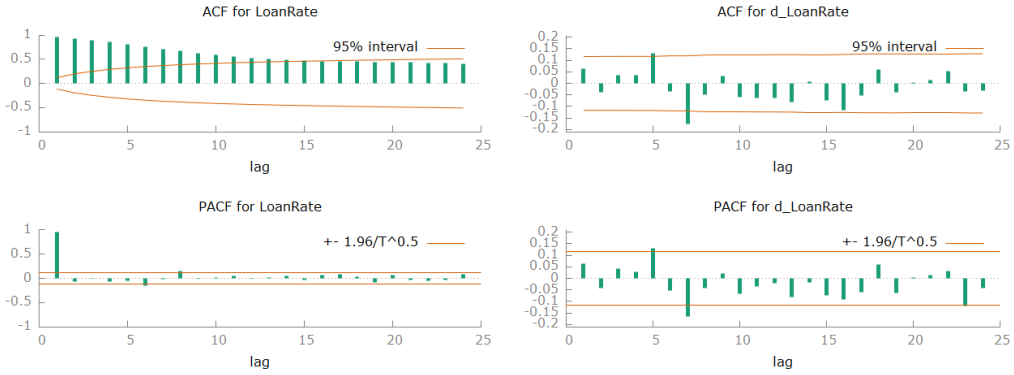
(a) Wealth (b) Windfall

Figure 37: Wealth & Windfall



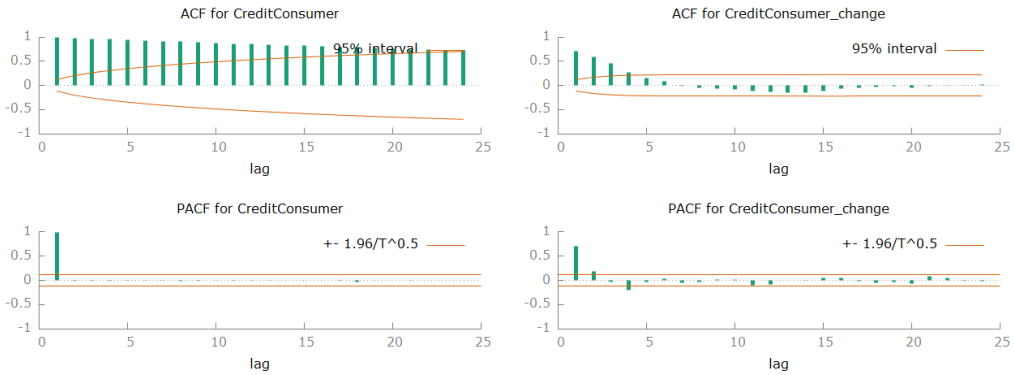
(a) Income Distribution (b) Change in Income Distribution

Figure 38: Private Income Distribution



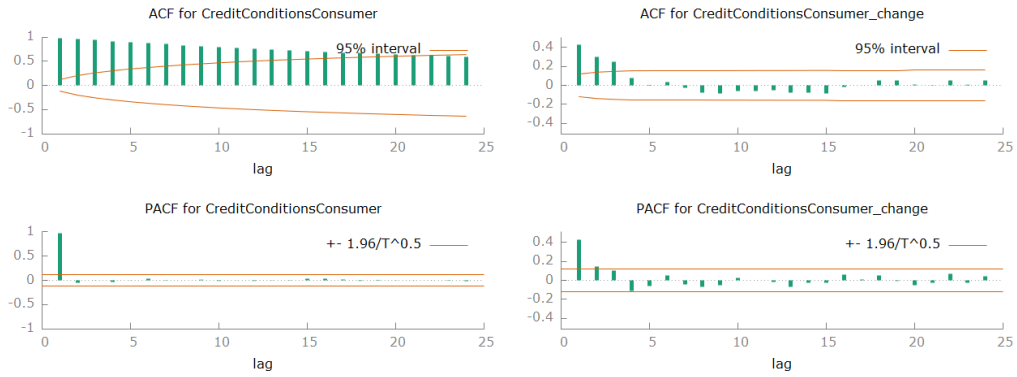
(a) Real Bank Prime Loan Rate (b) First Difference of Real Bank Prime Loan Rate

Figure 39: Real Interest Rate



(a) Consumer Credit (b) Change in Consumer Credit

Figure 40: Total Consumer Credit



(a) Consumer Credit Conditions (b) Change in Consumer Credit Conditions

Figure 41: Consumer Credit Conditions

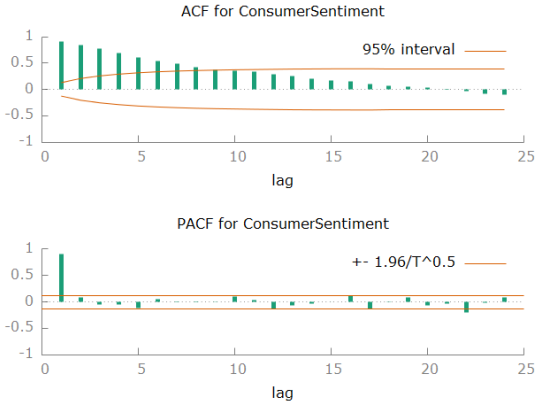
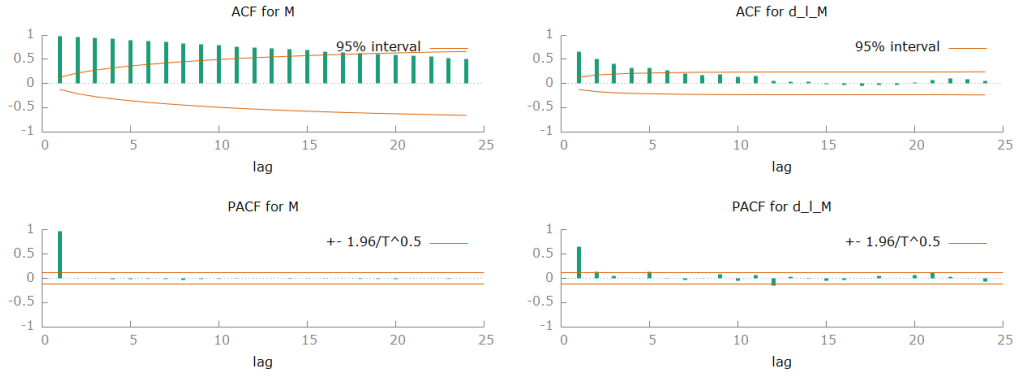


