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Income Distribution, Productivity and Stagnation

An Alternative to the 'Secular Stagnation'-Narrative

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Colophon

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Mots clés : salaires, productivité, wage-led, profit-led, loi de verdoorn, analyse méta-régression, effet marx-webb

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To Alexandra Elbakyan, who fights for the righteous cause

After sacrificing a chicken and shedding its blood on the external HD containing the data, the desperate AP (missing just one top-field for his tenure case) lights a couple of black candles and prays to the gods of econometrics to get a 0.049 instead of a 0.051, on which his future career, financial stability, mortgage, city of choice, and marriage, depend.

Economist '903c' on
econjobrumors.com, 15.11.2018

Income Distribution, Productivity and Stagnation
An Alternative to the 'Secular Stagnation'-Narrative

Abstract

Since the Global Financial Crisis in 2007, mainstream economics debate has revolved around the possibility of 'secular stagnation', that is, a prolonged period of no or very low GDP growth. Adherents of the secular stagnation-narrative usually find possible explanations in imperfect capital markets, demographic change and capital-saving rather than capital-using innovations. The aim of the present PhD thesis is to present an alternative to the secular stagnation-narrative, by connecting income distribution, demand and productivity. We argue that increasing income inequality led to lower aggregate demand and productivity. Stagnation is not secular but human-made and measures can be taken to combat it. Chapter I is dedicated to Verdoorn's law – the link between output growth and productivity growth. While the overwhelming majority of empirical studies finds statistically significant and positive results for Verdoorn's law, there is no consensus about its magnitude. Using meta regression analysis (MRA) on 52 studies with 665 estimations of Verdoorn's law, we find no publication bias and statistically significant meta-averages for Verdoorn's law in all specifications used by Verdoorn (1949), Kaldor (1975), and Rowthorn (1975). Apart from Rowthorn's first specification, all used specifications yield Verdoorn coefficients between 0.44 and 0.69 which indicate increasing returns to scale.

Chapter II estimates Verdoorn's law and the Marx-Webb effect based on data for 23 EU28 members for the period 1995-2017 using the EU-KLEMS data set (Stehrer et al. 2019). As EU-KLEMS separates by sector, the panel data analysis can differentiate between manufacturing and non-manufacturing sectors. Our contribution to the existing literature consists in 1) the use of auto-regressive distributed lag (ARDL) models, in order to separate between short-run Okun effects and long-run Verdoorn effects. Another contribution lies in the fact that, contrary to most of the available literature on Verdoorn's law and the Marx-Webb effect, the analysis undertaken controls for potential cross-sectional dependence. Again, our analysis finds statistically significant Verdoorn coefficients – between 0.378 and 0.966 – and statistically significant Marx-Webb effects – between 0.193 and 0.315.

Chapter III again uses meta-regression analysis to provide an overview of the literature on the Bhadhuri-Marglin model. Most industrial countries have experienced a long-term fall in the wage share since the 1970s. Thus, there has been a shift in the functional distribution from wages to profits with consequences for economic growth. The overall strength of the approach consists in presenting a compromise between the neo-Kaleckian and neo-Goodwinian views of how changes in income distribution affect economic growth. The estimation results can thus be directly used for policy recommendations and are thus (at least amongst heterodoxy) subject to great debates. Two problems arise out of this. First, there is a strong split between wage-led and profit-led country results which are assumed to be partly explained by differences in estimation methodology. Therefore, there exists a need for a definitive answer how strongly these differences affect the overall outcome. This meta-regression analysis assesses 34 studies with 494 empirical estimates for domestic and total demand. Here, the MRA finds indications of small-magnitude publication bias in favour of wage-led demand regimes. More precisely, the average country is found to be wage-led when analysing domestic demand and profit-led in the case of total demand.

Keywords: wages, productivity, wage-led, profit-led, verdoorn's law, meta-regression analysis, marx-webb effect

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Résumé

Depuis la crise financière mondiale de 2007, le débat économique dominant s'articule autour de la possibilité d'une "stagnation séculaire", c'est-à-dire une période prolongée de croissance nulle ou très faible du PIB. Les partisans de la stagnation séculaire trouvent généralement des explications possibles dans l'imperfection des marchés des capitaux, les changements démographiques et les innovations qui économisent le capital plutôt que de l'utiliser.

L'objectif de cette thèse thèse de doctorat est de présenter une alternative au récit de la stagnation séculaire, en reliant la distribution des revenus, la demande et la productivité. Nous soutenons qu'inégalité croissante des revenus entraîne une baisse de demande globale et la productivité. La stagnation n'est pas séculaire mais d'origine humaine et des mesures peuvent être prises pour la combattre. Le chapitre I est consacré à la loi de Verdoorn – le lien entre la croissance de la production et la croissance de la productivité. Si l'écrasante majorité des études empiriques semble trouver des résultats statistiquement significatifs et positifs pour la loi de Verdoorn, il n'y a pas de consensus à propos de son ampleur. En utilisant une méta-analyse (MRA) sur 52 études avec 665 estimations de la loi de Verdoorn, nous ne trouvons aucun biais de publication et des méta-moyennes statistiquement significatives pour la loi de Verdoorn dans toutes les spécifications utilisées par Verdoorn (1949), Kaldor (1975) et Rowthorn (1975). Hormis la première spécification de Rowthorn, toutes les spécifications utilisées donnent des coefficients de Verdoorn compris entre $0,44$ et $0,69$ qui indiquent des rendements d'échelle croissants.

Le chapitre II estime la loi de Verdoorn et l'effet Marx-Webb sur la base des données de 23 membres de l'UE28 pour la période 1995-2017 en utilisant l'ensemble de données EU-KLEMS (Stehrer et al. 2019). Comme EU-KLEMS permet l'analyse par secteur, l'analyse des données de panel peut différencier les secteurs manufacturiers et non manufacturiers. Notre contribution à la littérature existante consiste en 1) l'utilisation de modèles ARDL (auto-regressive distributed lag), afin de séparer les effets Okun à court terme des effets Verdoorn à long terme. Une autre contribution réside dans le fait que, contrairement à la plupart de la littérature disponible sur la loi de Verdoorn et l'effet Marx-Webb, l'analyse entreprise contrôle la dépendance transversale potentielle. Encore une fois, notre analyse trouve des coefficients de Verdoorn statistiquement significatifs – entre $0,38$ et $0,97$ – et des effets Marx-Webb statistiquement significatifs – entre $0,19$ et $0,32$.

Le chapitre III utilise à nouveau la méta-régression pour donner un aperçu de la littérature sur le modèle de Bhadhuri-Marglin. La plupart des pays industriels ont connu une baisse de la part des salaires depuis les années 1970. Il y a donc eu une déformation du partage de la valeur ajoutée en faveur des profits, avec des conséquences sur la croissance économique. L'originalité de notre approche consiste à présenter un compromis entre les points de vue néo-Kaleckien et néo-Goodwinien sur la façon dont les changements dans la distribution des revenus affectent la croissance économique. Les résultats de l'estimation peuvent donc être directement utilisés pour des recommandations politiques et sont donc sujets de grands débats. Deux problèmes en découlent (au moins parmi les hétérodoxes). Tout d'abord, il existe un fort clivage entre les résultats des pays tirés par les salaires et ceux des pays tirés par les bénéfices, qui s'expliquerait en partie par des différences dans la méthodologie d'estimation. Il est donc nécessaire d'apporter une réponse tranchée à la question de la mesure dans laquelle ces différences affectent le résultat global. Cette analyse de méta-régression évalue 34 études avec 494 estimations empiriques pour la demande intérieure et totale. Ici, la méta-régression trouve des indications d'un biais de publication de faible ampleur en faveur des régimes de demande tirés par les salaires. Plus précisément, on constate que le pays moyen est wage-led lorsqu'on analyse la demande intérieure et profit-led dans le cas de la demande totale.

Mots clés : salaires, productivité, wage-led, profit-led, loi de verdoorn, analyse méta-régression, effet marx-webb

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Without wishing to diminish my own achievement, the truth is that I have an intact infrastructure of people and institutions at my disposal, without which it would probably not have come to this moment. In the following lines, I would like to express my gratitude to them for their support.

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In terms of my academic career so far, there are some people and groups that have had a particularly strong influence on me. Karl Milford is responsible for the few hours in my bachelor's degree the were not consisting neoclassical teaching, as well as for the – only ever-existing – units on philosophy of science. All economists would benefit from the latter. During my Master's studies, Engelbert Stockhammer in particular was groundbreaking for my further educational path. His thoughtful and clear comments were essential in digesting the literature. I still find myself using his formulations in my own lectures. I would like to thank my co-authors Quirin Dammerer, Miriam Rehm and Matthias Schnetzer for their cooperation in our joint project so far. Chapter III of this thesis is based on our joint efforts. I am indebted to Michael Berger, Louison Cahen-Fourot, Quirin Dammerer and Thibaut Lenormant for the many hours of discussion, as well as the multiple proofreading of large parts of my thesis. Any PhD student can only count himself lucky to have such friends. Last but not least, I would like to thank Dany Lang for becoming my supervisor and for bringing Verdoorn's law to my attention as a possible topic of research.

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During the past 6 years, I have taught more than 10 university courses. I am convinced that it is teaching that enables economists to break down complex relationships to simple explanations everybody can relate to. It is also teaching that ensures an exchange with the real world outside of the ivory tower that university research can become sometimes (at least with the real world of those privileged people to whom studying at a university is an option). With this in mind, I want to express my sincere thanks to my former and current students at Sorbonne Paris Nord (formerly Paris 13), Vienna University of Economics and Business and the University of Applied Arts Vienna.

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Acronyms

AIC Akaike Information Criterion.

AMECO Annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs.

ARDL Auto-regressive distributed lag model.

CES Eonstant elasticity of substitution production function.

CS-ARDL Cross-sectional auto-regressive distributed lag model.

DCCE Dynamic common correlated effects model.

EU28 The 28 member countries of the European Union (prior to Brexit).

FAT Funnel-asymmetry test.

GDP Gross domestic product.

IMF International Monetary Fund.

MAER Meta-Analysis of Economics Research Network.

MMT Modern modern monetary theory, a sub-group within post-Keynesian economics which is especially prevalent in the US.

MRA Meta-regression analysis.

OECD Organisation for Economic Co-operation and Development.

PEESE Precision-effect estimate with standard error.

PET Precision effect test.

TFP Total factor productivity – the portion of growth in output not explained by a traditional Cobb-Doublas production function.

US United States of America.

WLS Weighted-least-squares.

Symbols

α output elasticity of capital (assuming a Cobb-Douglas production function)

β output elasticity of labour (assuming a Cobb-Douglas production function)

c_Π propensity to consume out of profits s_W

c_W propensity to consume out of wages

$\dot{e}$ employment growth

η elasticity of labour supply with respect to the real wage (assuming a Cobb-Douglas production function)

g_n 'natural' growth rate

I aggregate private investment

$\frac{I}{Y}$ investment-output ratio

K aggregate capital stock

$\frac{K}{Y}$ capital-output ratio

μ returns to scale

n number of observations

p precision (the inverse standard errors of the primary literature)

Π aggregate profits

π profit share (the relative share of total profits with respect to output, wage share and profit share together result in total GDP)

ψ wage share (the relative share of total wages with respect to output, wage share and profit share together result in total GDP)

$\dot{q}$ output/demand growth

r partial correlation

S aggregate private savings

s_Π propensity to save out of profits s_W

s_W propensity to save out of wages

$\frac{S}{pY}$ saving-income ratio

se standard error

σ elasticity of substitution between labour and capital

t t-statistics of the primary literature

τ_1 demand regime (positive in wage-led demand regime, negative in profit-led demand regime)

$\dot{w}$ real wage growth

ξ effect of demand-induced technical change (used by Basu and Budhiraja (2020))

Y aggregate output/demand

$\dot{y}$ productivity growth

$\dot{y}_q$ Verdoorn effect (effect of output growth on productivity growth)

$\dot{y}_w$ Marx-Webb effect (effect of real wage growth on productivity growth)

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Introduction

One of the central advantages of Capitalism with regard to former systems of economic and political order is its dynamism, reflected in positive productivity growth rates. As can be seen in Figure 1, before the industrial revolutions, we lived in a world of permanent economic stagnation. This state of living was called the '*cycle of misery*' by political economist Thomas Malthus – better known today as the 'Malthusian trap'. Productivity growth rates were close to zero before the 18^{th} century and therefore, gross domestic product (GDP) could only increase due to an increase in population. GDP per capita, however, stayed constant and humanity was doomed to live in a world without much of an increase in living conditions. It was only with increases in productivity, starting with the first industrial revolution, lead by the use of fossil fuels, slave economies in colonial regions and higher wages (Allen 2011) - that GDP per capita experienced an extreme rise. The achievements obtained by the industrial revolution started in Western European countries and then diffused across the globe - that is, of course, without taking into account the increase in income inequality which accompanied the emergence of capitalism (Piketty 2020).

One of the questions arising out of this is whether these increases in productivity can be sustained in 'mature capitalism' just as well as during its 'infant stage'. My bachelor in Economics at the University of Vienna started back in 2009, in midst of the

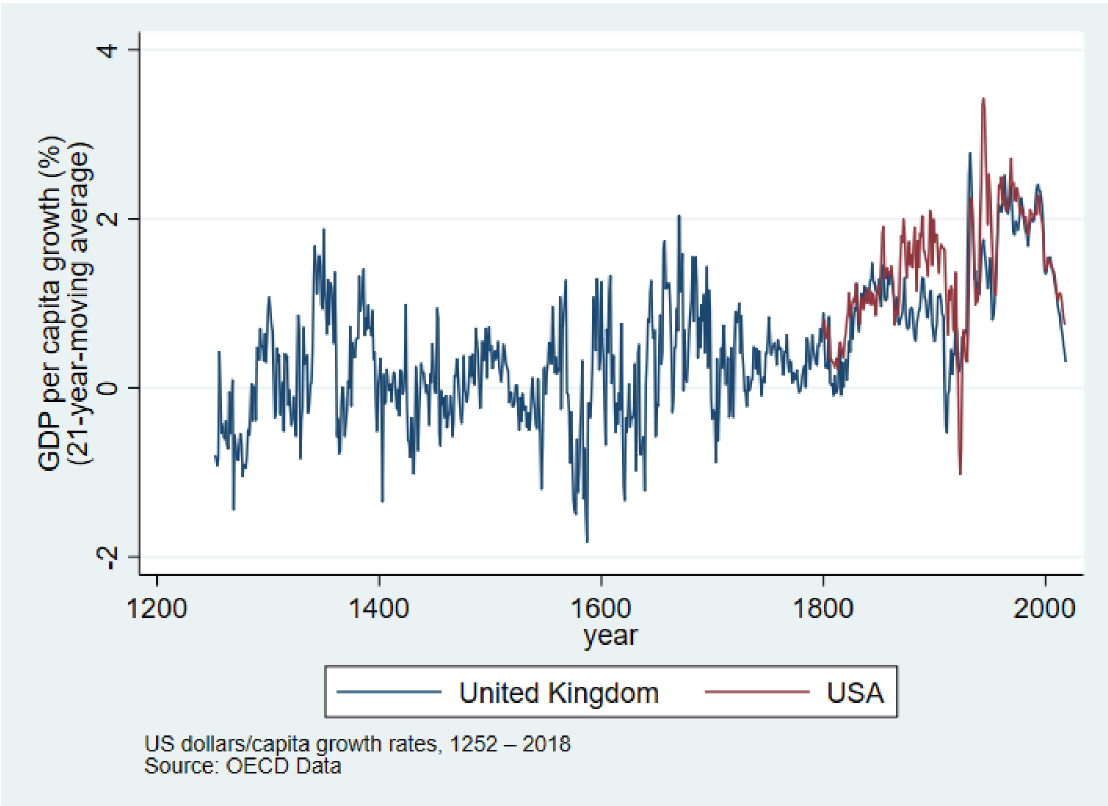

Figure 1 – GDP per capita growth rates 1252-2018 using 21-year moving averages

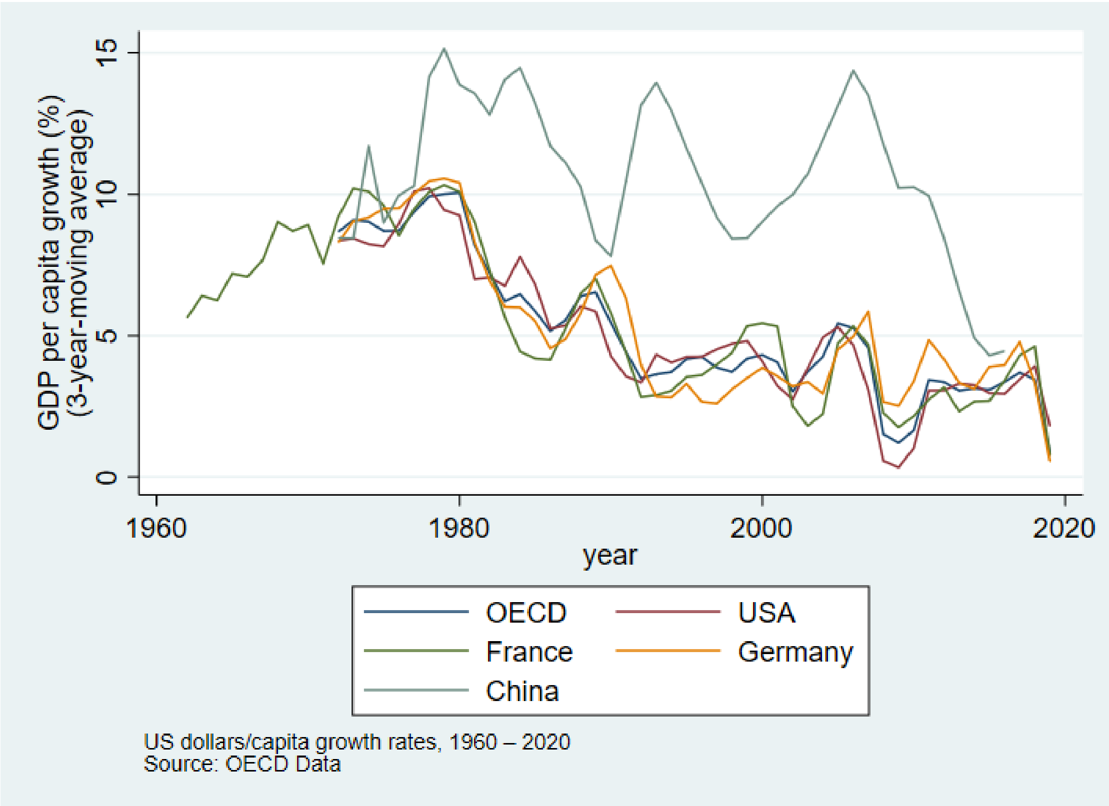

Figure 2 – GDP per capita growth rates 1960-2020 using 3-year moving averages

shock waves of the Global Financial Crisis and the Great Recession. Both events marked yet another decline in the long-run development of world-wide growth which already started during the 20^{th} century. Indeed, this trend of falling growth rates had already started from the last quarter of the 20^{th} century onward, as can be seen in Figure 1. In the past years, GDP per capita growth rates for both the United Kingdom and the United States (US) have reached levels lastly seen at the beginning of the 20^{th} century. Since the Global Financial Crisis, many countries have not been able to return to pre-crisis GDP growth rates. This is even more evident when comparing their growth experiences to the post-war period. As can be seen in figure 2, the GDP per capita growth rates for Germany, China, the US and members of the Organisation for Economic Co-operation and Development (OECD) in general have been continually falling from the 1980s onward. Even China, although not following the overall trend, finds itself confronted with the lowest recorded growth rates in its history.

For some mainstream economists, these stylised facts represent not just a short-run deviation from the respective countries' long-run growth path. Rather, the growth path itself changed. Low growth rates are not signs of the economic cycle's longer downturn. Instead, according to certain economists, low growth has come to stay (Summers 2014b; Gordon 2015). As is often the case with grand ideas in economics, both good and bad, this idea is not novel but rather a rehash of an 'academic scribbler of a few decades back' (Keynes 1936). The idea of 'secular stagnation', a grim future, paved with sustained low or no GDP growth rates was first expressed by Alvin Hansen back in the 1930s. Hansen (1938) created this concept in midst of the Great Depression, the longest, deepest and widest crisis in capitalism's history up to date (Kindleberger, DeLong, and Eichengreen 2013). In its current version, the possible explanations of such secular stagnation range from a global 'savings glut', innovations becoming less innovative to demographic changes.

In this thesis, we argue that the mainstream's attempt to explain low growth rates during the past decades is both unsuccessful and throwing out the baby with the bathwater. Negative equilibrium interest rates, less innovative innovation or an ever-ageing and -indebted population are overly complicated explanations and are put forward for consistency within mainstream economics more than to point at the problem at heart. Instead, we propose a different explanation for weak long-term growth rates, building on 85 econometric studies on the determinants of demand growth and productivity growth. Furthermore, we conduct a panel data analysis of our own using data for 23 of the (former) EU28 member states. As we will argue, there is nothing secular about this stagnation. Following well-known heterodox literature, the Verdoorn effect (Verdoorn 1949; Kaldor 1966; McCombie, Pugno, and Soro 2002) might be a much better explanation for long-term low growth rates. Our counter-proposal lies in taking demand effects seriously, even in the long run. According to this view, the long-run increase in personal and functional income inequality on the national scale has resulted in relatively lower aggregate income and thus lower aggregate demand. This decrease in demand not only leads to lower growth rates today, but via Verdoorn's law results in lower productivity growth rates. Stagnation is thus not secular - it is human-made and appropriate measures can in consequence be taken against it.

Using 'Verdoorn's law' – the relation between aggregate demand growth and productivity growth – to explain today's low GDP growth via higher income inequality presupposes an economic effect from inequality to GDP growth. While in mainstream economics, this topic has been completely out of the centre of attention, interactions between the functional distribution of income and GDP growth have been a core issue for several schools of economic thought for a long time. In particular, the post-

Keynesian and neo-Goodwinian literature have focused on this relationship for decades. The Bhadhuri-Marglin model (Bhaduri and Marglin 1990, also known as the 'wage-led/profit-led model') has been commonly used for the past 30 years to analyse changes in functional income distribution and GDP growth.

In continuation, section 1 presents an overview of the theoretical debate on secular stagnation in the mainstream and its critique. Section 1 then presents the alternative framework we use in the remainder of this thesis.

Secular stagnation - the theoretical debate

The debate about secular stagnation is older that is commonly assumed. While the term 'secular stagnation' today is broadly assumed with New Keynesian economist Larry Summers, it tracks back to the 1930s and was first used by Alvin Hansen. Figure 4a shows a Google Ngram plot of the word 'secular stagnation' in four different ways of spelling. Google Ngram is an online search engine that charts the frequencies of any given set of words using digitalised sources of Google's text archive. If the given word or word combination is found in 40 or more books the yearly frequency relative to the overall text archive is displayed as a graph.

Hansen's (1938) worries where heavily discussed until the mid-1905s amongst economic theoreticians, most notably Joseph Schumpeter and Paul Sweezy (Roubtsova 2016). This intermezzo is of particular interest to our thesis, as the arguments put forward by Sweezy were reformulated into a seminal book on the US economy by Baran (1966). This book contained arguments that would be used in both the debates surrounding secular stagnation and the debates on income distribution and growth that would later on emerge as the Bhadhuri-Marglin model (Lavoie 2017a, p. 202). The

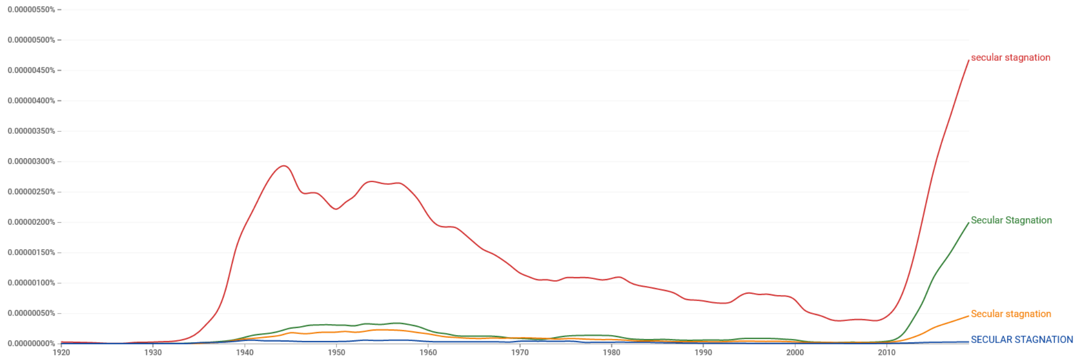

Figure 3 – Google Ngram of 'secular stagnation'

(a) The values on the y-axis represent the relative share the word 'secular stagnation' relative to all words in Google corpus as a percentage.

mainstream debate on secular stagnation has the same roots as the heterodox debates on demand, productivity and employment regimes. Nevertheless, the debate inside the economic mainstream only started again after the influential contributions of Summers (2014a) and Summers (2014b).

Summers argued that Hansen's (1938) theory of secular stagnation might explain the current weak growth performance of the United States. According to Summers (2014a), the US growth experience from the 1990s onward has been weaker than before and only sustained by ever-increasing financial bubbles. Economic growth has not been stable and indeed built upon an unsustainable base of ever-rising prices of financial assets for the past 20 years, combined with rising private debt. Therefore, the US economy, according to Summers (2014a), has been structurally stagnant due to a lack of aggregate demand, even in the long run. This had lead to a negative natural rate of interest (the interest rate that guarantees full employment in the Wicksellian sense), against which central banks could not intervene with sufficient strength due to the 'zero lower bound'.

The zero lower bound expresses the fact that the nominal interest rate set by central banks cannot go below zero. According to mainstream economic theory, central banks conduct monetary policy via interest-rate targeting in such a way that aggregate supply of ’loanable funds’ (savings) equals its demand (investments). In this case of excessively high savings and/or excessively low investments, Summers (2014a) explains, the resulting equilibrium interest rate can turn negative. In this case, central banks could try to increase investments via expansionary monetary policy in form of lower interest rates. Under the extreme circumstanced described by Summers (2014a) however, central banks find themselves unable to accommodate this excess supply in loanable funds. Instead, central banks find themselves ’running out of ammunition’ at the lower bound of zero percent interest rates.

In normal times this excess in savings would lead to a capital outflow into the rest of the world because rentiers would be looking for higher financial profits elsewhere. Contrary to the prediction of mainstream theory however, this equilibrating outflow of domestic financial flows did not happen. The result is a reinforcement of already existing global current account imbalances between excess-saving current account surplus countries and indebting current account deficit countries[1]. Since the financial outflows needed for full employment did not happen, Summers (2014a) concludes that secular stagnation might affect not only the US economy, but rather the world as a whole.

The main reason brought forward for such a ’global savings glut’ is the ageing populations of important parts of our world. This issue becomes especially important in

[1]While these current account imbalances according to mainstream economics textbooks should not exist, the real-world imbalances are of significant magnitude. Both current account surpluses as well as current account deficits are unsustainable in the long run. A country running a current account deficit is accumulating debt against the rest of the world. If the respective country has to indebt itself in a currency over which it has no sovereignty over (i.e. which it can create itself), a continued current account deficit leads to a countries’ bankruptcy. While one country’s current account surplus represents higher financial independence, its’ excess savings represent forgone investments that could have improved living standards. More importantly, a growth strategy based on current account surpluses is unstable in the long run, as it relies of the falling demand of ever-higher indebted current account deficit countries.

countries with not adequately developed pension systems like China, India and Japan where people need to allocate adequate savings for future retirement.

A fall in relative prices of global investment goods might further reinforce global imbalances. The Great Depression of 2007-2008 itself created significant uncertainty about the stability of the global financial system, triggering a rise in the demand of safer assets. At the same time, the increase in public debt due to necessary government spending in form of financial aids during the Great Recession and its aftermath is put forward as another reason for insecurity on global financial markets. This idea is what Paul Krugman calls the 'confidence fairy'. According to this view within mainstream economics, a cut in government expenses would project a long-term strategy to lower public debt and avoid bankruptcy. As these measures would restore confidence about a country's public debt development in global financial markets, interest yields on government bonds would fall. Yet, the mainstream policy recommendations of 'balanced budgets', based on zero-deficit spending are precisely what the amount of safe assets that governments around the world could provide for finance, desperately looking for secure profits. The global savings glut, in consequence, embodies nothing else but the flip-side of the 'balanced budget' dogma that governments all over the world subjected themselves to.

A third potential reason for low growth in the secular stagnation literature is the debt overhang in many parts of the world. Prominent examples consist in high student debts, especially in Anglo-Saxon countries. Another example is the world-wide rise of indebtedness of firms since the Great Recession which was perceived by economists with increasing discomfort. Here, different explanations are put forward. On the one hand, the gigantic expansionary monetary policies put forward by central banks in the western world enabled firms to preserve unsustainable business models for much longer than usually possible. These fears of 'zombie firms' are especially prevalent amongst European countries and have only increased following the repeated enforced shutdowns of economic activity due to the repeated COVID-related lock-downs of 2020 and 2021. On the other hand, the reluctance of private banks to give out loans to businesses and households because of doubts concerning credit-worthiness is seen as a possible source of stifled demand.

Two final reasons possibly leading into an age of lower growth are being put forward. One concerns the overall decrease in human capital, for example in form of workers' average years of studies a topic especially discussed in the case of the US. The other prominent idea is Hansen's (1938) argument that innovations became less innovative over time.

In summary, the potential 'headwinds' (Gordon 2015) of demography, debt, education, inequality, lacking innovation as well as passive private and public investment demand are the main culprits put forward as possible causes for secular stagnation. As was already argued in chapter I, the debate around secular stagnation might have triggered renewed interest in Verdoorn's law, the relation between output/demand growth on productivity growth.

In 'The New Normal: Demand, Secular Stagnation, and the Vanishing Middle class', Storm (2017) argues that the current debate on secular stagnation is an artificial question. Rather than exogenous shocks or supply constraints it really is depressed demand that permanently lowered productivity growth, the engine of long-term economic growth.

After devoting a considerable part of his article to criticising the concept of both total factor productivity (TFP) as well as the use of any model based on a Cobb-Douglas-type of production function, Storm (2017) argues that the secular stagnation of U.S. economic growth and the vanishing of the American middle class actually do have common roots

– in the deliberate creation after 1980, through economic policies, of a structurally low-wage-growth economy that not only polarised jobs, incomes, and wealth as well as slowed down capital deepening, the division of labour, and labour-saving technical progress in the dynamic segment of the economy.

Because labour productivity growth, in turn, is influenced by demand factors, the causes of secular stagnation must lie in inadequate demand. Inadequate demand, in turn, is the result of a growing segmentation of the U.S. economy into a 'dynamic' group of sectors that is shedding jobs and a 'stagnant' or 'survivalist' group of sectors that acts as an 'retention basin of employment' for those that cannot find jobs in the dynamic sectors. Hence the outlook might be similar to Storm and Naastepad (2013): Unemployment might be averted but the price to pay might be too high, namely in form of low-quality employment, also known as 'Bullshit-Jobs' (Graeber 2018; Galbraith 2017). '*Hence, sluggish business investment in the United States has been a key factor behind the stagnation of TFP growth as well as responsible for propagating hysteresis-like adverse consequences for TFP and potential output after 2008*' (Storm 2017, p. 182). The argument is illustrated with long-run growth-accounting data for the U.S. economy (1948–2015). The mechanics of dualist growth are highlighted using a Baumol-inspired model of unbalanced growth. Using this model, it is shown that the 'output gap', the anchor of monetary policy, is itself a moving target. As long as this endogeneity of the policy target remains not understood, monetary policy makers will continue to contribute to unbalanced growth and premature stagnation.

Storm (2017) makes a powerful argument from a post-Keynesian perspective, stating the importance of demand-side effects not only in the short, but in the long run as well. Rather than some mysterious external forces condemning the US to everlasting low growth it might very well be that some internal mechanism led to this outcome. Storm

(2017) stresses the importance of income distribution and its link to innovation via the Kaldor-Verdoorn effect from a macro-economic point of view.

However, several question could be asked to be discussed in greater detail. First, why is there no discussion of financialisation? Given the overall timeline covered by the author, one would expect to at least have a short mentioning of the most important contributions highlighting the fundamental changes that the financial system went through during the last sixty years, thereby changing the options of states, capitalists and workers as well. There might indeed be reason to think that the Kaldor-Verdoorn effect itself might have gotten weaker during financialisation. Secondly, the effect of off-shoring, the 'platform-capitalism' and crowd-working might explain some part in the overall process of de-industrialisation reported by Storm (2017). Jobs like cleaning, which in national account standards count towards manufacturing might change their position to the service sector when the cleaning personal in question is starting to work for an external firm. This might mean that the overall effect of de-industrialisation is being over-estimated.