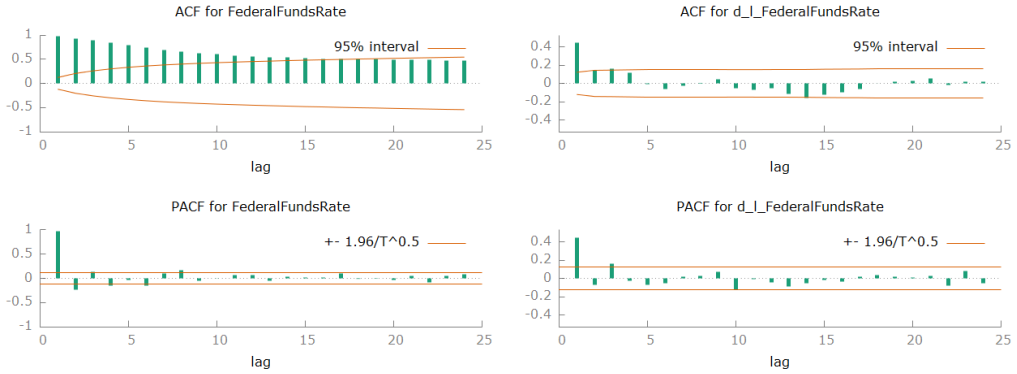
Figure 42: Consumer Sentiment

Inducement to Invest



(a) M1 (b) First Difference of the Natural Logarithm of M1

Figure 43: Money Supply



(a) FED Funds

(b) First Difference of the Natural Logarithm of FED Funds

Figure 44: Federal Funds Rate

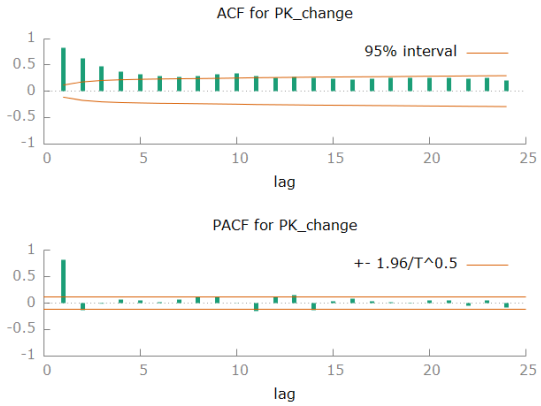
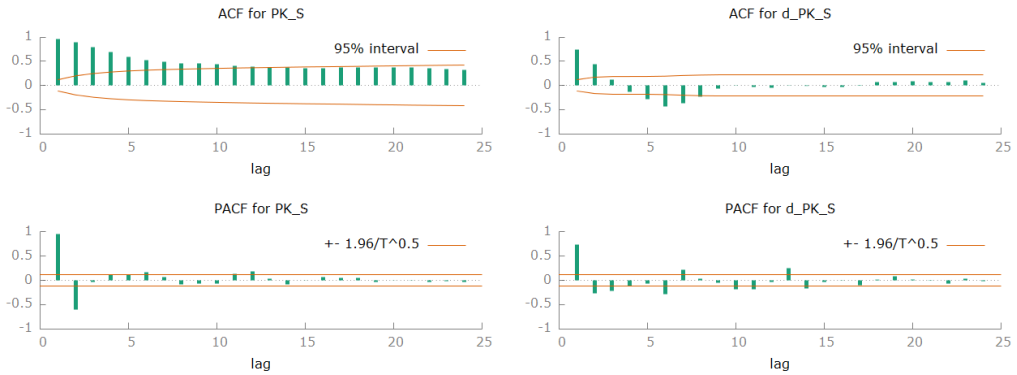


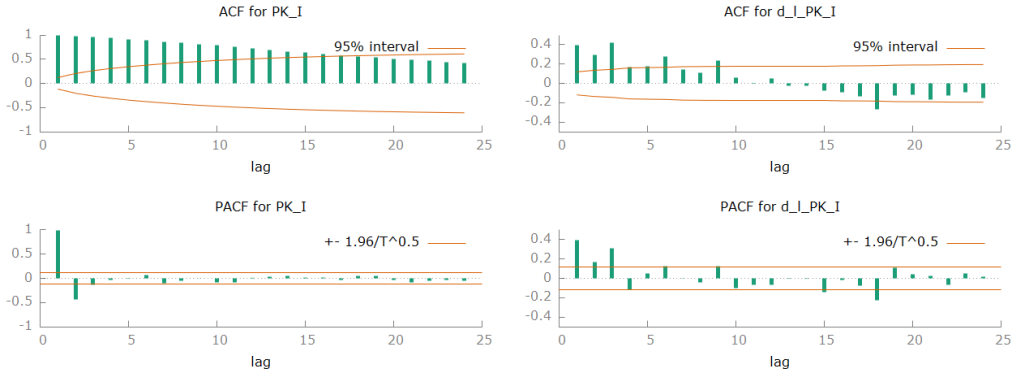
Figure 45: Change Produce Price Index - Private Capital Equipment