While Galbraith (2017) shares Storm's (2017) dismissal of TFP growth as an exogenous determinant, there are more disagreements than points in common when it comes to questions of methodology as well as the political and economic implications of inequality, wage repression and the role of demand for the poor performance of the US in the last decade. Starting with a critique of Storm's (2017) use of equilibrium-based modelling and the use of neo-classical modelling in order to convey a message across schools of thought-borders, the author emphasises the need for Evolutionary Economics as an alternative to continuing equilibrium-based demand-centered modelling. According to the author in using this kind of paradigm, 'the conceptual distinction between demand-side and supply-side effect fades away' (Galbraith 2017, p. 212). According to the author, this creates a complete misunderstanding of the underlying problems. '*The distinction between equilibrium and evolution affects the policy menu directly. For those who favour the hysteresis view, the solution appears to be steady pressure on the demand front* [...] *In the evolutionary view, the engine is broken and may or may not be possible to repair.*' (ibid.). There is also severe disagreement on the overall social conditions of the US-American middle class. While Storm (2017) perceives its' vanishing, Galbraith (2017) cannot see any proof for this, stating that although under attack, the social pillars of the American middle-class still prevail. He also criticises Storm's (2017) use of the median wage as an indicator for the middle-classes' well-being while doubting the usefulness of presenting each economic sector on its own rather than stressing the connectivity of certain industrial and service-sectors (using the car industry and car retailers as an example). Agreeing with the author of the original paper, Galbraith (2017) claims the experience of Sweden to be a prime example of wage-led innovation policy, stressing that '*labor market deregulation, depressing wages, discourages productivity growth*' (Galbraith 2017, p.214).

Galbraith's (2017) comment is certainly valuable in that he adds another layer questioning Storm's (2017) methodology, especially when it comes to his neglect of sectorial interdependencies. Several other remarks made seem to be surprising however. It seems hard to imagine that following the recent events in US politics the author really cannot see in what kind of way the US middle-class should be declining, or at least feel as if it was declining. On more economic terms, it seems inconsistent to mention Sweden as an argument for the use of high-wage policies for long-term growth and at the same time arguing that this relationship changes once 'countries get rich' (as if that were a static term) and that '*the employment of large numbers at modest wages* [..] *would have to be afforded and tolerated by the population that pays for them*' just one paragraph later. Similarly one phrase later, Galbraith (2017) comments that higher wages in education or health-care would increase productivity, as both are very labour-dependent. While this might be true in the middle term, there would be no cars if everybody had agreed on the notion that 'all we need is a faster horse'.

Contrary to Galbraith (2017), Lazonick (2017) agrees with Storm (2017) about the general decline of the US middle-class as well as the ever-increasing income inequality. While overall agreeing with Storm (2017), the author provides a micro-economic explanation of the effect of financialisation of the firm, away from 'refrain and re-invest' to 'downsize and distribute' that is quite in harmony with the macro-economic explanation provided by Storm (2017). The major difference is that Lazonick (2017) sees most of the processes mentioned by Storm (2017) as supply-side, rather than demand-side effects. Altogether, three forces of change are being identified, namely rationalisation (characterised by plant closings and permanent layoffs, terminating the jobs of high-school-educated blue-collar workers, many of them well-paid union members), marketisation (characterised by the explicit eradication of a career with one company as an employment norm) and globalisation (characterised by an acceleration of the movement of employment offshore to lower-wage nations and the movement to the United States of foreign workers). In the words of the author,

> '*U.S. corporations often pursued rationalisation, marketisation, and globalisation to cut current costs rather than to re-position themselves to produce competitive products* [while at the same time] *Trillions of dollars that could have been spent on innovation and job creation in the U.S. economy over the past three decades have instead been used to buy back stock for the purpose of manipulating stock prices. For the decade 2007–2016, U.S. corporations' total*

> *net equity issues—new share issues less shares taken off the market through buybacks and merger and acquisition deals— averaged minus $412 billion per year. For 2007–2016, the 461 companies in the S&P 500 Index in January 2017 that were publicly listed over the decade expended $4.0 trillion on stock buybacks, representing 54.5%'* (Lazonick 2017, pp.221).

To recapitulate, the secular stagnation-narrative is nothing new stems from the seminal work of Hansen (1938). While Hansen (1938) argued in a (relatively) demand-side fashion, the secular stagnation narrative today uses mainly supply-side arguments. While these arguments are certainly important issues to take into account, they do ignore crucial economic mechanics that are highlighter by authors such as Storm (2017), Galbraith (2017), and Lazonick (2017). Contributions such as Gordon (2015) are intriguing in that they lead us to think about deeper structural changes happening in leading economies such as the US. They are however fatalist in nature and provide a glimpse into a rather bleak future. We argue that the decline in GDP per capita growth cannot be explained by imperfect capital markets or demographic changes alone. In that regard, our argument is similar to the one put forward by Storm (2017), that is, the changes in real wages and demand during the recent decades had long-run impacts on productivity.

The Distribution-Productivity-Employment Nexus - An Alternative To The Secular Stagnation-Narrative

Table 5 is based on Storm and Naastepad (2013) and represents the underlying reasoning behind the effects of wages in the long run. The squared boxes represent macroeconomic

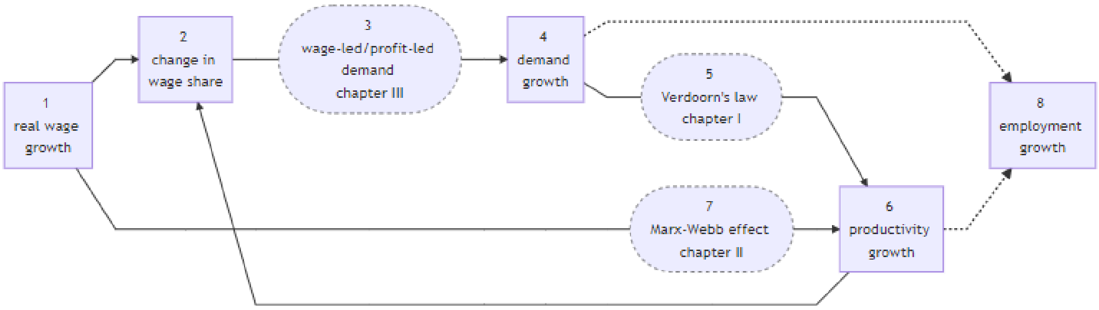

Figure 5 – The distribution-productivity-employment nexus, based on Storm and Naastepad (2013)

effects resulting from changes in other macroeconomic variables. These squared boxes are linked together via arrows, with round boxes in between in some cases. The round, dashed boxes represent the contributions provided by this thesis in chapters I to III concerning three macroeconomic relations: the respective nature of the demand regime (wage-led or profit-led), Verdoorn's law and the Marx-Webb effect. Only the lines with an arrow represent economic causalities. With these chapters, we intend to contribute to a heterodox explanation for low growth rates in the long run providing an alternative to the mainstream secular stagnation debate. The model is able to depict changes in demand regimes, productivity regimes and employment regimes. In this thesis, the focus shall lie on the demand and productivity regimes.

We start with a change in wages. This has two potential effects on productivity growth. First, a change in wages might lead to a change in the wage share. This, however, is subject to the relative growth of real wages and productivity. If real wages rise faster than productivity, the wage share increases. If real wages rise slower than productivity, the share of wages in the total economy decreases - even if total real wages increased.

Next, we are interested in the effect of the change of functional income distribution on GDP growth. Here, the model proposed by Bhadhuri and Marglin (1990) provides a flexible framework to represent two opposed macroeconomic effects of wages - wages as a source of income and hence, private consumption; and wages as a source of cost of production and hence, private investment. As both effects influence final aggregate demand, the question arises which of the two effects dominates. If the private consumption aspect dominates we speak of a 'wage-led demand-regime'. In the case that the effect that real wages have on private investment dominates we speak of a 'profit-led demand-regime.

The overall nature of the demand-regime will determine the effect that a change in wages will have on aggregate demand. The change in aggregate demand will then affect productivity growth via 'Verdoorn's law' - the effect that aggregate output/demand growth has on productivity growth in the long run due to macroeconomic increasing returns to scale.

The second mechanism via which real wages affect productivity growth is depicted in the lower path of table 5. Here, higher real wages lead to an increase in the cost of production. This increase in production costs incentivises capitalists to invest into labour-saving technology, which ultimately increases productivity. This effect is know as the wage-push effect.

We can immediately see that in this model, the productivity regime, and hence productivity growth, will ultimately be determined by the combined effects of aggregate demand (via Verdoorn's law) and the change in the costs of production (via the wage-push effect). Both higher production costs and higher aggregate demand lead to higher increases in productivity. The effect of an increase in real wages will always be increased costs of production. We can therefore assume that an increase of real wages, via the wage-push effect, will always lead to faster productivity growth. The effect of an increase in real wages on productivity growth via Verdoorn's law, however, is unknown as long as we cannot determine the underlying demand-regime. In the case of a wage-led demand-regime, the private consumption effect dominates the investment effect and thus, an increase in real wages will lead to higher aggregate demand. The increase in aggregate demand then leads to an increase in productivity growth via Verdoorn's law. In the case of a profit-led demand-regime, an increase in real wages leads to a stronger reaction of private investment than of private consumption. Aggregate output will therefore decline, which in consequence will lead to slower productivity growth due to Verdoorn's law. Here, chapter III provides a meta-regression analysis of 34 empirical studies on domestic and total demand regimes, finding that the average country has a profit-led demand regime.

Combining both Verdoorn's law and the wage-push effect, we are faced with two possibilities. First, we have a scenario of an economy with a wage-led demand-regime. This 'favourable productivity scenario' leads to higher productivity growth via both Verdoorn's law and the wage-push effect. Second, we have the 'conflictive productivity scenario' with a profit-led demand-regime. Here, higher real wages lead to higher productivity growth via the wage-push effect, but lower productivity growth via Verdoorn's law. The final effect of real wage growth on productivity growth then depends on the relative strength of the two effects. Productivity growth, in turn, will determine the overall wage share in the economy as described at the beginning.

There still remains the question of the employment regime. By definition, employment growth is the residual of demand growth and productivity growth (employment growth = demand growth - productivity growth). This means that while even under a wage-led demand regime productivity will certainly increase, this is not necessarily the case for employment. Indeed, in many cases we might face a combination of rising demand and productivity but falling employment. This highlights again the centrality of productivity growth in a capitalist economy, linking distribution, growth and employment. A wage-led growth strategy, even in countries with a wage-led demand regime, might not be enough to ensure rising living standards for all workers, as the increase in wages and productivity might need to be paid by those workers who lose their jobs do to higher productivity.

This finding however does not mean that rising unemployment is inevitable. Given that the private market will not employ these workers, the only means to stabilise employment growth is government policies that boost employment. One example might be a dedicated campaign to create public jobs. These jobs are traditionally Keynesian in nature, but are especially advocated amongst followers of 'Modern Monetary Theory' (MMT) today. Another way to influence employment growth lies in a general decrease in weekly working time, for example from 40 to weekly 30 hours as we had already argued in List (2019).

The outline of the present thesis is as follows: In the remainder of this introduction, we present the main concepts and debates surrounding the idea of secular stagnation provide a post-Keynesian alternative to the secular stagnation-narrative. Chapter I adds to the available literature by providing a more detailed summary of the idea behind Verdoorn's law and the available theoretical and empirical literature related to this issue. Furthermore, it elaborates and improves the available literature via a meta-regression analysis of the available empirical literature on Verdoorn's law. Chapter II provides estimates of the Marx-Webb effect which, analogous to the estimates of Verdoorn's law, are found using panel data analysis of Verdoorn's law in 23 EU member countries between 1996 and 2017 using the EU-KLEMS data set (Stehrer et al. 2019). The value added here is that the EU-KLEMS data set provides us with data at the sectorial level, thereby enabling us to estimate with a much higher number of observations. Also, we are able to distinguish between the manufacturing sector, where Verdoorn's law is supposed to be at work, and other non-manufacturing sectors. For the estimation of both effects, we use a modified 'auto-regressive distributed lag' (ARDL) model provided by Ditzen (2021), which takes into account both the distinction between Okun's law and Verdoorn's law and potential cross-sectional dependence. Chapter III extends the available literature on the Bhaduri/Marglin model, also known as the wage-led/profit-led model, via the use of a meta-regression analysis. It describes the available empirical literature on the wage-led/profit-led model as well as the differences in econometric specifications and theoretical assumptions. It further pools the available demand-regime estimates and checks for an underlying true effect, while also explaining the deviation of the reported estimates from this underlying effect. Chapter IV summarises the main findings and presents the value-added provided in this thesis, discusses policy implications and presents potentials for further research.

Part I

Uncovering the relationship between output and productivity - A meta-regression analysis of Verdoorn's Law

Chapter 1

A meta-regression analysis of Verdoorn's law

1.1 Introduction

In 1949, P.J. Verdoorn published an article pointing at a potential link between the long-run rate of growth of labour productivity and the rate of growth of output. Verdoorn's conclusion was that the causation runs from the rate of growth of output to productivity growth. Typically, this 'Verdoorn coefficient' is found to be positive and smaller than 1. This finding was first referred to by Arrow (1962) and later on was coined as 'Verdoorn's law' by Kaldor (1966).

Kaldor (1966) also used the findings of Verdoorn (1949) in order to explain the by then slow rate of growth of the UK economy – the reason for which Verdoorn's law is also known as 'Kaldor's second law'.[1]

[1] 'Kaldor's first law' characterises a positive relationship between the growth rate of manufacturing output and aggregate output. The third law states a positive relation between productivity growth in the manufacturing sector and the non-manufacturing sector. This happens because based on the assumption of decreasing returns to scale in non-manufacturing - if resources are being moved out of the latter,

In summary, Verdoorn's law is important for four reasons. First, a positive Verdoorn coefficient signifies that an increase in output growth creates an increase in productivity growth. For demand-side economists, Verdoorn's law provides a link between aggregate demand and long-run economic growth. Second, if Verdoorn's law exists, it implies a learning curve. During the descent along the learning curve, more firms enter the market. As demand for the product is not saturated yet, real wages can grow. We can thus enter a phase of 'triple rents' for profits, wages and tax income. Third, since Verdoorn's law is supposed to be smaller than 1, there will be some additional employment created (since by definition employment growth is the residual of output growth and productivity growth). Verdoorn's law is supposed to be valid in manufacturing only. Manufacturing therefore becomes the 'engine of growth' and structural change, as more and more employment from other sectors gets absorbed. Finally, such a 'well-behaved' Verdoorn coefficient implies increasing returns to scale, which themselves imply ever-improving terms-of-trade and tendencies towards monopolies and a divergence of growth rates across industries and countries.

Kaldor (1966) and his use of Verdoorn's law caused an intensive debate regarding its theoretical implications. While Verdoorn might have stopped believing in a law-like relationship, others did not. Since the 1950s there has been a plethora of studies trying to estimate 'Verdoorn's law' . While the overwhelming majority seems to find positive results (if statistically significant) for such a relation, there is no real consensus about its overall strength.

It is important to remember that Verdoorn himself never referred to his findings as a law-like relation. Indeed, in an exchange of letters with A. P. Thirlwall, Verdoorn explicitly forbid the publication of an English translation of his own work by Thirlwall,

average productivity will rise.

stating that, unlike at the time of the original publication, he was now convinced that this relationship was only stable at the steady state. Verdoorn restated in 1980 that '*(t)he "law" that has been given my name appears therefore to be much less generally valid than I was led to believe in 1949*' (Verdoorn 1980, p.385).

In this paper, we conduct a closer and more detailed literature survey using 'meta-regression analysis' (abbreviated MRA from here on). To the best of our knowledge, this is the first MRA ever conducted on Verdoorn's law. For the purpose of this study, a new data set containing 665 estimates of Verdoorn's law from 52 studies (called primary literature from now on) has been created. By date of publication (if published), the studies registered in this data set range from 1966 to 2019, with the primary literature's data sets covering periods between 1800 and 2011. We use this data set to test for the existence of Verdoorn's law. Thus via the use of MRA, we examine the scientific validity of Verdoorn's law not only based on an arbitrary subgroup of studies but the field of research as a whole. Meta-regression analysis is still only emerging in economics but an established standard in other domains such as medicine or psychology.

The remainder of this paper is organised as follows: section 1.2 presents the common estimation specifications concerning Verdoorn's law, as well as further issues that might arise during the empirical estimation of Verdoorn's law. Section 1.3 presents MRA as a useful tool for both a complete and detailed literature survey as well as a means to synthesise the different results into an overall result. The section then explains the methodology in detail using FAT-PET-PEESE MRA as state-of-the-art in meta-regression analysis. The search process through the available literature and the structure of the newly created data set is explained in detail in section 1.4. In section 1.5, we conduct a meta-regression analysis on the 52 aforementioned studies estimating Verdoorn's law, using both both simple and multivariate MRA techniques. Section 1.6 concludes.