(a) PK - Stock Market

(b) First Difference of PK - Stock Market

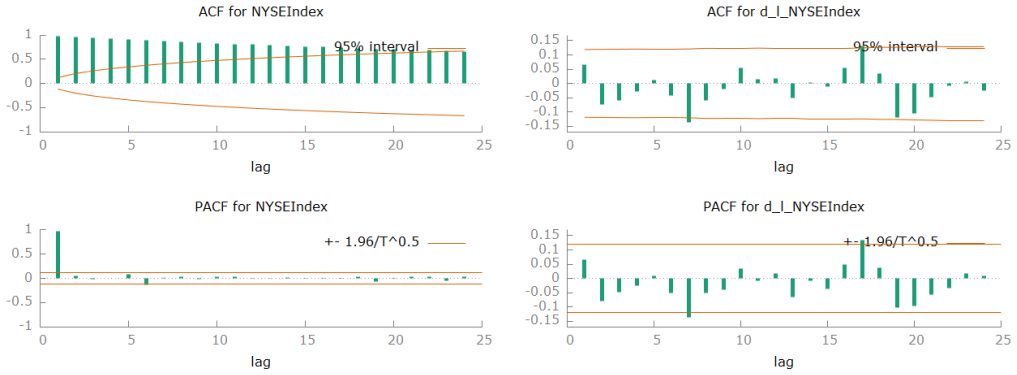
Figure 46: Capital Price - Stock Market



(a) PK - Investment

(b) First Difference of the Natural Logarithm of PK - Investment

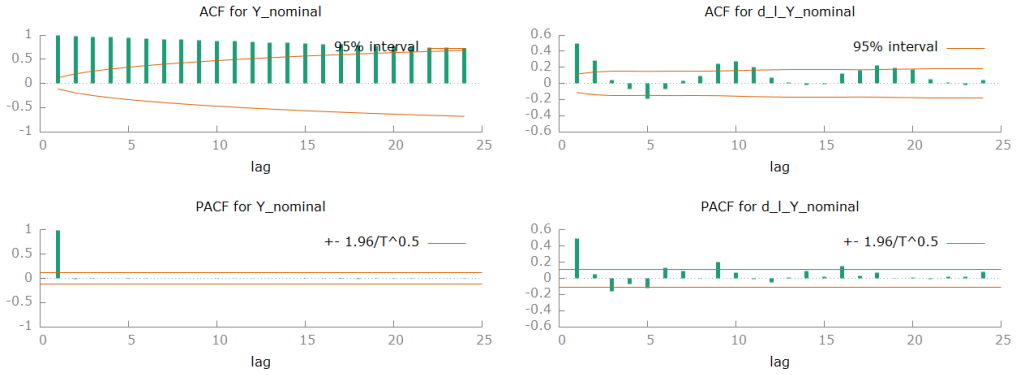
Figure 47: Capital Price - Stock Market



(a) NYSE

(b) First Difference of the Natural Logarithm of NYSE

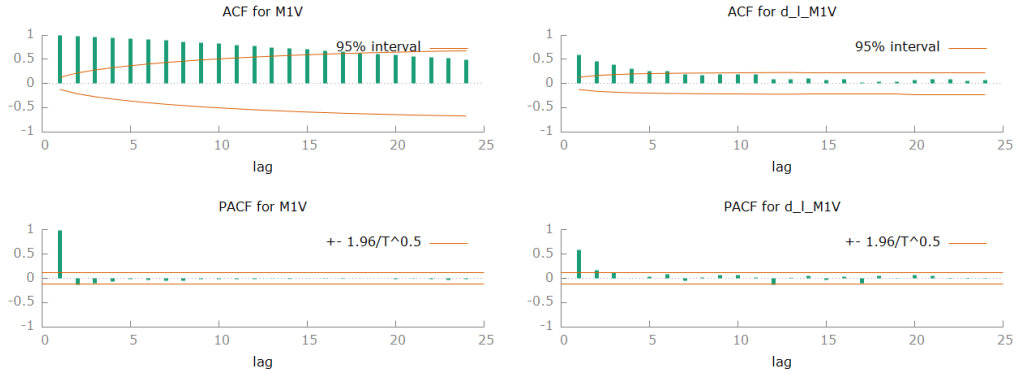
Figure 48: NYSE Composite Index



(a) Nominal Income

(b) First Difference of the Natural Logarithm of Nominal Income

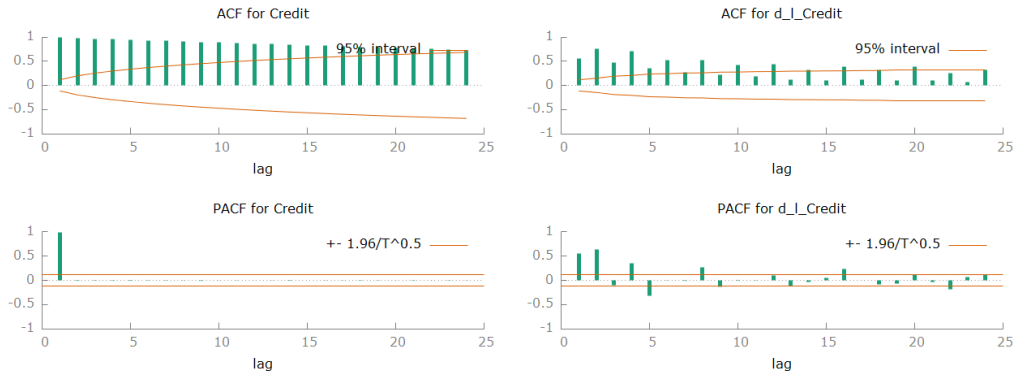
Figure 49: Nominal Private Investment



(a) M1V

(b) First Difference of the Natural Logarithm of M1V

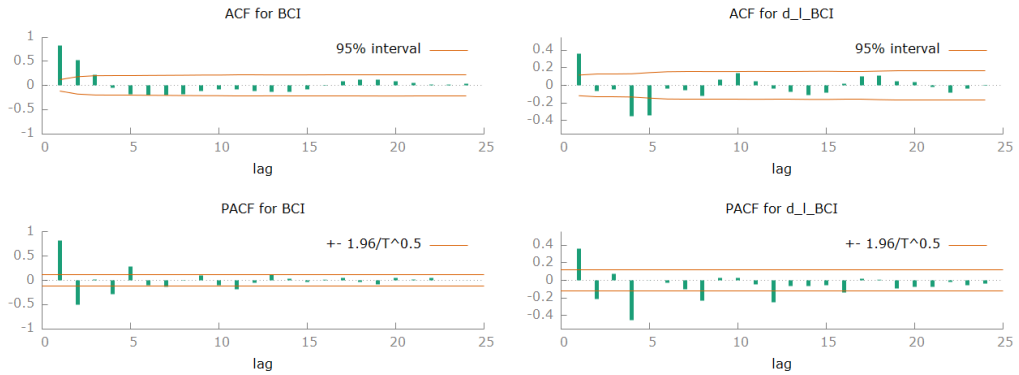
Figure 50: Velocity of Money Supply



(a) Credit

(b) First Difference of the Natural Logarithm of Credit

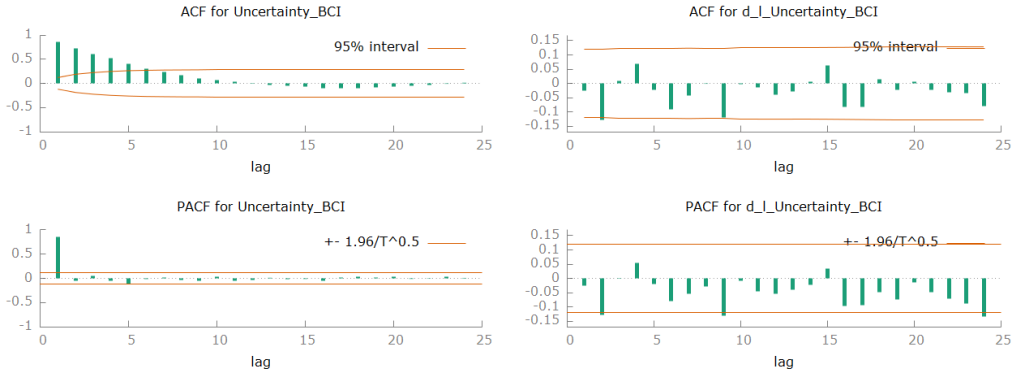
Figure 51: Total Private Credit



(a) BCI

(b) First Difference of the Natural Logarithm of BCI

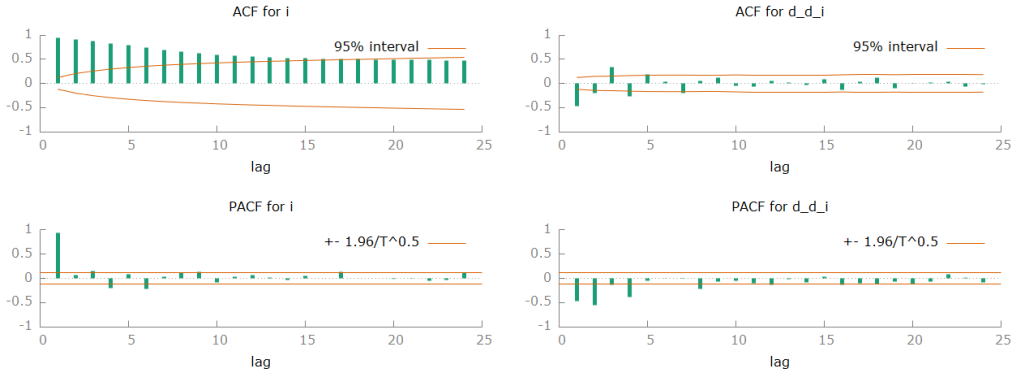
Figure 52: Business Confidence Index



(a) BCI Uncertainty

(b) First Difference of the Natural Logarithm of BCI Uncertainty

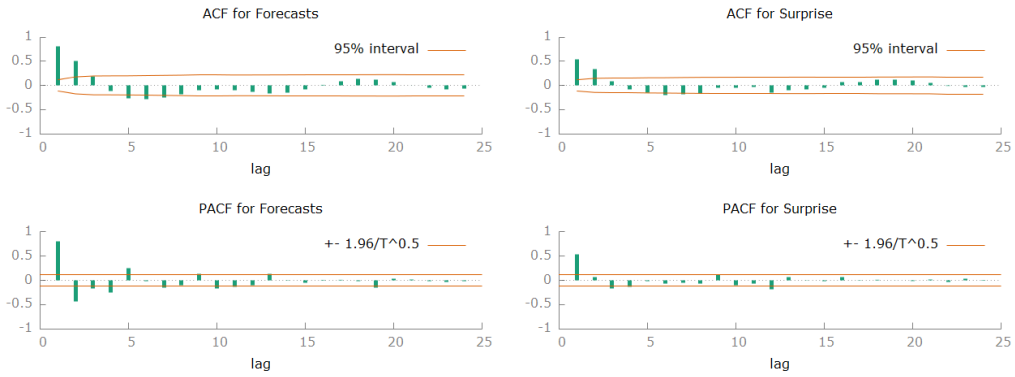