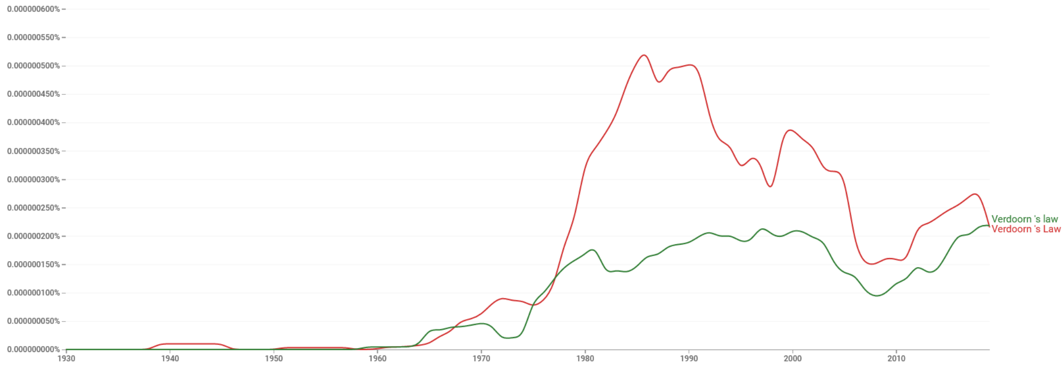

Figure 1.1 – Google Ngram of 'Verdoorn's law'

(a) The values on the y-axis represent the relative share the word 'Verdoorn's law' relative to all words in Google corpus as a percentage.

1.2 Verdoorn's law : Estimation, misnomers and theoretical implications

A lot of empirical studies have been conducted on the general validity of his 'law', amongst many others Kaldor (1966), Rowthorn (1975), Stoneman (1979), McCombie (1982a), McCombie and Ridder (1984), Bairam (1987), Targetti and Foti (1997), Leon-Ledesma (2002), McCombie, Pugno, and Soro (2002), and Storm and Naastepad (2013). The largest part of those studies were published in the 1980s and in general the debate on Verdoorn's law reached its peak during the 1980s, as can be seen in the following *GoogleNgram* plot in Figure 1.2a.

During the 1990s, interest in the possible existence of the Verdoorn effect declined again, with a short renewal around the year 2000. Only in the recent decade there seems to be renewed interest in this topic, which might have to do with the emerging idea of a future period of 'secular stagnation' among economists (Hansen 1938; Gordon 2015; Storm 2017). In such a period, innovation would have to play a key role and thus the determinants of productivity growth become increasingly important again.

An attempt at summarising the available econometric literature on the Verdoorn effect has been made by McCombie, Pugno, and Soro (2002), who surveyed the literature dating from Verdoorn's first publication on this topic in 1949 until 2001. The authors conclude that a one percentage point increase in output growth raises productivity growth between 0.3 and 0.6 percentage points. This relationship generally holds in sector-wide, single country or regional studies, and in different forms of estimations, for example cross-section estimations or time series. McCombie, Pugno, and Soro (2002) give a historical survey of Verdoorn's (1949) work and in particular its impact on the work of Nicholas Kaldor. They also discuss several methodological issues as well as the different interpretations of this law-like relationship and its application to several growth models. McCombie, Pugno, and Soro (2002) also include a thorough literature review of studies estimating the overall effect from 1949 until 2001, finding that

> '*On the whole, the law appears to be largely substantiated in these studies, although, as is the case for most statistical economic relationships, the estimates sometimes need to be qualified. Indeed, in certain circumstances, the law still needs further work to solve a number of econometric problems. However, it is fair to say that Verdoorn's Law should be regarded as something more than just a 'stylised fact"*(McCombie, Pugno, and Soro 2002, p.1).

Hein (2014) extends this survey by several recent studies and reaches similar conclusions.

In econometric terms, Verdoorn's law can be estimated in different ways, all starting from the basic identity between productivity growth productivity growth, output growth output/demand growth and employment growth employment growth.

$$\dot{y} \stackrel{!}{=} \dot{q} - \dot{e}$$

The straightforward method consists in estimating productivity growth $\dot{y}$ as a function of output growth $\dot{q}$, where α_1 is a constant and β_1 the coefficient of output/demand growth (the 'Verdoorn coefficient'). This is the method used by Verdoorn (1949) himself.

$$\dot{y}_i = \alpha_i + \beta_1 \dot{q}_i + \epsilon_i \tag{1.1}$$

Productivity growth $\dot{y}_i$ is supposed to be positively correlated with the growth of output $\dot{q}_i$. The importance of this relationship lies in its implications for economic development, suggesting that a substantial part of productivity growth is endogenous to the growth process due to *macroeconomic* economies of scale. If we do assume that the relation underlying Verdoorn's law is based on a Cobb-Douglas production function, the relationship between the Verdoorn coefficient and the output elasticities of capital output elasticity of capital and labour output elasticity of labour are given by $\beta_1 = \frac{\alpha+\beta-1}{\beta}$. If α and β are equal, which is a common assumption for manufacturing, then an often cited Verdoorn coefficient of 0.5 implies increasing returns to scale returns to scale of around 1.33 ($\mu = \frac{2}{1+\beta_1}$, since the degree of macroeconomic returns to scale is given by $\mu = \alpha + \beta$).

Now the measurement of productivity itself is a delicate subject. The measurements of productivity are subject to fundamental problems, of which many were highlighted during the Cambridge capital controversies (Robinson 1953; Samuelson 1966; Sraffa 1975). We might thus be interested in a re-specification of Verdoorn's law without the use of productivity growth.

In his famous inaugural lecture on the reasons for the low growth rate of the post-war UK, Kaldor (1966) stressed the macroeconomic impact of aggregate demand on growth. Kaldor argued in the tradition of his mentor Allyn Young. According to Young (1928), Verdoorn's (1949) findings were supposed to be reflecting both static as well as dynamic increasing returns to scale at the macroeconomic, not the microeconomic level. Young argued that because of higher demand and competition, firms where under stress to separate internal production processes into separate firms in order to lower production costs. This allowed for more specialised firms, new production processes and the rise of new subsidiary industries. A similar argument, although only at the firm level, can already be found in Adam Smith's *Wealth of Nations* (Smith 1776), namely that the division of labour increases with the activity of the market. If Young (1928) was right, Verdoorn's law would only be identified at the industry, regional or national level, but not at the firm level.

Kaldor (1966) argued that this effect was prevalent especially in the manufacturing sector, as 'industry is the engine of growth'. Furthermore, increasing returns to scale imply a divergence, rather than a convergence of international growth rates and form the basis of Kaldorian cumulative causation models of economic growth. Higher (foreign) demand and the following increase in output leads to higher productivity gains, which translate to lower production costs and thus to bigger market shares and again to higher foreign demand. As Verdoorn's law is supposed to be stronger in the manufacturing sector than in non-manufacturing sectors, de-industrialisation might have hampered long-term growth due to weaker productivity growth. Similarly, in a country with sustained higher growth, the respective country would not necessarily lose in competitiveness since the increase in output would induce higher productivity growth. As a result, GDP growth itself might be reinforcing. On the other hand, a sustained period of slow growth might put a country into a descending spiral of ever-deteriorating competitiveness.

Excluding the emphasis on economies of scale, Kaldor (1966) argued that the existence of 'Verdoorn's law', as he called it, proved the importance of aggregate demand for the long-run growth trajectory of the national economy. In other words, growth is demand-constrained, not supply-constrained, and equation 1.1 could be estimated using output growth $\dot{q}_i$ as regressor and $\hat{e}_i$ as regressand. This had the additional benefit of getting rid of the spurious correlation inherent in equation 1.1, as $\dot{q}_i$ can implicitly be found on both the left-hand and right-hand side.

$$\dot{e}_i = \gamma_i + \beta_2 \dot{q}_i + \epsilon_i \tag{1.2}$$

or

$$\dot{e}_i = -\alpha_i + (1 - \beta_1)\dot{q}_i + \epsilon_i$$

Kaldor (1966) further argued that the reason for the UK's low rate of productivity growth in the manufacturing sector was the exhaustion of labour surplus from other sectors. The prevalent economies of scale in the manufacturing sector could therefore not be used efficiently.

This opened up a new debate between Kaldor and Rowthorn (Rowthorn 1975; Kaldor 1975). Rowthorn argued that if Kaldor's (1966) argument was true then the economy was ultimately supply-constrained and equation 1.2 was miss-specified, as there is an issue of simultaneous equation bias. Employment growth $\hat{e}_i$ is correlated with wage growth, which in turn is correlated with productivity growth $\hat{y}_i$. Running regressions on equation 1.2 is therefore not the correct specification. The proper way to estimate

Verdoorn's law should therefore be in the opposite way, with employment growth $\dot{e}_i$ as regressor and output growth $\dot{q}_i$ as regressand.

$$\dot{q}_i = \delta_i + \beta_3 \dot{e}_i + \epsilon_i \tag{1.3}$$

or

$$\dot{q} = \frac{\alpha_i}{1 - \beta_1} + \frac{1}{1 - \beta_1}\dot{e} + \epsilon_i$$

It should be noted that a series of misunderstandings concerning the names of the different specifications used to exist. Rowthorn (1975) himself did not use equation 1.3 as the subsequent literature assumes, but rather the following specification, explaining productivity growth $\dot{y}$ via employment growth $\dot{e}$.

$$\dot{y}_i = \zeta_i + \beta_4 \dot{e}_i + \epsilon_i \tag{1.4}$$

or

$$\dot{y}_i = \frac{\alpha_i}{1 - \beta_1} + \frac{\beta_1}{1 - \beta_1}\dot{e}_i + \epsilon_i$$

In his study, Rowthorn (1975) always used equation 1.4 for estimation purposes, even though, in a fleeting manner, he mentions equation 1.3 as well. Apparently, it was John McCombie who coined the term 'Rowthorn's specification' for equation 1.3 in a series of studies (McCombie 1982a; McCombie 1982b; McCombie and Ridder 1984; McCombie 1986), while one could argue that the 'true' specification according to Rowthorn (1975) would be equation 1.4. Still, most economists today refer to equation 1.3 when debating Rowthorn's (1975) approach. Therefore, for the sake of convenience, we will name equation 1.3 'Rowthorn's first specification' and 1.4 'Rowthorn's second specification' for the remainder of this study.

Unfortunately, the misunderstandings do not stop here, since Rowthorn (1975) calls the term $\frac{\beta_1}{1-\beta_1}\dot{e}$ inherent in equation 1.4 'Kaldor's implicit estimator' (Rowthorn 1975, p.16). Kaldor (1966) however never used this term, as he favoured equation 1.2 over 1.4. Indeed, in a reply to Rowthorn (1975), Kaldor (1975) explains that the case of the UK labour shortage was an exception and his choice of specification was related to his conviction that the economy as a whole was ultimately demand-constrained, rather than supply-constrained.

> '*The important implication of these assumptions is that economic growth is demand-induced, and not resource-constrained - i.e. that it is to be explained by the growth of demand which is exogenous to the industrial sector' and not by the (endogenously given) growth rates of the factors of production, labour and capital, combined with some (endogenously given) technical progress over time.*' (Kaldor 1975, p.895)

The overall result has thus to be classified by the estimation technique used, as *a priori*, there is no objective way to know whether specification 1.2 or 1.3 is correct. Indeed, it is impossible to choose a 'correct' specification without an implicit economic theory as guiding principle. If one believes that output growth is demand-constrained rather than supply-constrained, then equation 1.2 would be the correct interpretation rather than Rowthorn's (1975) formulation, represented by equation 1.3.

There exist several issues concerning the correct estimation of Verdoorn's law. One interpretation of the Kaldor-Verdoorn law is that it is a specification of a technical progress function. Kaldor from the very beginning emphasised the importance of the *rate of growth* of output, rather than its *level* for the Verdoorn law. Nevertheless, it can be shown that the linear technical progress function inherent in the Verdoorn law can be derived from a traditional Cobb-Douglas production function(McCombie, Pugno, and Soro 2002). This is important because if the underlying relation of the linear progress function should really be a Cobb-Douglass production function, there would not be much novelty in the approach put forward by Kaldor. Compared to the traditional *dynamic* form of the Kaldor-Verdoorn law in growth rates, the alternative method of obtaining the estimation specification consists in regressing the logarithmic *level* of productivity on the logarithmic level of output. A priori, both the dynamic as well as the static forms should yield the same results, but there exists a paradoxical finding concerning the functional form of Verdoorn's law estimation specification. While the dynamic form usually finds Verdoorn specification values smaller than 1, indicating increasing returns to scale, the *static* version of the Kaldor-Verdoorn law normally finds values close to 1, indicating constant returns to scale[2] (McCombie 1981; McCombie 1982a; Fingleton and McCombie 1998; Destefanis 2002). One explanation for this is the possible existence of a 'second-order identification problem'. There might be many different underlying structures of the dynamic law depending on the constant of integration. The different results of the dynamic and static forms could thus indicate that the Verdoorn law may not rely on a conventional Cobb-Douglas production function.

As was laid out in the previous section, it is impossible to chose an econometric specification of Verdoorn's law without making an implicit value of judgement on whether the economy is supply- or demand-constrained first. Depending on whether the researcher sees the economy as ultimately supply- or demand-constrained, the

[2]remember that $\mu = \frac{2}{1+\beta_1}$.

opposite specification will appear to suffer from simultaneous equation bias, without any proper way to empirically test the underlying economic theory before. Additionally, due to the idea of cumulative causation there is the possibility that both $\dot{q}$ and $\dot{e}$ are endogenous in nature. In this case, both Kaldor's, as well as Rowthorn's specification would be subject to simultaneous equation bias. Normally, a straightforward solution to this problem could consist in using an instrumental variable approach. In this case this is not feasible, as the instrument changes depending on whether we use $\dot{q}$ or $\dot{e}$ as regressor. Another open question is whether or not to include the capital stock as a control variable. Again, Kaldor (1968) argued that the stock of capital should not be included in the estimation, as 'capital accumulation is a symptom rather than cause of growth' (p. 390). Another opportunity lies in using total factor inputs as proxies[3], because the stock of capital is already implicitly taken into account this way.

Rowthorn (1975) argued that most of Japan's growth experience after World War II could be attributed to its' technological catching-up to other more advanced countries, which would have nothing to do with Verdoorn's law. Hence, one should add as a control variable the initial level of productivity relative to that of more advanced countries (for example the US) when estimating Verdoorn's law. However this does not solve the problem, as due to existing economies of scale the levels of productivity will vary amongst countries even when they all have access to the same technological blueprints.

A number of studies have used time series-data. This can lead to problems due to changes in the use of capital and labour over the economic cycle. For example, labour hoarding during the downswing of the cycle might lead to an artificial positive relationship between the growth of output and that of productivity. This relationship is only a short-run phenomenon and is representing 'Okun's law', not Verdoorn's law.

[3] defined as $\alpha e + (1 - \alpha)k$ where α and $(1 - \alpha)$ are the shares of labour and capital in total income.

Furthermore, there are problems caused by the failure to adjust control variables like the capital stock for changes in capacity utilisation over the business cycle. It is therefore recommended to estimate the Kaldor Verdoorn effect using average growth rates in cross-sectional models, with peaks of the growth cycle for first and last years in the data set.

If the interpretation of Verdoorn (1949) is correct, then the reason for Verdoorn’s law needs to be looked for in the literature on the ’manufacturing progress function’: the idea that an increase in *cumulated* output creates the possibility for a greater division of labour, which would help to develop static internal and dynamic external economies of scale. Such a theory implies that Verdoorn’s law is indeed a macroeconomic phenomenon and as such cannot be found when using firm level data. This means that sectoral, regional or national level data need to be used in order to properly estimate Verdoorn’s law. The use of regional data also has the advantage that it can account for differences in institutional layout across countries as was discussed in the previous subsection. But there is still no agreed description as to how exactly Verdoorn’s law is supposed to work *in detail*. Consequently, there can be no clear consensus whether to preferably use sectoral, regional or national data.

In a similar vein, one might argue that wage growth should be included as a control variable to take into account the so-called ’Marx-Webb effect’ (Lavoie 2017a), whereby an increase in wages is pressuring capitalists to invest into labour-saving machinery, thus increasing productivity growth (Storm and Naastepad 2011; Storm and Naastepad 2013; Storm and Naastepad 2017; Hein 2014).

1.3 Meta-regression analysis (MRA) as a quantitative literature survey

In this section, we will be presenting meta-regression analysis as a method to explain the heterogeneity in results concerning Verdoorn's law. Meta-Regression Analysis (MRA hereafter) builds upon a technique commonly known as 'meta analysis' in other fields like psychological and educational research, medicine and the social sciences (Stanley and Jarrell 2005). Meta analysis tries to summarise and integrate the existing empirical literature about a common parameter. As such, it presents a systematic review of all scientific knowledge currently available and explains the given findings in all its vast variety in a comprehensive way (Stanley and Doucouliagos 2012).