Figure 53: Business Confidence Index Uncertainty



(a) Interbank Rate

(b) Second Difference of Interbank Rate

Figure 54: Immediate Interbank Rate



(a) Forecasts

(b) Surprise

Figure 55: Prospective Yields

Appendix 15 - Unit Root Tests

The lags used in each unit root test are chosen with the *"testing-down"* option, beginning at 15 lags, and employing the AIC information criterion.

The General Theory of Employment

Variable	Test	Trend	Lags	p-value	Test Statistic	5% CV
N	ADF	No	13	0.0385		
N	GLS	No	12	0.129		
d_N	ADF	No	12	0.0000		
d_N	GLS	No	0	0.0000		
ASF	ADF	Yes	12	0.6744		
ASF	GLS	Yes	12		−0.7875	−2.89
d_l_ASF	ADF	No	1	0.0000		
d_l_ASF	GLS	No	2	0.0000		
Capacity Utilization	ADF	No	12	0.1461		
Capacity Utilization	GLS	No	12	0.0916		
d_CapacityUtilization	ADF	No	11	0.0000		
d_CapacityUtilization	GLS	No	0	0.0000		
ConsumerCredit_change	ADF	No	3	0.0000		
ConsumerCredit_change	GLS	No	1	0.0000		
Industrial Production	ADF	Yes	9	0.3429		
Industrial Production	GLS	Yes	12		−1.605	−2.89
d_IndustrialProduction	ADF	No	11	0.0000		
d_IndustrialProduction	GLS	No	0	0.0000		
d_l_IndustrialProduction	ADF	No	11	0.0000		
d_l_IndustrialProduction	GLS	No	0	0.0000		

Table 9: Unit Root Tests (*1*)

Propensity to Consume

Variable	Test	Trend	Lags	p-value	Test Statistic	5% CV
C	ADF	Yes	2	0.8637		
C	GLS	Yes	12		0.1533	−2.89
d_C	ADF	No	2	0.0000		
d_C	GLS	No	15	0.2061		
I	ADF	Yes	2	0.9351		
I	GLS	Yes	1		−2.3236	−2.89
d_I	ADF	No	1	0.0000		
d_I	GLS	No	1	0.0000		
Y	ADF	Yes	1	0.9999		
Y	GLS	Yes	1		0.4853	−2.89
d_Y	ADF	No	0	0.0000		
d_Y	GLS	No	8	0.0033		
Windfall	ADF	No	5	0.0014		
Windfall	GLS	No	1	0.0028		
Income Distribution	ADF	Yes	2	0.0275		
Income Distribution	GLS	Yes	1		−3.1569	−2.89
IncomeDistribution_change	ADF	No	1	0.0000		
IncomeDistribution_change	GLS	No	3	0.0000		
Loan Rate	ADF	No	7	0.0824		
Loan Rate	GLS	No	8	0.0905		
d_LoanRate	ADF	No	6	0.0000		
d_LoanRate	GLS	No	4	0.0000		
Consumer Credit Conditions	ADF	No	2	0.6173		
Consumer Credit Conditions	GLS	No	2	0.9253		
ConsumerCreditConditions_change	ADF	No	1	0.0000		
ConsumerCreditConditions_change	GLS	No	2	0.0000		
Consumer Sentiment	ADF	No	0	0.0152		
Consumer Sentiment	GLS	No	0	0.0155		

Table 10: Unit Root Tests (*2*)

Inducement to Invest

Variable	Test	Trend	Lags	p-value	Test Statistic	5% CV
M	ADF	Yes	9	0.9999		
M	GLS	Yes	9		−1.0512	−2.89
d_l_M	ADF	No	1	0.0000		
d_l_M	GLS	No	4	0.0003		

Table 11: Unit Root Tests (*3*)

Variable	Test	Trend	Lags	p-value	Test Statistic	5% CV
Fed Funds Rate	ADF	No	7	0.3103		
Fed Funds Rate	GLS	No	7	0.1389		
d_l_FederalFundsRate	ADF	No	2	0.0000		
d_l_FederalFundsRate	GLS	No	2	0.0000		
Price Capital	ADF	Yes	13	0.2336		
Price Capital	GLS	Yes	7		−1.243	−2.89
PK_S	ADF	No	14	0.3297		
PK_S	GLS	No	14	0.4462		
d_PK_S	ADF	No	13	0.0000		
d_PK_S	GLS	No	0	0.0000		
PK_I	ADF	No	14	0.3817		
PK_I	GLS	No	15	0.2555		
d_l_PK_I	ADF	No	5	0.0009		
d_l_PK_I	GLS	No	8	0.0016		
NYSE Index	ADF	Yes	0	0.9454		
NYSE Index	GLS	Yes	0		−0.5523	−2.89
d_l_NYSEIndex	ADF	No	1	0.0000		
d_l_NYSEIndex	GLS	No	0	0.0000		
Y_nominal	ADF	Yes	2	0.9985		
Y_nominal	GLS	Yes	0		0.5239	−2.89
d_l_Y_nominal	ADF	No	9	0.0123		
d_l_Y_nominal	GLS	No	15	0.0158		
M1V	ADF	Yes	2	0.9638		
M1V	GLS	Yes	2		−0.8213	−2.89
d_l_M1V	ADF	No	2	0.0000		
d_l_M1V	GLS	No	10	0.0667		
Credit	ADF	Yes	9	0.9905		
Credit	GLS	Yes	9		−0.1220	−2.89
d_l_Credit	ADF	No	4	0.0050		
d_l_Credit	GLS	No	4	0.1944		

Table 12: Unit Root Tests (*4*)

Variable	Test	Trend	Lags	p-value	Test Statistic	5% CV
BCI	ADF	No	12	0.0000		
BCI	GLS	No	4	0.0013		
d_l_BCI	ADF	No	15	0.0000		
d_l_BCI	GLS	No	0	0.0002		
Uncertainty_BCI	ADF	No	0	0.0003		
Uncertainty_BCI	GLS	No	0	0.0000		
d_l_Uncertainty_BCI	ADF	No	1	0.0000		
d_l_Uncertainty_BCI	GLS	No	0	0.0000		
i	ADF	No	8	0.3445		
i	GLS	No	8	0.1522		
d_d_i	ADF	No	11	0.0000		
d_d_i	GLS	No	0	0.0000		
Forecasts	ADF	No	12	0.0000		
Forecasts	GLS	No	0	0.0000		
Surprise	ADF	No	11	0.0000		
Surprise	GLS	No	1	0.0000		

Table 13: Unit Root Tests (*5*)

Appendix 16 - Prospective Yields (Harvey 2021)

Harvey (2021) proposes two variables to proxy *prospective yields*, the nominator in the *MEK* equation (13): *Forecasts* & *Surprise*.[102] The first is built using the *purchasing managers' index*, which measures the overall confidence of purchasing managers. If its value is above 50, then these expect economic conditions to improve, and the opposite if it is below 50. It does not, however, provide a baseline on which one could base the sentiment of improvement, that is, a value of 55 in the middle of a recession and during an expansion have two very different meanings. In the latter, one can expect that this results in an increase of investment spending, while in the former, not so much.

Hence, to bridge this gap, Harvey (2021) proposes that use of the 1-year moving average of the standardized percentage change in *corporate profits*.[103] The interpretation of this variable is straightforward: if the previous year's average was $+1$, then profits were growing 1 standard deviation above their baseline average. The *PMI* is also standardized, such that it is now measure in standard deviations from the mean. Since both series are now in the unit, we can simply sum them, to obtain *Forecasts*. This is an indicator of the general state of the economy. For example, if profits were 1 standard deviation below their average, but entrepreneurs don't expect an improvement, then, overall, profits are forecasted to be 1 standard deviation below the previous year's average, the economic context is predicted to continue deteriorating. In an environment characterized by uncertainty, as is our monetary economy, the fulfilment or disappointment of expectations has consequences, for it can result in euphoria or panic, which further fuels expectations. To take this into consideration, Harvey (2021) simply subtracts the forecasts from realized profits. Thus, if entrepreneurs forecast their profits to grow by 1 standard deviation above the mean, but these actually contracted in the same proportion, then *Surprise* takes the value of -1. This is likely to result in a downward revision of next period's forecasts, and thus a decrease in investment purchases.