1.3.1 The specification problem

Traditional literature surveys are often not able to present an all-encompassing survey of already existing studies, one of the obvious reasons being the word limit imposed by academic journals. But there is more to it. As Stanley and Jarrell (2005) argue,

> '*The reviewer often impressionistically chooses which studies to include in his review, what weights to attach to the results of these studies, how to interpret those results, and which factors are responsible for the differences among those results. Traditionally, economists have not formally adopted any systematic or objective policy for dealing with the critical issues which surround literature surveys As a result, reviews are rarely persuasive to those who do not already number among the converted.*' (Stanley and Jarrell 2005, p. 300)

Meta analysis can thus be of great help when it comes to examining a certain effect on which a lot of empirical studies have been published – it enables the researcher to see the bigger picture. Additionally, MRA offers the tools to estimate the effect of different model specifications on the overall results and their significance. This way the researcher can distinguish true economic effects from disturbances caused by wrong model specification more easily.

Another reason for the use of MRA is the file drawer problem: as the standard error of the estimated correlations are becoming smaller with an increase in the number of observations number of observations, studies using a data set with a comparatively small amount of observations face higher difficulties to obtain significant results. This might become important insofar as peer-reviewed journals may prefer publishing only studies that offer significant results, even though from a methodological and theoretical point of view the publication of not significant results would be equally important for the progress of economics. Such strict publication policies might incentivise researchers to alter their estimation model successively until significant results have been obtained (publication selection bias). In the worst case scenario, the researcher(s) might not publish their findings at all – the study stays in the file drawer.

Meta analysis has been increasingly used in the economics literature during the past decades. The most commonly quoted studies include Rose and Stanley (2005) on the effect of common currencies on international trade, Doucouliagos (2005) on the link between freedom and economic growth, Nijkamp and Poot (2005) on the unemployment elasticity of wages, Weichselbaumer and Winter-Ebmer (2005) on the gender wage gap, Knell and Stix (2005) on the income elasticity of money demand and Doucouliagos and Stanley (2009) on the effect of minimum wages on employment.

While MRA has become a well-accepted approach in other scientific fields, its appearance in economics is yet a comparatively rare sight. Nevertheless, a guideline for a more standardised use of MRA in economics has been proposed by the Meta-Analysis of Economics Research Network (MAER) in order to improve both the transparency and the quality of future Meta analysis.

While the estimation methods used in meta-regression analysis are not overly complex, the previous stages are very intensive work-wise as well as time-wise. To conduct a MRA, there are several steps to be followed. First, the researcher is collecting all available studies on a specific effect she or he wants to study. These studies are called 'primary literature' amongst meta-regression analysts. Whether those studies are published in peer-reviewed journals or not should *a priori* not play any role. Indeed, one is even encouraged to include non-published studies, as the fact that the studies are unpublished need not necessarily indicate unscientific methods or a lower quality with respect to the used methods, but rather point at potential publication selection bias, as was explained in the former section.

In a second step, the reported estimates in these gathered studies are being treated as individual entries in a new data set. For a study to be included in the data set, the researcher has to code at least the estimate, and the corresponding t-value (or its standard error). If those two variables can be obtained, then the estimate can be included in the data set. Furthermore, the researcher might be interested in adding several characteristic elements of the specific study that might be worth considering in the form of dummies, such as the sources of the data sets being used, the year of publication (if the paper is published), the method of estimation, the country or sector examined *etc*. This possibility is in fact one of the advantages of MRA. Not only is it possible to infer a more precise estimate for any given variable, but MRA also enables the researcher to find out which socio-economic circumstances might skew the estimated results and lead to possible under- or overestimation of the effect in question. Finding and explaining these differences via MRA is based on statistical, not economic theory and can thus help to shed light into controversies between different schools of thought. This implies that the researcher conducting MRA is well-aware of the available literature, not only with regards to empirical estimation methods, but especially the theoretical discussion and potential differences in interpretation resulting from this.

The third step consists of a two-step regression in which the first regression points at the presence or absence of publication selection bias (called the Funnel asymmetry test, or (FAT)-test) – which in the existing MRA literature has almost always been found – while the second regression tries to estimate this very publication selection bias and the 'true value' of the parameter in question (called the Precision effect test, or (PET)-test).

1.3.2 The basic model

Following Stanley and Jarrell (2005), the most common approach to do meta-analysis in economics consists in using effect sizes in reported econometric studies. The following section builds mostly on Stanley and Doucouliagos (2012), as well as the guidelines published by the MAER network (Stanley, Doucouliagos, et al. 2013). The notation used in the following section is drawing from Paldam (2015).

In order to be used for MRA, studies that estimate Verdoorn's law are collected only when they meet two conditions. First, the studies collected must be estimating comparable effects (Becker and Wu 2007). In order to make them comparable MRA studies are using effect sizes.

Secondly, the studies have to be transparent, in that the researcher is able to gather at least the estimated coefficient, its corresponding standard error standard error or t-value t-statistics of the primary literature, and the number of observations used in the primary literature in order to compute the corresponding partial correlations partial correlation. Partial correlations are helpful because they are able to standardise effect sizes of different size and quality, a difficulty that is encountered very often in MRA. Their ability to make all studies comparable to each other is their most desirable property, as it enables the researcher to get more information about the state of the literature. Partial correlations are computed as presented,

$$r = \frac{t}{\sqrt{t^2 + df}}$$

with its corresponding standard error being $se_r = \sqrt{\frac{1-r^2}{df}}$. Partial correlations are not easy to interpret, as their nature is more statistical rather than economic. Standardised partial coefficients can be interpreted as the number of standard deviations the dependent variable increases for every increase in the standard deviation of the independent variable, holding all other variables constant. It is therefore desirable to use additional effect sizes to get results that can easily be interpreted in economic terms. Nevertheless the desirable properties that partial correlations have with respect to other effect sizes makes them the most used effect size in MRA (Stanley and Doucouliagos 2012).

MRA uses the relation between an effect size b_i and its precision precision (the inverse of its standard error se_i) to draw its conclusions. Consider a sample of estimated studies with reported estimates b_i and an underlying effect γ_0.

$$b_i = \gamma_0 + \gamma_1 se_i + \epsilon_i \tag{1.5}$$

In this case, the reported estimates should all be randomly and symmetrically distributed around the true underlying value, γ_0. As the term 'true value' can be seen as rather problematic, the term 'meta-average' will be used from now on. In the end, all that MRA does is constructing an average of all estimates corrected for publication bias (Stanley and Doucouliagos 2012).

The idea of publication selection assumes that researchers with a smaller sample and thus higher standard errors are forced to search longer for statistically significant results than their colleagues with bigger samples (for example via searching for additional data or for reasons to eliminate 'potential outliers'). The latter ones will be satisfied with their potentially smaller, but significant estimates. Hence, in the case of publication selection, the estimate will be positively correlated with the standard error se_i. This forces the estimates to become larger than they should be (i.e. there is overestimation) in order to become statistically significant. Hence, $\gamma_1 se_i$ describes potential publication selection bias and γ_0 describes the meta-average, corrected for potential publication bias (as $se_i \rightarrow 0, E(b_i) \rightarrow \gamma_0$). Since MRA is using estimates from different studies, those estimates will typically embody differing variances, which will have to be normalised in order to take care of heteroskedasticity issues. The errors can be weighted via dividing equation 1.5 over the reported estimate's standard error. Dividing by se_i will give us a weighted-least-squares (WLS) estimation of equation 1.5, which is in fact a basic MRA of the estimate's t-value against its precision, $p = \frac{1}{se_i}$. In case of homogeneity, the former error divided by the measured sampling error must be equal to 1.

$$t_i = \gamma_0 p_i + \gamma_1 + v_i \tag{1.6}$$

t_i refers to the estimate's t-value and γ_0 is the 'meta-average' – the average effect of the primary literature corrected for publication bias – with p being the 'precision score' $\frac{1}{se_i}$. Equation 1.6 can equally be rewritten as $t_i = \gamma_0 \frac{1}{se_i} + \gamma_1 + v_i$. Both parts of equations 1.5 and/or 1.6 (depending on the chosen effect size) are being used for testing. Testing γ_1 in equation 1.5 or γ_1 in equation 1.6 for the null hypothesis that $\gamma_1 = 0$ or $\gamma_1 = 0$ is called the 'funnel-asymmetry test' (FAT-test) part of the FAT-PET and checks for heterogeneity. A rejection of the null hypothesis points at the existence of publication selection bias. $\gamma_0 = 0$ in equation 1.5 and $\gamma_0 = 0$ in equation 1.6 represents the 'precision estimate test' (PET-test) part of the FAT-PET and is used to estimate the meta-average in case of publication selection bias. Estimates far away from the underlying effect should have low precision, while estimates closer to the 'true effect' should have high precision. At the same time, the precision score itself acts as a weight. Estimates with a higher precision will have a higher weight when estimating the meta-average than low level precision estimates.

The FAT-PET test thus enables MRA to not only find out about the possible existence of publication selection bias, but to also correct the ordinary average of the reported estimates for the estimated publication selection bias in order to get a 'cleaner' estimate closer to the actual underlying effect (provided such an effect exists). However, even the PET-test gives a biased estimate of the empirical effect in case of publication selection.

Doucouliagos and Stanley (2009) and Stanley and Doucouliagos (2012) offer an improved correction for publication selection that uses the effect size's variance (i.e. the square of the standard error) in MRA modelling, the Precision-Effect Estimate with Standard Error (PEESE) test.

$$b_i = \gamma_0 p_i + \gamma_1 se_i^2 + \nu_i \tag{1.7}$$

The FAT-PET-PEESE tests are supposed to be used one after another. Monte Carlo simulations have shown that the PEESE provides a better estimate of the underlying true effect (Stanley and Doucouliagos 2014). However, this is not true when there is no effect and only publication selection. If the PET-test indicates a genuine underlying effect then the researcher is expected to run the PEESE-test for a more robust estimate.

1.3.3 Multiple MRA

Clearly, it will often be the case that potential misspecification in the literature will not be able to be explained solely by publication bias. Rather, there might be reasonable differences amongst the available studies that can explain part of this misspecification. That being said, it can be interesting to obtain more details about publication bias, what study-specific characteristics drive it, and when there might be more general sources of misspecification that transcend the population sample (such as a dominant theory that is perceived to perform better than others or certain results that are expected by the scientific community beforehand).

The basic MRA equation 1.5 can be expanded in order to take these intricacies into account.

$$b_i = \gamma_0 + \sum \gamma_k Z_{ki} + \gamma_1 se_i + \sum \delta_j se_i K_{ji} + \epsilon_i \tag{1.8}$$

Equation 1.8 can be interpreted similarly to equation 1.5. The reported estimates b_i are still assumed to be randomly and equally distributed around the meta-average γ_0, with two different sources of misspecification present. The first, $\sum \gamma_k Z_{ki}$, represents all the discrepancies due to heterogeneity amongst the studies and the second, $\gamma_1 se_i + \sum \delta_j se_i K_{ji}$, represents publication bias. δ represents dummy variables which are called 'moderator variables' in the MRA literature. Moderator variables can help gathering more information about the available literature than represented by just their respective output tables. The most used moderator variables include the year of publication, the journal of publication, the year span covered in the data set and many other study-specific characteristics.

1.4 The data set

The literature search process as well as the ensuing coding of this present study was based on the MAER-NET guidelines in Stanley, Doucouliagos, et al. (2013). The platforms used for finding the relevant studies cover the biggest array possible in order to account for as many studies as possible and consist of Econlit, JStore, Google Scholar and Google Search. Keywords for the searching process were 'Verdoorn effect', 'Verdoorn's law' and similar terms such as 'Kaldor-Verdoorn effect' and 'Kaldor's second law', 'productivity', 'productivity-growth nexus' and others relevant. In addition, the search was extended to the list of references (or footnotes) found in the primary literature. The literature search was finished on February 30^{th} 2020. In order to be eligible for inclusion in the data set, the studies had to match certain criteria. First of all, the studies on Verdoorn's law had to be written in either English, German, French or Spanish, the languages spoken by the authors.

The following step included extracting the estimated coefficient, its t-values and standard errors, the number of observations and/or the degrees of freedom from every specific regression for each single study. Additionally, several other variables of possible interest were recorded as dummies for further analysis. For robustness checks in form of other effect sizes, more variables should be included. The number of observed variables/the degrees of freedom are very important in this regard, since they can be used to compute partial correlations which are a further effect size apart from the elasticities commonly used in MRA. This might be explained by their date of publication. Econometric standards were not as agreed upon in economics in the 1980s as they are today. Furthermore, without the use of powerful statistical programs that are available to us today, doing econometric estimations was far more challenging. This naturally diminishes the explanatory power of this MRA since less studies can be investigated upon. Whenever the corresponding number of observations was not reported, it was estimated using the overall years covered in the respective data sets. This creates some potential for errors in our studies but was preferable compared to losing a higher amount of studies and therefore explanatory power for our analysis. Studies that failed to adhere to these criteria where not included. The literature search left as a result 74 studies, of which 22 had to be rejected. The resulting data set contains 52 studies with 665 estimates of Verdoorn's law[4]. As such, it is the first database on Kaldor-Verdoorn coefficient estimates so far and is created completely anew. The years covered in the respective literature range from 1800 to 2011.

A key issue is that most of the studies found were not reporting all the key variables needed. For an MRA to be done, the database needs to contain at least the estimate, and either the corresponding standard error or its t-value (since the t-value is the ratio of the estimate divided by the standard error, assuming that the null hypothesis is b = 0). Most of the 52 studies in the data set did not explicitly state their null hypotheses. In theory, this makes it impossible to calculate missing standard errors or t-statistics if needed (and in consequence the resulting partial correlations cannot be derived). For

[4]The data set used in this study will be published in the meta-data repository together with a list of papers not included and the reason for their rejection shortly after this study is accepted for publication.

the present study, the null hypothesis was assumed to be $b = 0$ if not stated otherwise. The omission of the null hypothesis is no trivial problem. If not stated anywhere in the literature, it is not possible to follow the authors' calculations in a transparent way, as any null hypothesis could be assumed in order to get statistically significant results. For example, some regressions exhibit positive estimates but negative t-statistics. This is only possible if the null hypothesis is assumed to be smaller than 0 - but this has never been mentioned in the respective study. Assuming b = 0 for the null hypothesis might thus severely underestimate publication bias if the null hypotheses actually chosen were different.

The existence of four different estimation specifications in the case of the Kaldor-Verdoorn literature (Verdoorn's specification, Kaldor's specification and Rowthorn's first and second specification) further complicates the use of MRA methods. Ideally, all estimates would be transformed in one of the four specifications in order to make them directly comparable and increase explanatory power. The Kaldor specification can easily be transformed into the Verdoorn specification (called 'Kaldor-Verdoorn specification' from now on), while the corresponding standard errors stay the same. In the case of Rowthorn's first and second specification however, the standard errors would change as a result of the transformation and would need to be calculated using the delta method. In our case, however, this is not possible due to missing sample means in the primary literature. In theory, one could construct new data sets with corresponding sample means using external sources for every respective estimate. In practice this possibility is flawed for two reasons. First, it creates another potential source of bias in this analysis. Second, in panel and cross-sectional studies it is often not recognisable which countries entered a specific estimation. This could lead to the inclusion of the wrong number of countries in the external data and thus create wrong sample means. For these reasons, our study will therefore abstain from doing so and focus most of its attention on the Kaldor-Verdoorn specification alone. Luckily, with 507 out of 665 estimates, the Kaldor-Verdoorn specification covers most of the primary literature estimates. As a result, we will use three specifications for the remainder of this analysis: the Kaldor-Verdoorn specification, Rowthorn's first specification and Rowthorn's second specification.

The variance of the estimated effect in equation 1.5 and hence u will vary between reported estimates. In order to deal with potential heteroskedasticity, weighted least square (WLS) estimation, similar to equation 1.6, is being used. As every estimate gets weighted with its corresponding standard error, estimates with large standard errors are given smaller weight while more precise estimators are given more weight. This makes WLS-MRA more resistant to outliers. Nevertheless, we used studentised residuals in order to minimise the effect of outliers. For testing reasons, regressions were first run without specifying vce parameters like weights or cluster-robust standard errors. Then studentised residuals were created. Since the residuals behave like t-statistics, the critical value for elimination was chosen to be 1.96. If the absolute value of the residuals exceeded this critical value, the respective data point were considered as an outlier and deleted from the final sample. After this, the normal regressions with vce parameters were run. All in all, 28 estimates had to be dropped after using this method.