[102] C.f. Figures 29 & 55.

[103] We used before-tax profits, while Harvey (2021) instead opted for their after-tax counterparts.

Appendix 17 - BCI Uncertainty (Grier and Perry 1998)

We build our uncertainty variable following the method proposed in Grier and Perry (1998). The *business confidence index* (*BCI*)[104] exhibits some volatility, with some periods where the latter is more pronounced (the 1970s & 1980s, for example), and others were it is less so (1990s & early 2000s for example). This type of clustering patterns could indicate the some form of generalized ARCH behaviour, with the variance following an autoregressive path.

Before proceeding with the estimation of a *GARCH* model,we need to ensure that the series is stationary, that its AR residuals are white noite, and that the estimated residual variance is significantly time-varying, from a statistical standpoint. Both the ADF and the GLS unit root tests[105] have us rejecting the null hypothesis of non-stationarity. Informed by *lag select*, we model the *BCI* as an AR(13) process. Its residuals appear to be white-noise, while the squared residuals exhibit clusters of high and low volatility.[106]

Again making use of *lag select*, we model the squared residuals of the *BCI* as an AR(1), an AR(3), and an AR(4). The results for the presence of ARCH behaviour are follows:

Lags/Order	p-value
1	**0.0003**
3	**0.0006**
4	**0.0000**

Table 14: ARCH Test (*1*)

We reject the *null hypothesis* of *no ARCH behaviour*, and thus can proceed with the estimation. As mentioned in Grier and Perry (1998), a GARCH(1;1) approximates any arbitrary ARCH model, thus it is the one we will use. The estimated conditional variance equation, assuming that the error term follows a *T student* distribution is:

[104] C.f. 26.
[105] C.f. Unit Root Tests (*5*).
[106] C.f. 56 & 57.

$$\sigma^2_{\epsilon,t} = 0.0432 + 0.2262\epsilon_{t-1} + 0.6892\sigma^2_{\epsilon,t-1}$$ [107]

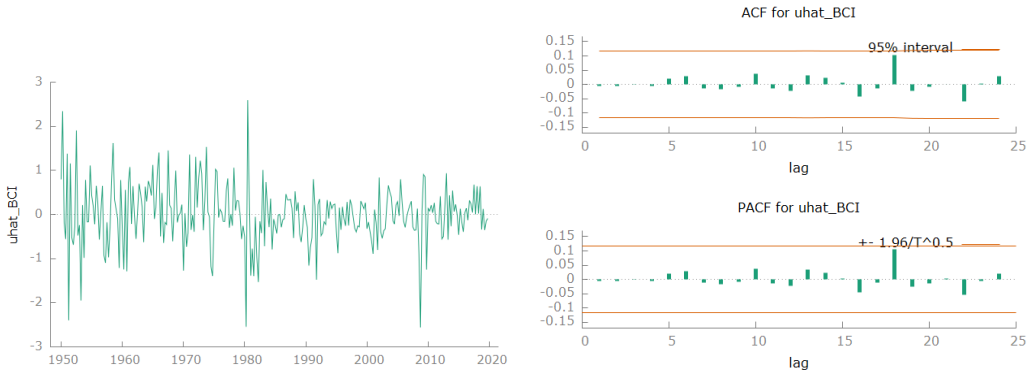
Neither the residuals, nor the squared residuals appear to have any significant lags, as expected.[108] To make sure that our model is successfully capturing all of the ARCH behaviour, we model the squared residuals as an AR(1), and perform the same test as before.

Lags/Order	p-value
1	**0.946**

Table 15: ARCH Test (2)

With a *p-value* close to the unit, we do not reject the *null hypothesis* of *no ARCH behaviour*, and thus can are able to conclude that our GARCH(1;1) properly models the ARCH patterns exhibited by the *BCI*. Following Grier and Perry (1998), we measure the *business confidence uncertainty* as the time-varying residual variance of the AR(13)-GARCH(1;1) model we estimated.

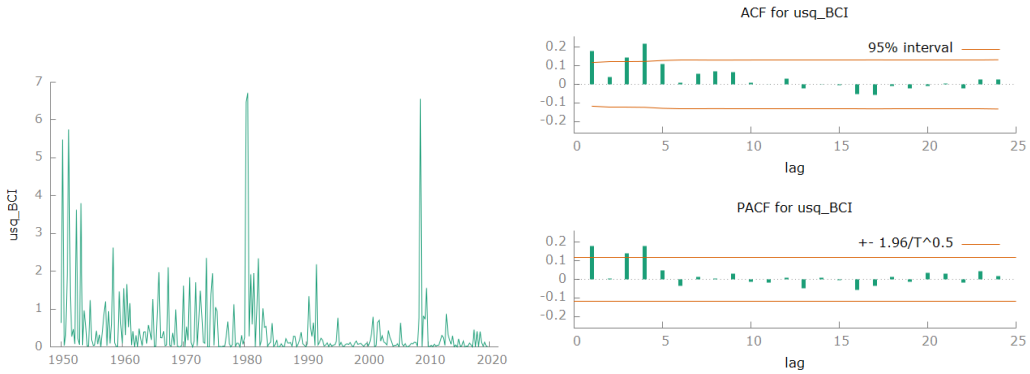
Plotting *business confidence* and its *uncertainty* (Figure 60), we can clearly observe that confidence appears to decrease when uncertainty increases, and vice-versa. This is what we would expect.



(a) Time Series Plot (b) Correlogram

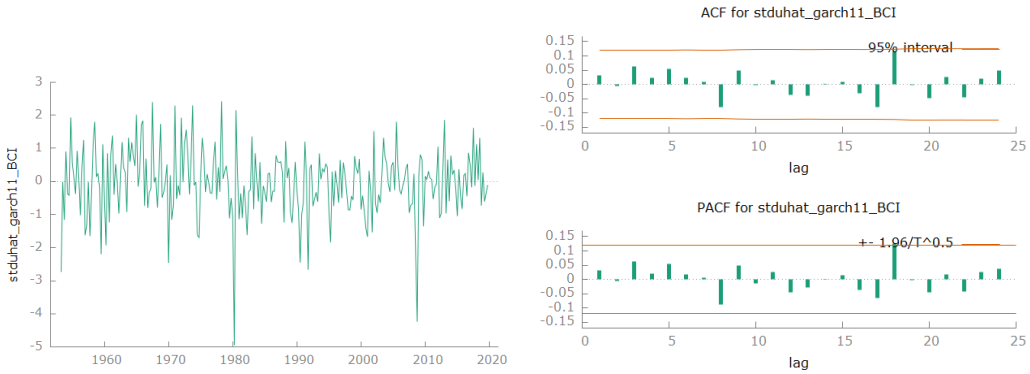
Figure 56: BCI AR(13) Residuals

[107] All coefficients are significant at the 10% level.
[108] C.f. 58 & 59.



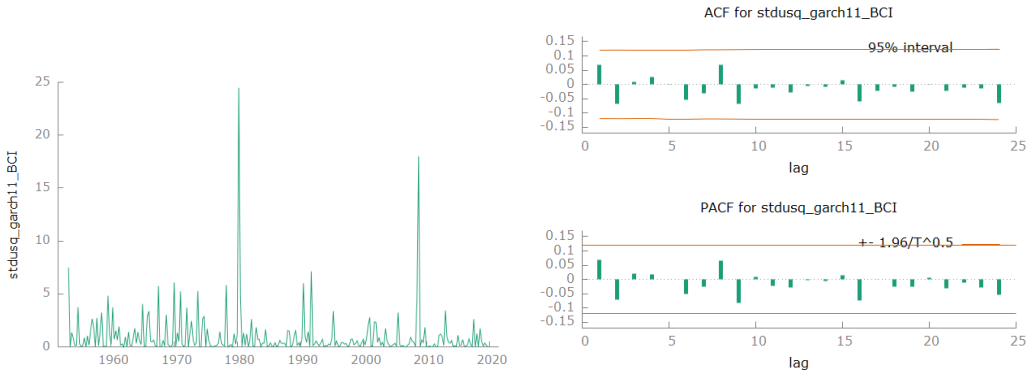
(a) Time Series Plot (b) Correlogram

Figure 57: BCI AR(13) Squared Residuals



(a) Time Series Plot (b) Correlogram

Figure 58: GARCH (1;1) Residuals



(a) Time Series Plot (b) Correlogram

Figure 59: GARCH (1;1) Squared Residuals

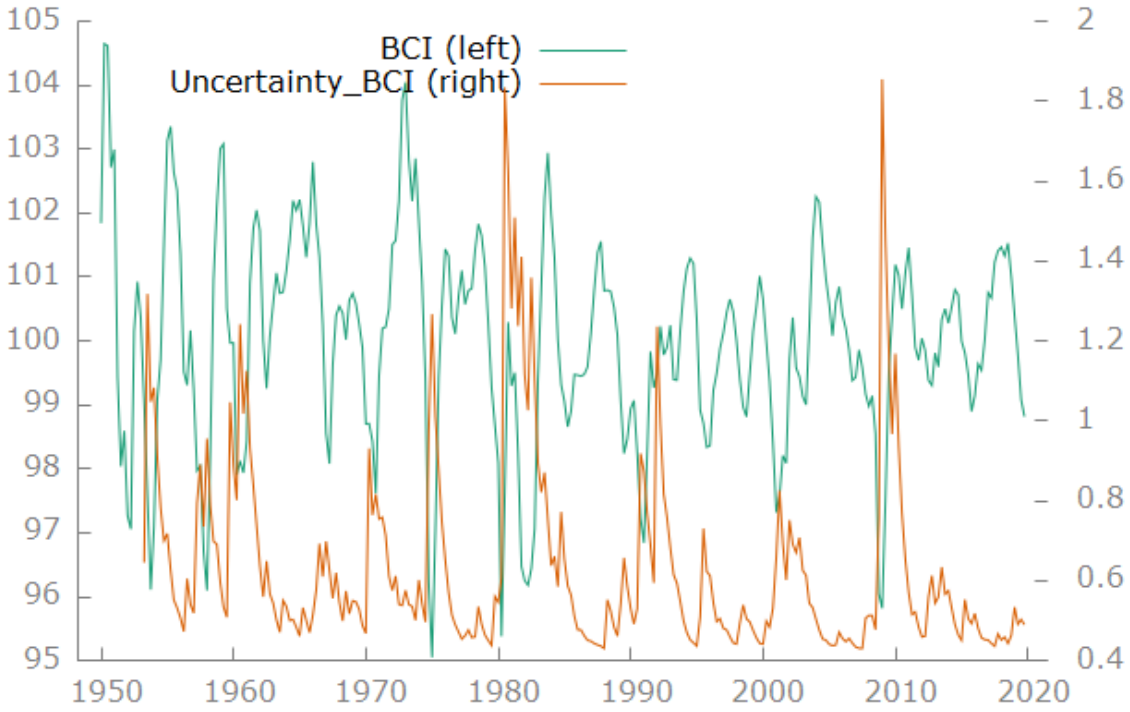


Figure 60: BCI & Business Confidence Uncertainty

Appendix 18 - Complete System

$$
\begin{cases}
M_t^D = \beta_1 FederalFundsRate_t + \beta_2 P_{K,t}^S + \beta_3 NYSEIndex_t + \beta_4 Y_{nominal,t} \\
+\beta_5 M1V_t + \beta_6 Credit_t + \beta_7 BCI_t + \beta_8 Uncertainty_{BCI,t} + \epsilon_t \\
i_t = \beta_1 M_t^D + \beta_2 FederalFundsRate_t + \beta_3 i_{t-1} + \beta_4 i_{t-2} + \beta_5 i_{t-3} + \beta_6 i_{t-4} + \epsilon_t \\
I_t = \beta_1 Forecasts_t + \beta_2 Surprise_t + \beta_3 P_{K,t}^I + \beta_4 i_t + \beta_5 I_{t-2} + \epsilon_t \\
Y_t = \beta_1 I_t + \epsilon_t \\
C_t = \beta_1 Y_t + \beta_2 Windfall_t + \beta_3 IncomeDistribution_t + \beta_4 LoanRate_t \\
+\beta_5 CreditConsumerConditions_t + \beta_6 ConsumerSentiment_t + \epsilon_t \\
N_t = \beta_1 I_t + \beta_2 C_t + \beta_3 N_{t-1} + \epsilon_t \\
N_t = \beta_1 ASF_t + \beta_2 CapacityUtilization_t + \beta_3 N_{t-1} + \epsilon_t
\end{cases}
$$