Figure 1.3 summarises the distribution of 665 estimates from 52 studies over the different estimation models discussed in this section. Even though most of the available studies hint at the presence of such an effect as Verdoorn (1949) described, the size of the reported overall effect is not clear. Based on this descriptive representation, if Verdoorn's law is real, the resulting estimated effect seems to be differing according to the estimation specification chosen.

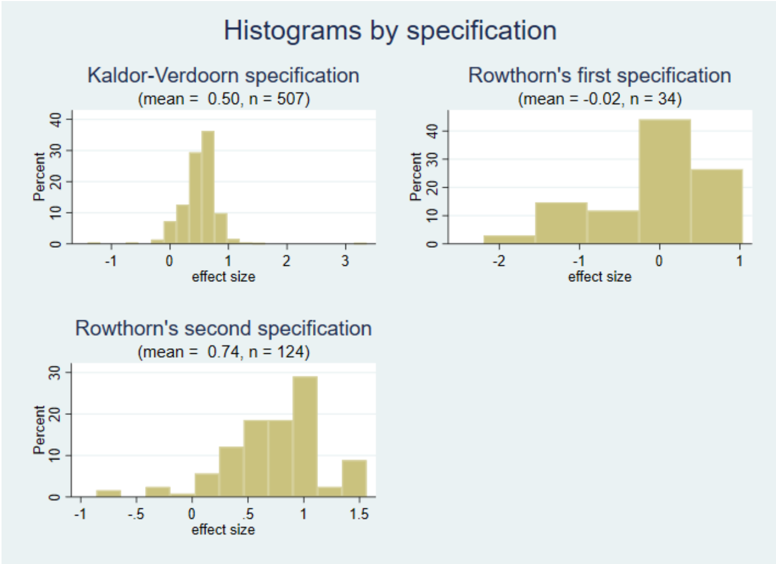

Figure 1.3 – Histogram of the different estimation specifications

Figure 1.4 presents the combined 665 observations from 52 studies on Verdoorn's law with years of publication ranging from 1966 to 2019 in a scatter plot called the 'funnel plot'. Funnel plots are a representation of reported estimates commonly used in MRA.

The funnel plot, even though only being descriptive in nature, is useful for an initial overview of the existing literature. It plots the distribution of all reported estimates in the primary studies against their precision (the inverse of their corresponding standard error). In case of homogeneity, the reported estimates should be randomly distributed around the meta-average, with estimates decreasing in precision the further away they are from the meta-average. A skewed distribution of reported estimates can be interpreted as a first hint of possible publication selection bias. The average estimated value for Verdoorn's law depends on whether the Kaldor-Verdoorn specification (0.50), Rowthorn's first specification (-0.02) or Rowthorn's second specification (0.74) is observed and is marked in the corresponding graphs with a dashed red line. All three

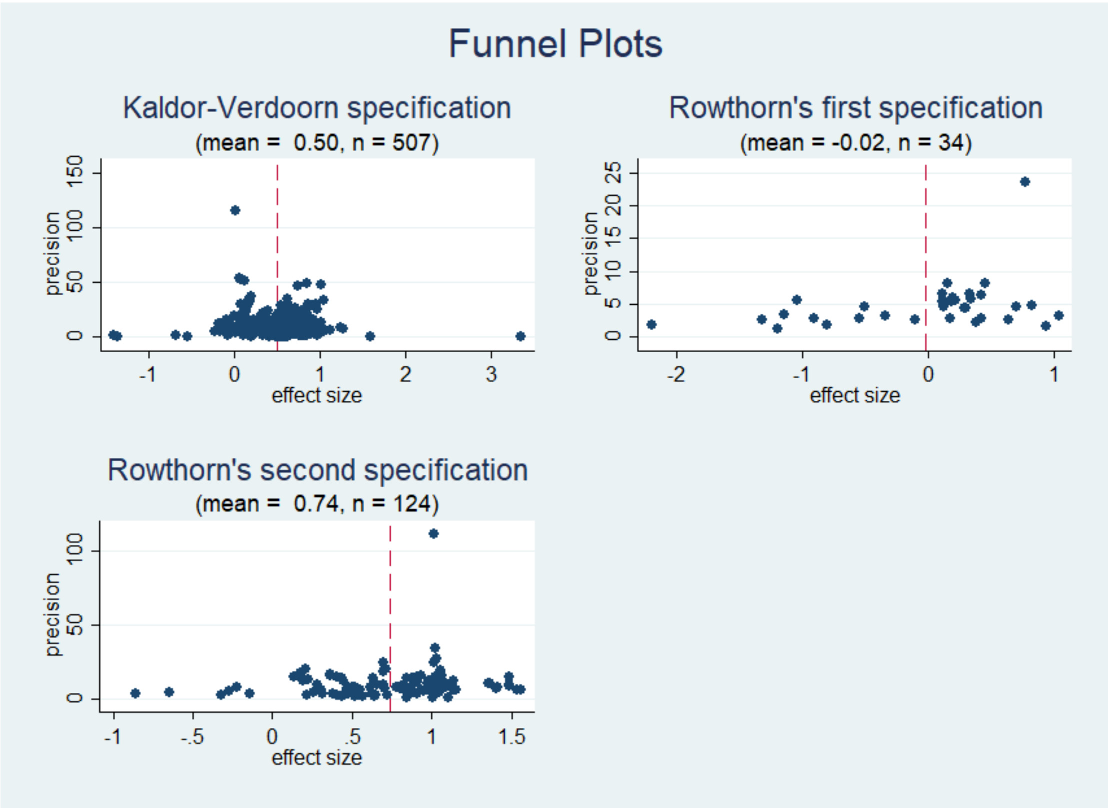

Figure 1.4 – Funnel Plots, separated by specification

specifications seem to indicate a tendency towards one most precise point, with the Kaldor-Verdoorn specification hinting at a second group of high-precision estimates. No graph really shows a symmetric distribution of estimates around the high-precision estimates, which can be interpreted as a first hint at potential publication bias.

With descriptive analysis giving us first insights, we can now turn to a more thorough investigation.

1.5 A Meta-regression analysis on Verdoorn's law

Another problem usually faced in meta-analysis is the fact that different studies report a different number of estimates. Thus, single studies with a high number of reported estimates might dominate the overall sample (Stanley and Doucouliagos 2012, pp. 99). It is thus common for MRA studies to use cluster-robust standard errors in order to take this possibility into account. Unless stated otherwise, all following regression specifications were run in effect form with $\frac{1}{SE^2}$ as analytical weights.

MRA uses a regression between a reported effect size and its standard error as a more objective method of finding and measuring potential publication selection bias. In the absence of publication selection bias, there should be no significant correlation between the estimate and its standard error, while the opposite would be true in case of publication selection bias. Once we account for publication bias we can answer our question of interest: Is there an underlying Verdoorn effect when taking into account a sizeable share of the available literature?

A further advantage of MRA is the use of dummy variables to account for the impact of omitted variables and their impact on publication selection bias. Especially in economics, where researchers are often working with pre-compiled data-sets and important variables might not be taken into account, omitted variable bias might indeed be one of the biggest drivers of misspecification. Similarly, other study-specific properties might be of interest to the researcher if a good summary of the respective literature is desired. Other often used variables include the difference in proxies used to represent the respective effect, nature and origin of the data set, the estimation technique used in the paper as well as year and journal of publication (if published), sources of funding, etc.

As we have discussed in section 1.2, there is a certain paradox regarding Verdoorn's law's value, depending on whether growth rates or logarithms of the level of productivity and output are chosen. The 'dynamic' specification typically finds Verdoorn coefficients around 0.5, implying increasing returns to scale, while the 'static' specification usually finds coefficients implying constant returns to scale. It thus makes sense to distinguish the estimates by their respective dynamic or static nature. Table 1.1 shows the results for a basic meta-regression analysis. The majority of this MRA is only taking into account estimates from the Kaldor-Verdoorn specification. Columns 1 and 4 are the results for the meta-average estimation, assuming no publication bias. Columns 2 and 5 contain the FAT-PET MRA results and columns 3 and 6 show the results for the PEESE MRA Columns 1-3 analyse all dynamic specification estimates, while columns 4-6 analyse static specification estimates only. In the case of the simple meta-average estimation, the elasticity gets regressed on the constant plus an error term. If the constant thus is statistically significant from zero, we can assume that there is a clear correlation between output and productivity growth and Verdoorn's law is a real mechanism underlying the capitalist economic system. The exact value of the constant then indicates how large the overall effect is.

In our case, the meta-average of the Kaldor-Verdoorn specification in column 1 is statistically significant, with a value of 0.528. Assuming that there is no publication bias, Verdoorn's law seems to exist, implying significant increasing returns to scale. This can however not be said about the static version in column 3, which is not statistically significant. As was argued before, in theory both the dynamic as well as the static version should yield the same results. If they do not, the relation underlying the technical progress function might not be a Cobb-Douglas production function, and the dynamic and static specifications might measure two entirely different things. However, most MRA studies find that publication bias is prevalent in most research areas, i.e. reported estimates of Verdoorn's law do not vary randomly around the meta-average (as can be seen in the funnel plots in figure 1.4). Publication bias can be represented as a statistically significant relationship between an effect and its standard error. Columns 2 and 5 show the results for the FAT-PET MRA, which aims at explaining this publication bias, while also estimating the meta-average corrected for this bias. The FAT-PET test is defined as $b_i = \gamma_0 + \gamma_1 se_i + \epsilon_i$. Without publication bias, there should be no correlation left between the reported estimate and its' standard error. Typically, the FAT-PET MRA will find different results from a simple meta-average estimation. In the case of no publication bias, the meta-average which is the result of the PET-test should be very close to the unweighted average of the reported estimates. The PET-test should thus be taken into account as well. It represents the meta-average, corrected for potential publication selection bias even if there was none reported via the FAT-test. In both cases, publication bias associated with the standard error SE_i is not statistically significant, even at the 10% level, yet the estimated meta-average in case of the dynamic specification is roughly the same as in column 1. In the case of the static version, again no underlying effect is left.

However it has to be taken into account that the FAT-test is seen as a relatively weak test for publication bias by the MRA-community (Stanley and Doucouliagos 2012). Let us look at the PEESE MRA, the results of which can be seen in columns 3 and 6. The PEESE test is defined as $b_i = \gamma_0 p_i + \gamma_1 se_i^2 + \nu_i$. In case of publication bias, the FAT-PET MRA underestimates the total publication bias. Thus, the MRA literature recommends running a PEESE MRA following the FAT-PET MRA. Taking into account a non-linear relation between the estimate and its standard error, the meta-average is again statistically significant in the case of the dynamic specification and not significant in the case of the static specification. As with the FAT-PET MRA in columns 2 and 5, the PEESE MRA cannot find statistically significant publication bias.

Table 1.1 – Kaldor-Verdoorn specification: all estimates

	dynamic			static		
	(1)	(2) FAT-PET	(3) PEESE	(4)	(5) FAT-PET	(6) PEESE
SE		0.385 (0.546)			1.097 (1.507)	
SE_SQR			0.000 (0.001)			0.009 (0.013)
Constant	0.528+ (0.038)	0.502+ (0.066)	0.528+ (0.038)	0.282 (0.182)	0.246 (0.213)	0.282 (0.183)
Adjusted R^2	0.00	0.00	−0.00	0.00	0.00	−0.01
Observations	404	404	404	103	103	103
Number of studies	46	46	46	12	12	12
BIC	−64.23	−60.78	−58.23	95.36	98.66	99.99

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Kaldor (1966), however, only believed Verdoorn's law to be existent and important in the case of industry. Table 1.2 repeats the analysis from table 1.1 for all manufacturing sector estimates, with similar results. The dynamic specification yields strong Verdoorn coefficients, although this time a bit smaller than in the full sample. Again, the contrast with the dynamic specification could not be any clearer. Our MRA for the static specification finds no statistically significant meta-average, i.e. the static specification finds no sign of existence of Verdoorn's law. While no publication bias can be found when taking into account all estimates, in the case of manufacturing, publication bias does exist in the case of the static specification, inflating the overall estimation result. Comparing the results with table 1.1, it is surprising to find a smaller effect in the manufacturing sector (the supposed *engine of growth* according to Kaldor (1968)) compared to the whole economy.

Table 1.2 – Manufacturing sector only

	dynamic			static		
	(1)	(2) FAT-PET	(3) PEESE	(4)	(5) FAT-PET	(6) PEESE
SE		0.338			2.379***	
		(0.598)			(0.582)	
SE_SQR			0.000			0.021**
			(0.001)			(0.007)
Constant	0.497+	0.473+	0.497+	0.101	0.038	0.101
	(0.054)	(0.088)	(0.054)	(0.090)	(0.059)	(0.091)
Adjusted R^2	0.00	0.00	−0.00	0.00	0.29	−0.02
Observations	293	293	293	57	57	57
Number of studies	30	30	30	7	7	7
BIC	−143.26	−139.81	−137.58	−7.35	−23.65	−3.34

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

The form of the Kaldor-Verdoorn law can easily lead to worries about potential endogeneity between output growth and productivity growth. Although no specific estimator can be used here without making implicit assumptions on whether the economy is ultimately supply-constrained or demand-constrained, MRA can be used in this case as well. Table 1.3 presents results for all estimates that take into account potential endogeneity. The pattern continues, with the dynamic specification finding no publication bias and rather high and statistically significant Kaldor-Verdoorn values, while the static version finds no publication bias and no genuine effect whatsoever.

Table 1.3 – Only estimates which take into account endogeneity

	dynamic			static		
	(1)	(2) FAT-PET	(3) PEESE	(4)	(5) FAT-PET	(6) PEESE
SE		0.475			1.097	
		(0.287)			(0.403)	
SE_SQR			0.001			0.900
			(0.001)			(0.620)
Constant	0.431+	0.396+	0.431+	0.041	0.016	0.040
	(0.041)	(0.047)	(0.041)	(0.025)	(0.014)	(0.025)
Adjusted R^2	0.00	0.01	−0.01	0.00	0.36	−0.02
Observations	137	137	137	22	22	22
Number of studies	12	12	12	3	3	3
BIC	45.91	49.08	50.83	−69.83	−77.75	−67.35

* $p< 0.1$ ** $p < 0.05$, *** $p < 0.01$, + $p < 0.001$; standard errors in parentheses.

Table 1.4 depicts the MRA results for single-country estimates. Again we find strong and statistically significant Kaldor-Verdoorn values for the dynamic version and no genuine effect or publication bias for the static version. Table 1.5 repeats the analysis with cross-country estimates only, with marginally higher estimates that in the single-country case being the only difference.

1.5.1 Taking into account study heterogeneity: multivariate MRA

In this section, MRA is used to explain the variance in estimates in its entirety, taking into account differences in estimation strategies, omitted variables as well as specific study characteristics. For this analysis, 21 variables are used, which are summarised in table 1.6.

Most of the variables consist of dummy variables and represent important variables for the correct estimation specification with regards to Verdoorn's law or try to catch

Table 1.4 – Only single-country estimates

	dynamic			static		
	(1)	(2) FAT-PET	(3) PEESE	(4)	(5) FAT-PET	(6) PEESE
SE		0.549			3.453	
		(0.836)			(3.055)	
SE_SQR			0.001			30.424
			(0.001)			(22.888)
Constant	0.515+	0.478+	0.515+	0.052	−0.010	0.026
	(0.052)	(0.094)	(0.052)	(0.046)	(0.030)	(0.018)
Adjusted R^2	0.00	0.01	−0.00	0.00	0.19	0.17
Observations	249	249	249	14	14	14
Number of studies	26	26	26	6	6	6
BIC	−85.30	−82.99	−79.79	−8.83	−10.23	−9.99

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table 1.5 – Only cross-country estimates

	dynamic			static		
	(1)	(2) FAT-PET	(3) PEESE	(4)	(5) FAT-PET	(6) PEESE
SE		0.218			−1.208	
		(0.778)			(2.510)	
SE_SQR			−0.052			−0.003
			(0.118)			(0.017)
Constant	0.552+	0.537+	0.552+	0.437	0.489	0.437
	(0.060)	(0.104)	(0.061)	(0.227)	(0.298)	(0.229)
Adjusted R^2	0.00	−0.00	−0.01	0.00	0.01	−0.01
Observations	155	155	155	89	89	89
Number of studies	20	20	20	6	6	6
BIC	17.97	22.69	22.99	93.69	96.60	98.17

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

specific characteristics of the primary studies. The first group of dummy variables captures differences in estimation strategy *endogeneity* measures whether the studies tried to correct for endogeneity using either independent variable (*IV*), general method of moments (*GMM*), limited-information maximum likelihood (*LIML*), two-stages least squares (*2SLS*), or three-staged least squares (*3SLS*) estimation techniques. Several other dummies specify other differences in estimation models, such as fixed effects models (*fixed effects*), random effects models (*random effects*) and non-linear least squares (*nonlinear).* Given the theoretical debate reviewed in section 1.2, we might be interested in whether studies did not control for changes in the business cycle, thus estimating Okun's law instead of Verdoorn's law (*no cycle control*), the stock of capital (*no capital stock*), the difference in technology between countries (*no tech. gap*) or wage growth (*no wages*) when estimating Verdoorn's law. Additionally, *tfi* specifies whether total factor inputs where used as a proxy for the stock of capital. The variable *average year* represents the average year of the studies' data set, normalised to the average of all the Kaldor-Verdoorn specification estimates (1978). This variable will be used in order to detect possible time trends, i.e. whether Verdoorn's law became gradually weaker or stronger over time. The third group of dummies represents differences between studies that might affect the overall difference in estimates. Specifically, the dummies try to account for whether the country studied is a member of the OECD (*OECD member*), whether a single country was studied (*single country*), cross-sectional or timeseries data where used (*crosssectional*, *time series*), whether regional data, non-manufacturing data or all-sector data where used (*regional data*, *non-manufacturing*, *all sectors*), whether the study was not published (*unpublished*) or whether the static Verdoorn law specification was estimated (*static*).