$$
Dependant\ Variable : M_t^D
$$

$$
Instruments : FederalFundsRate_t; P_{K,t}^S; Y_{nominal,t}; M1V_t; Credit_t; BCI_t; Uncertainty_{BCI,t}
$$

	Coefficient	Std. Error	z	p-value
$FederalFundsRate_t$	−0.0045	0.0011	−4.11	0.0000
$P_{K,t}^S$	0.0032	0.0013	2.42	0.0154
$NYSEIndex_t$	0.0071	0.0024	2.92	0.0035
$Y_{nominal,t}$	0.8032	0.0201	39.87	0.0000
$M1V_t$	−0.9753	0.01388	−70.24	0.0000
$Credit_t$	0.1165	0.0175	6.66	0.0000
BCI_t	−0.0512	0.02724	−1.88	0.0603
$Uncertainty_{BCI,t}$	0.0047	0.0014	3.29	0.0010
Mean dependent var	0.0139	S.D. dependent var		0.0126
Sum squared resid	0.0023	S.E. of regression		0.0031

Table 16: Liquidity Preference

$Dependant\ Variable : i_t$
$Instruments : M_t^D; FederalFundsRate_t; i_{t-1}; i_{t-2}; i_{t-3}; i_{t-4}$

	Coefficient	Std. Error	z	p-value
M_t^D	11.7551	3.4577	3.40	0.0007
$FederalFundsRate_t$	1.9734	0.3413	5.78	0.0000
i_{t-1}	−0.9295	0.0508	−18.29	0.0000
i_{t-2}	−0.9042	0.0641	−14.11	0.0000
i_{t-3}	−0.4830	0.0638	−7.58	0.0000
i_{t-4}	−0.3546	0.0492	−7.21	0.0000
Mean dependent var	−0.0030	S.D. dependent var		1.760
Sum squared resid	279.95	S.E. of regression		1.080

Table 17: Interbank Rate

$Dependant\ Variable : I_t$
$Instruments : Forecasts_t; Surprise_t; P_{K,t}^I; i_t; I_{t-2}$

	Coefficient	Std. Error	z	p-value
$Forecasts_t$	0.2620	0.0239	10.97	0.0000
$Surprise_t$	0.1001	0.0257	3.89	0.0001
$P_{K,t}^I$	−0.3512	0.1967	−1.79	0.0741
i_t	−0.0499	0.0137	−3.64	0.0003
I_{t-2}	0.1424	0.0467	3.05	0.0023
Mean dependent var	0.1184	S.D. dependent var		0.5863
Sum squared resid	52.808	S.E. of regression		0.4691

Table 18: Investment Function

$Dependant\ Variable : Y_t$
$Instruments : IndustrialProduction_t$

	Coefficient	Std. Error	z	p-value
I_t	2.1985	0.0908	24.20	0.0000
Mean dependent var	0.5772	S.D. dependent var		0.8281
Sum squared resid	145.096	S.E. of regression		0.7775

Table 19: Multiplier

$Dependant\ Variable: C_t$
$Instruments: IndustrialProduction_t; Windfall_t; IncomeDistribution_t;$
$LoanRate_t; CreditConsumerConditions_t; ConsumerSentiment_t$

	Coefficient	Std. Error	z	p-value
Y_t	0.5560	0.0305	18.21	0.0000
$Windfall_t$	0.1199	0.0416	2.88	0.0039
$IncomeDistribution_t$	0.1121	0.0151	7.41	0.0000
$LoanRate_t$	−0.0944	0.0151	−6.25	0.0000
$CreditConditionsConsumer_t$	0.0608	0.0104	5.85	0.0000
$ConsumerSentiment_t$	0.0008	0.0002	3.39	0.0007

Mean dependent var	0.4589	S.D. dependent var	0.4383
Sum squared resid	20.4376	S.E. of regression	0.2918

Table 20: Propensity to Consume

$Dependant\ Variable: N_t$
$Instruments: I_t; CreditConsumer_{change,t}; N_{t-1}$

	Coefficient	Std. Error	z	p-value
I_t	0.2623	0.0169	15.54	0.0000
C_t	0.0584	0.0242	2.41	0.0159
N_{t-1}	0.4613	0.0396	11.66	0.0000

Mean dependent var	0.0084	S.D. dependent var	0.3228
Sum squared resid	10.3230	S.E. of regression	0.2074

Table 21: Employment Function - Demand Side

$Dependant\ Variable: N_t$
$Instruments: IndustrialProduction_t; CapacityUtilization_t; N_{t-1}$

	Coefficient	Std. Error	z	p-value
ASF_t	2.9458	1.0991	2.68	0.0074
$CapacityUtilization_t$	0.0905	0.0067	13.59	0.0000
N_{t-1}	0.4758	0.0344	13.82	0.0000

Mean dependent var	0.0084	S.D. dependent var	0.3228
Sum squared resid	6.6109	S.E. of regression	0.1660

Table 22: Employment Function - Supply Side

Order	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 6	Equation 7
1	0.3993	0.9291	0.1373	0.5502	0.3184	0.4310	0.2071
2	0.1505	0.9843	0.3269	0.4795	0.2973	0.6371	0.4246
3	0.2429	0.9446	0.4137	0.2596	0.2909	0.7539	0.4078
4	0.2017	0.4862	0.5811	0.3201	0.4357	0.4495	0.3441

Table 23: Ljung-Box Chi-Squared Autocorrelation Tests - p-values