The resulting constant of our MRA regression will thus constitute the case where

	Verdoorn and Kaldor	Rowthorn	Rowthorn 2
General			
effect size	0.50	-0.02	0.74
SE	0.54	0.29	0.19
Estimation			
endogeneity	0.31	0.26	0.60
fixed effects	0.00	0.00	0.02
random effects	0.00	0.00	0.02
no cycle control	0.54	0.56	0.65
nonlinear	0.01	0.00	0.00
capital stock	0.30	0.53	0.60
no tech. gap	0.86	0.94	0.97
no wages	0.88	1.00	1.00
tfi	0.31	0.03	0.42
Time			
average year	0	-21	-7
Region and Data			
no OECD member	0.14	0.21	0.32
single country	0.52	0.76	0.62
crosssectional	0.10	0.00	0.15
time series	0.38	0.62	0.34
regional data	0.24	0.03	0.28
unpublished	0.05	0.00	0.03
static	0.20	0.00	0.23
non-manufacturing	0.05	0.18	0.06
all sectors	0.26	0.38	0.24
Observations	507	34	124

Table 1.6 – Explanatory variables with averages and numbner of observations, by estimation specification

all dummy variables are equal to 0. Our baseline specification thus assumes a panel data analysis using OLS regression of the *dynamic* Kaldor-Verdoorn specification, with the stock of capital, the technological gap and wage growth. Furthermore, our baseline scenario analyses multiple OECD member countries, using manufacturing data, with 1978 as the average year of the data set.

Like before, cluster-robust standard errors have been used for the regression. In addition, a general-to-specific approach via stepwise regression is used as recommended by Stanley and Doucouliagos (2012). The resulting MRA can be seen in table 1.7. Using 507 estimates of the Kaldor-Verdoorn specification from 49 studies, the FAT-PET MRA as well as the PEESE MRA find exactly the same results. The reason for this lies in the fact that no signs of publication bias can be found at the 10% significance level and therefore both the standard error (in the case of the FAT-PET test) as well as the variance (in case of the PEESE test) are being dropped during the stepwise approach. The chosen specification finds a highly significant genuine Verdoorn coefficient of 0.597, which is in the higher end of the spectrum of the empirical literature. McCombie, Pugno, and Soro (2002) find that the overall effect size might vary between 0.3 and 0.6. Using MRA, this study aims to explain these differences in results. Out of the eight statistically significant variables, four variables (*no OECD member, regional data, time series* and *nonlinear*) are correlated with higher reported Verdoorn coefficients. The statistical significance of *time series* could reflect an overestimation of Verdoorn's law due to a confusion with the short-run Okun effect. This would be a problem, especially as the effect of *time series* stays significant during most robustness checks. Since the variable *no cycle control* yields no significant results, we might assume that the reported results do not indicate the presence of Okun's law in the empirical literature on Verdoorn's law. The alternative explanation, of course, would be that the existent controls might be flawed.

There are two possible explanations as to why non-OECD countries do experience higher Verdoorn coefficients than OECD member countries. This could either represent technological catching-up of emerging countries or the global restructuring of industry, with high-income countries becoming more and more service industry-heavy and middle-income countries becoming more industrialised. Four more variables (*endogeneity, single country, regional data* and *capital stock*) are correlated with lower reported Verdoorn coefficients. The present results of this multivariate MRA model explain half of the total variation. Neither *non-manufacturing*, nor *all sectors* are statistically significant.

Contrary to the simple MRA in tables 1.1 to 1.5, the static specification seems to produce statistically significant signs of Verdoorn's law. Nevertheless, the static specification of the Kaldor-Verdoorn law seems to deliver lower estimates than the dynamic specification. This is consistent with the rest of the literature and indicates that the underlying technical progress function might not be based on a Cobb-Douglas production function after all. If this is the case, however, then combining both dynamic and static specifications is problematic, as they will not measure the same thing. Thus, table 1.8 repeats the FAT-PET-PEESE multivariate MRA from table 1.7, but this time distinguishes between dynamic and static specification.

Similar to table 1.7, no sign of publication bias can be found even at the 10% significance level. As was shown before, the dynamic specification reports higher meta-averages (0.539) than its' static sibling (0.460). Here, the statistical significance of the models explanatory variables depends on the specification chosen. The dynamic specification yield five variables with positive influence on the meta-average (*tfi, no OECD member, nonlinear, regional data* and *time series*) and five variables with negative

Table 1.7 – Multiple meta-regression analysis

	(1) FAT-PET	(2) PEESE
single country	−0.240**	−0.240**
	(0.110)	(0.110)
endogeneity	−0.235+	−0.235+
	(0.059)	(0.059)
no OECD member	0.204***	0.204***
	(0.067)	(0.067)
regional data	0.246**	0.246**
	(0.103)	(0.103)
time series	0.216**	0.216**
	(0.100)	(0.100)
nonlinear	0.235+	0.235+
	(0.056)	(0.056)
capital stock	−0.147***	−0.147***
	(0.045)	(0.045)
static	−0.270***	−0.270***
	(0.092)	(0.092)
Constant	0.597+	0.597+
	(0.076)	(0.076)
Adjusted R^2	0.50	0.50
Observations	507	507
Number of studies	49	49
BIC	−41.10	−41.10

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table 1.8 – Multiple meta-regression analysis: dynamic vs. static specification

	dynamic		static	
	(1) FAT-PET	(2) PEESE	(3) FAT-PET	(4) PEESE
regional data	0.090***	0.090***	0.734+	0.734+
	(0.031)	(0.031)	(0.008)	(0.008)
endogeneity	−0.133***	−0.133***		
	(0.049)	(0.049)		
fixed effects	−0.099***	−0.099***		
	(0.029)	(0.029)		
random effects	−0.094+	−0.094+		
	(0.026)	(0.026)		
single country	−0.097**	−0.097**	−1.157+	−1.157+
	(0.036)	(0.036)	(0.117)	(0.117)
nonlinear	0.253+	0.253+		
	(0.045)	(0.045)		
capital stock	−0.163***	−0.163***	−0.158**	−0.158**
	(0.047)	(0.047)	(0.064)	(0.064)
time series	0.111***	0.111***	1.242+	1.242+
	(0.033)	(0.033)	(0.261)	(0.261)
tfi	0.112***	0.112***		
	(0.037)	(0.037)		
no OECD member	0.199+	0.199+	0.300***	0.300***
	(0.038)	(0.038)	(0.087)	(0.087)
all sectors			−0.374***	−0.374***
			(0.116)	(0.116)
unpublished			−0.276**	−0.276**
			(0.116)	(0.116)
Constant	0.539+	0.539+	0.460***	0.460***
	(0.029)	(0.029)	(0.114)	(0.114)
Adjusted R^2	0.31	0.31	0.81	0.81
Observations	404	404	103	103
Number of studies	46	46	12	12
BIC	−181.77	−181.77	−61.86	−61.86

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

influence (*single country, endogeneity, fixed effects, random effects* and *capital stock*). *Single country, endogeneity, regional data* and *time series* report much lower values than in table 1.7 when only dynamic specifications are taken into account. Three new moderator variables seem to be important compared to table 1.7 (*fixed effects, random effects* and *tfi*), while the meta-average is slightly lower than previously reported. The static specification in comparison reports a distinctly lower meta-average than in table 1.7, with two new explanatory variables, *all sectors* and *unpublished.* Three variables are positively correlated (*no OECD member, regional data* and *time series*), while three are negatively correlated (*capital stock, all sectors* and *unpublished*).

Regarding differences in specific sectors, the results for the static version are similar to the available literature in that there is a statistically significant difference between manufacturing (due to our choice of dummies this is explicitly our baseline specification) and estimations that study all sectors together. Verdoorn's law seems to be lower for all sectors than for manufacturing alone, implying that Verdoorn's law is stronger in manufacturing than in non-manufacturing sectors. This is expected, as manufacturing has been presented as the key driver of growth by Kaldor (1966) himself, as well as much of the following literature. Indeed, most of the empirical literature assumes that *if* Verdoorn's law existed, it would do so in manufacturing only. The present MRA result do corroborate this interpretation. If the results are correct, then a manufacturing-based industrial strategy would lead to higher long-run growth rates than rivalling strategies.

Compared to the dynamic specification, *no OECD member* as well as *time series* have a slightly bigger impact, while the correlation of *regional data* is much higher in the static specification. Notwithstanding these differences, in both specifications we find statistically significant meta-averages in the upper echelon of typical reported Verdoorn coefficient estimates. Our multivariate MRA model can explain 31% of the variation for the dynamic specification and 81% for the static specification.

1.5.2 Robustness Checks

It has to be made clear that treating each regression as a single entry might introduce some bias, as papers with several control specifications will be over-represented. How to tackle this issue is not agreed upon in the economics MRA community (Stanley and Doucouliagos 2012). Unless stated otherwise, for this study weighted least squares (WLS) regression with inverse variance weights and cluster-robust standard errors are used as the main method of correction. Other possibilities include for example the use of the inverse number of estimates per paper as respective weights, which has been coded for robustness checks as well. Table 1.9 reports several different alternative estimation specifications which, following Havránek (2015) and Iamsiraroj and Doucouliagos (2015), have been used in order to control the robustness of our FAT-PET-PEESE MRAs.

For convenience, column 1 reports the same results as column 1 in table 1.7, which were derived using a general-to-specific approach. For column 2, the general model gets estimated, after which we test all variables that are not statistically significant at the 0.3 level at least. An F-test confirms that the variables chosen this way can be dropped from the MRA; F-test = 0.81 and p-value = 0.62. The general model then gets re-estimated without the dropped variables.

Comparing the results from column 2 with column 1, we can see that only two additional variables are found, however, without being statistically significant even at the 10% level. Both the meta-average as well as the moderator variables stay virtually unchanged.

Column 3 uses the same specification than column 1, only this time with the degrees of freedom as weight rather than the inverse variance. The reason for this is that reported standard errors might be endogenous to reported point estimates (Havránek 2015). Compared to column 1, the size of the coefficients in general is smaller (with the exception of *time series*. Also, *no OECD member, nonlinear*, and *no capital stock* are not statistically significant anymore, but a series of other variables (*fixed effects, random effects, se_i, no cycle control, all sectors, no wages* as well as *tfi*) do appear to have an influence on the meta-average.

As Stanley and Doucouliagos (2012, p.73) argue, the square root of the number of observations can serve as a lower-quality proxy of the standard error. Column 4 uses $\sqrt{n}$ instead of *se_i* in our baseline. The results stay the same, with a minimally higher meta-average. Still, as the number of observations contains less information on variability factors, se_i is preferable to $\sqrt{n}$.

Column 5 reports the same baseline specification as column 1, but this time with 1 over the number of estimates per study as analytical weights instead of the inverse variance. This specification seems to be a rather bad proxy of our FAT-PET MRA, as only two moderator variables (*nonlinear* and *no capital stock*) stay the same while the rest of the old specification is not significant. Additionally, two variables (*no techn. gap* and *unpublished*) gave a statistically significant effect on the reported Verdoorn coefficient, which is a bit higher than in the other specifications.

Finally, instead of using elasticities as effect size, the partial correlation can be used. The partial correlation has the advantage that it renders all estimates comparable with each other and thus the meta-average can be estimated based on a higher amount of observations. On the other hand, its interpretation is not straightforward, as partial correlations have more of a statistical meaning, rather than an economic one. Following Doucouliagos's (2011) guidelines on interpreting partial correlations, a small economic effect can be inferred from a partial correlation of 0.07 or higher, a medium one from 0.17 onward and a large one from estimates higher than 0.32. Here, the use of partial correlation points at a small statistically significant relation between output and productivity growth - according to the FAT-PET MRA using partial correlations, Verdoorn's law exists as well. Only three moderator variables stay statistically significant here (*no OECD member, single country* and *capital stock.* In conclusion, all robustness checks indicate that Verdoorn's law is real and the FAT-PET-PEESE MRA results can thus be considered robust.

1.5.3 Comparing differing estimation strategies

As was explained before, due to the lack of sample means it was not possible to transform the elasticities of the *Rowthorn1* and *Rowthorn2* specifications into the *Kaldor-Verdoorn* specification. In order to secure the maximum amount of transparency, tables 1.10 and 1.11 presents the multivariate FAT-PET-PEESE MRA for each of the *Verdoorn, Kaldor, Rowthorn1* and *Rowthorn2* specifications. Due to multicollinearity issues, *regional data* had to be dropped for this MRA in order to ensure direct comparability between the different specifications. All four specifications find a statistically significant Verdoorn coefficients, even though the overall value of this effect, as well as the important moderator variables differ severely according to the specification chosen.

Table 1.12 reports the meta-averages from tables 1.7, 1.10 and 1.11, the transformed meta-averages in terms of the Kaldor-Verdoorn specification and the implied returns to scale. As was discussed in section 1.2, if the economy is based on a Cobb-Douglas production function, the degree of macroeconomic returns to scale is given by $\mu = \frac{2}{1+\beta_1}$, where α and β are the output elasticities of capital and labour.

Table 1.9 – Robustness Checks

	(1) FAT-PET	(2) p<0.3	(3) df	(4) $\sqrt{n}$	(5) $\frac{1}{e}$	(6) r
single country	−0.240** (0.110)	−0.238** (0.110)	−0.166*** (0.049)	−0.247** (0.106)		0.398** (0.153)
endogeneity	−0.235+ (0.059)	−0.236+ (0.059)	−0.165** (0.066)	−0.244+ (0.062)		
no OECD member	0.204*** (0.067)	0.203*** (0.067)		0.192*** (0.069)		0.248** (0.119)
regional data	0.246** (0.103)	0.248** (0.103)	0.163*** (0.055)	0.231** (0.101)		
time series	0.216** (0.100)	0.212** (0.102)	0.313*** (0.095)	0.213** (0.094)		
nonlinear	0.235+ (0.056)	0.235+ (0.056)		0.227+ (0.058)	0.263+ (0.038)	
capital stock	−0.147*** (0.045)	−0.148*** (0.045)		−0.150*** (0.046)	−0.162** (0.062)	−0.107*** (0.038)
static	−0.270*** (0.092)	−0.273*** (0.093)	−0.120* (0.071)	−0.259** (0.098)		
fixed effects		−0.080 (0.059)	−0.118*** (0.038)			
random effects		−0.082 (0.059)	−0.114*** (0.038)			0.274* (0.154)
SE			0.014** (0.007)			
no cycle control			−0.116** (0.054)			
tfi			0.130** (0.053)			
no wages			0.105** (0.040)			
all sectors			0.122*** (0.036)			
non-manufacturing					0.152** (0.064)	
no tech. gap					−0.160** (0.072)	
unpublished						0.154* (0.092)
Constant	0.597+ (0.076)	0.599+ (0.076)	0.417+ (0.063)	0.614+ (0.080)	0.680+ (0.071)	0.142+ (0.021)
Adjusted R^2	0.50	0.50	0.16	0.51	0.09	0.45
Observations	507	507	495	495	507	495
Number of studies	49	49	49	49	49	49
BIC	−41.10	−41.79	−41.87	−44.35	214.70	−167.22

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table 1.10 – Comparison Verdoorn vs. Kaldor specification

	Verdoorn		Kaldor	
	(1) FAT-PET	(2) PEESE	(3) FAT-PET	(4) PEESE
non-manufacturing	0.255+ (0.062)	0.255+ (0.062)		
endogeneity	−0.231+ (0.049)	−0.231+ (0.049)	−0.385+ (0.060)	−0.397+ (0.060)
static	−0.388+ (0.074)	−0.388+ (0.074)	−0.288+ (0.049)	−0.264*** (0.070)
unpublished	−0.123** (0.045)	−0.123** (0.045)		
capital stock	−0.152** (0.069)	−0.152** (0.069)	−0.139+ (0.029)	−0.174+ (0.031)
no tech. gap	−0.226*** (0.074)	−0.226*** (0.074)		
no wages	0.304+ (0.066)	0.304+ (0.066)	−0.125** (0.057)	−0.145** (0.054)
tfi	0.270* (0.145)	0.270* (0.145)	0.144** (0.054)	0.142** (0.052)
single country	0.179*** (0.051)	0.179*** (0.051)	−0.168* (0.084)	
crosssectional	0.284+ (0.055)	0.284+ (0.055)	−0.228** (0.085)	−0.271*** (0.080)
SE			−1.388* (0.800)	
time series			0.094** (0.039)	
all sectors			0.285*** (0.080)	0.392+ (0.094)
no OECD member			0.258*** (0.082)	0.324+ (0.061)
fixed effects				−0.147*** (0.050)
random effects				−0.141*** (0.047)
Constant	0.441+ (0.090)	0.441+ (0.090)	0.869+ (0.131)	0.702+ (0.061)
Adjusted R^2	0.63	0.63	0.69	0.67
Observations	244	244	263	263
Number of studies	32	32	21	21
BIC	−118.06	−118.06	−83.87	−80.46

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table 1.11 – Comparison Rowthorn 1 vs Rowthorn 2 specification

	Rowthorn 1		Rowthorn 2	
	(1) FAT-PET	(2) PEESE	(3) FAT-PET	(4) PEESE
non-manufacturing	−1.225+	−1.225+		
	(0.116)	(0.116)		
tfi	0.638+	0.638+		
	(0.020)	(0.020)		
all sectors	0.189*	0.189*	0.506+	0.506+
	(0.092)	(0.092)	(0.111)	(0.111)
capital stock	0.238**	0.238**	−0.394+	−0.394+
	(0.068)	(0.068)	(0.079)	(0.079)
no tech. gap	0.204+	0.204+		
	(0.033)	(0.033)		
no OECD member	0.236+	0.236+		
	(0.030)	(0.030)		
single country	0.116*	0.116*	0.596+	0.596+
	(0.058)	(0.058)	(0.069)	(0.069)
endogeneity			−0.094**	−0.094**
			(0.042)	(0.042)
static			−0.238**	−0.238**
			(0.086)	(0.086)
no cycle control			−0.184***	−0.184***
			(0.058)	(0.058)
Constant	−0.254***	−0.254***	0.770+	0.770+
	(0.063)	(0.063)	(0.051)	(0.051)
Adjusted R^2	0.84	0.84	0.68	0.68
Observations	34	34	124	124
Number of studies	7	7	14	14
BIC	−4.51	−4.51	−81.60	−81.60

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table 1.12 – Reported meta-averages, transformed to Verdoorn specification and corresponding returns to scale

Specification	**Kaldor-Verdoorn**	**Verdoorn**	**Kaldor**	**Rowthorn1**	**Rowthorn2**
simple unweighted average	0.50	0.54	0.53	-0.02	0.73
simple unweighted average, transformed to Verdoorn specification	0.50	0.54	0.47	51	0.43
meta-average by specification	0.60	0.44	0.31	-0.25	0.77
meta-average, transformed to Verdoorn specification	0.60	0,44	0.69	5.00	0.44
returns to scale	1.25	1.39	1.18	0.33	1.39
number of Observations	507	244	263	34	124

Based on our sample from 49, 7 and 14 studies respectively, we now compare the different specifications. These specifications however are not equal to each other, but imply very different views regarding the nature of the economic problem. While the *Kaldor* specification emphasises the role of aggregate demand for economic growth, both the *Rowthorn1* and *Rowthorn2* specifications imply an economy under supply-side constraints. In term of meta-averages by specification, the *Kaldor-Verdoorn* specification finds a Verdoorn coefficient of 0.60 (compared to the unweighted average of 0.50), the Verdoorn specification yields a Verdoorn coefficient of 0.44 (compared to the unweighted average of 0.54), the *Kaldor* specification finds a Verdoorn coefficient of 0.69 (compared to the unweighted average of 0.47 transformed to the Verdoorn specification) the *Rowthorn1* specification yields a Verdoorn coefficient of 5.00 (compared to the unweighted average of 51 transformed) and the *Rowthorn2* specification finds a Verdoorn coefficient of 0.44 (compared to the unweighted average of 0.43 transformed). When we then calculate the returns to scale, the *Kaldor-Verdoorn* specification experiences strong increasing returns to scale of 1.25, the Verdoorn specifications implies returns to scale of 1.39, while the *Kaldor* specification yields returns to scale of 1.18. The *Rowthorn1* and *Rowthorn2* specifications imply very different returns to scale (0.33

and 1.39 respectively), although in the case of the *Rowthorn1* specification, the results could be challenged on the basis of a very low number of overall observations (34). Because of the low number of observations and the fact that *Rowthorn1* meta-average results are extremely different from the rest, we will exclude it in continuation when providing a possible range of the Verdoorn effect. Nevertheless, all other specifications imply increasing returns to scale. These differences in results show that the choice of specification matters. The resulting Verdoorn coefficient, and the implied returns to scale vary significantly according to the specification chosen.

1.6 Conclusion

Our study summarises the plethora of empirical estimates surrounding Verdoorn's law, the relation between growth in aggregate output/demand and productivity growth. Conventional literature reviews are very limited, in both the amount of pages dedicated to such an enterprise, as well as the level of detail they can delve into. Using a method known as Meta-regression analysis (MRA), 665 estimates of 52 studies in a newly created data set along with several study-specific properties were gathered and analysed FAT-PET-PEESE MRA using weighted least square (WLS) regression.

Four main findings can be drawn from this study. First, nearly none of the commonly used estimation specifications show signs of publications bias, even taking into account various control specifications. This is unusual, as most MRA studies find existing publication selection bias in the studied fields.

Secondly, the high statistical significance of a meta-average hints at the presence of a genuine underlying effect linking both output/demand growth and productivity growth. We find a statistically significant meta-average across all specifications. Verdoorn's law is real and ranges between 0.44 and 0.69, implying returns to scale between 1.18 and 1.39. As a result, the range of Verdoorn's law found in this meta-regression analysis exceed the range given by McCombie, Pugno, and Soro (2002) (0.30 to 0.6). This might have important implications for many different fields of research, such as economic development, trade and growth theory. As such, Verdoorn's law provides a powerful element in an alternative to the secular stagnation narrative (Hansen 1938; Gordon 2015), where reasons for long-term slow economic growth are usually only found using supply-side arguments. The existence of an effect as reported by Verdoorn (1949) might hint at the importance of demand-side explanations and possible solutions (Storm 2017). But even when the existence of this effect is acknowledged, its interpretation as well as its relation to supply- or demand-side arguments is different according to the specification chosen.

Thirdly, the choice of estimation specification matters. The overall effect differs strongly depending on the used specification, even more so than indicated by the overall literature. While most specifications find strong Verdoorn coefficients with increasing returns to scale, Rowthorn's first specification finds coefficients implying decreasing returns to scale.

Fourth, in not a single specification was the Verdoorn coefficient higher in non-manufacturing sectors than in manufacturing. Most of the time, our FAT-PET-PEESE MRA failed to find significant differences between manufacturing and non-manufacturing at all. We cannot determine whether the *non-manufacturing* and *all sectors* dummies where not significant because there was no difference in size between manufacturing and non-manufacturing or whether there simply is no effect in other sectors than manufacturing. The fact that the Verdoorn effect was at least higher in manufacturing than anywhere else is an expected result for Kaldorians. Kaldorians use to see the manufacturing sector as 'the engine of growth'. According to them, manufacturing may drive growth in the sense that it creates employment and business opportunities for entrepreneurs.

As this study tried to show using a new data set, contradictory results can be found according the the type of specification that is preferred. Specifications of this type are being used based on probably unsolvable differences regarding the kind of assumptions about contemporary capitalism we believe to be real. The results show that the estimates are very sensitive with regards to the level of aggregation, the estimation specification, as well as the control for endogeneity. Similarly, it should be seen as a call for other researchers to include fundamental test statistics in their published regression outputs, so that it can give rise to an increase in the use of meta-regression analysis in economics in general.

In this chapter, we have given an ample overview of the available literature on Verdoorn's law. We discussed its' history, the theoretical debates surrounding its working as well as the differences in interpretation depending on whether one sees the economy to be ultimately supply-constrained or demand-constrained. We further discussed additional control variables that need to be taken into account when conducting proper research on Verdoorn's law as well as the 'static-dynamic' paradox. As main contribution to the available literature, in the former chapter we've undertaken a meta-regression analysis on the primary literature regarding Verdoorn's law. Using a novel data set, we find no signs of publication bias, but we do find statistically significant meta-averages across all specifications.

Looking at the insights provided by the present chapter we can safely say that the model part that describes Verdoorn's law in figure 5 is correct. Figure 1.6a therefore presents the same model again, this time with a broad, green border around round

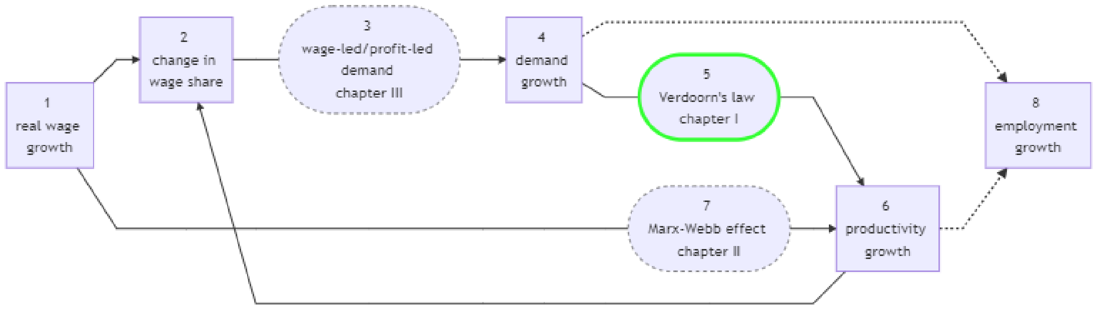

Figure 1.5 – The distribution-productivity-employment nexus, part I:

(a) Based on the present meta-regression analysis, Verdoorn's law is found to be real, with the Verdoorn effect ranging between 0.30 and 0.68.

box number 5. Based on the present meta-regression analysis, Verdoorn's law is found to be real, with the Verdoorn effect ranging between 0.44 and 0.69. With chapter I, we have thus established Verdoorn's law as an economic mechanism which links output/demand growth (box 4) to productivity growth (box 6). The next step consists in trying to establish such a link between real wage growth (box 1) and productivity growth via the Marx-Webb effect in chapter II.

Part II

Testing Verdoorns Law - A panel data analysis under cross-sectional dependence for 23 EU member countries

Chapter 2

Testing Verdoorn’s law on 23 EU member countries

2.1 Introduction

From 2000 onward, the OECD member countries experienced much lower rates than before, especially when compared to the period of 1970-1980 and as can be seen in Figure 2.1.

While some countries were able to sustain their relatively higher growth rates for a bit longer, the great recession of 2007-2008 was a game-changer for all countries. Since then, OECD member states have not been able to return to pre-crisis growth rates. For some economists, especially in mainstream economics, this represents not just a short-run deviation from the respective countries’ long-run growth path. Rather, for them the post-crisis world is one where the growth path itself changed. Low growth rates are not seen as signs of the economic cycle’s longer downturn. Low growth has come to stay. As is often the case with grand ideas in economics, both good and bad,

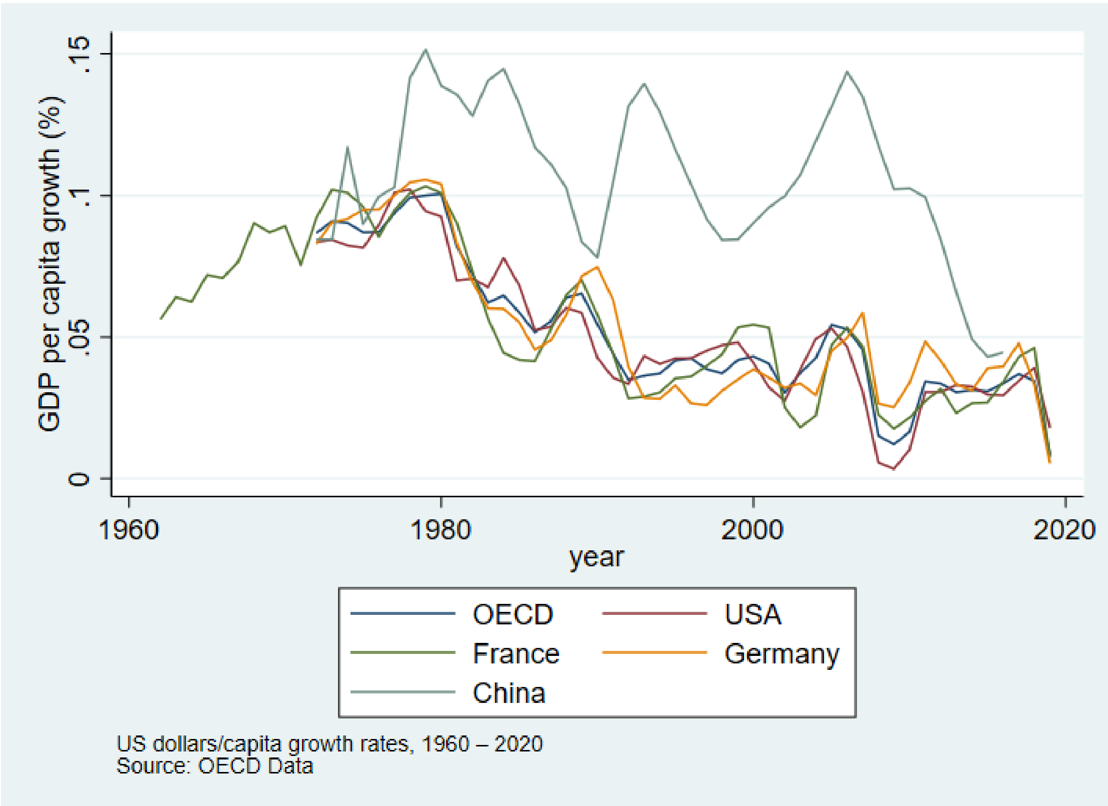

Figure 2.1 – GDP Growth Rates - 3-year moving average

this idea is not novel but rather a based on an 'academic scribbler of a few decades back'(Keynes 1936). The idea of a grim future, paved with sustained low growth rates was first expressed as 'secular stagnation' by Alvin Hansen back in the 1930s. Hansen (1938) created this concept in midst of the Great Depression, the longest and deepest crisis in capitalism's history up to date.

Hansen, influenced by the ideas of John Maynard Keynes (1936), argued that first, the post-Great Depression US economy was only stabilised by public spending. In his view, the downturn of 1937 was a 'double-dip recession'. By this term we understand an unwillingly created type of economic crisis which is triggered by political pressures to reduce state activities in the economy, thereby reducing aggregate demand. Second, Hansen (1938) argued that (by then) contemporary US capitalism's innovations became less and less innovative. Here, Hansen's main argument was that innovations had changed from being capital-using, thus creating new and higher demand for investment to capital-saving, and consequently reducing the overall investments needed for economic activity to diminish. In order to promote higher growth rates and end economic misery, Hansen (1938) therefore argued in favour of demand-led expansionary policies. This could mean either increasing public consumption or creating permanent public investment programs instead of just stimulating private investment (Roubtsova 2016).

This chapter seeks to estimate Verdoorn's law using data for 23 EU member countries for the period 1995-2017. The value hereby added lies in the fact that for the first time we estimate Verdoorn's law using the EU-KLEMS data-set, which enables us to compare all 23 members on a sectoral level, with a much higher number of observations. To our knowledge, this is the first time the EU-KLEMS data set is used in order to estimate Verdoorn's law. Our findings show that again, the resulting Verdoorn coefficients vary strongly according to the country group and the estimation specification chosen. Both estimations of Verdoorn's law specified in growth rates and logarithms consistently find statistically significant Verdoorn coefficients across all specifications. This is in contrast to the 'static-dynamic paradox' which is well-discussed in the available literature(McCombie, Pugno, and Soro 2002). The structure of this chapter is as follows. Section 2.3 provides a review of empirical literature regarding the fall in productivity growth. Section 2.4 explains the use of Verdoorn's law in this study to estimate the effect of changes in aggregate output/demand growth on productivity growth. We present the data set and the measures taken to obtain robust results in section 2.5. Section 2.6 presents the econometric results and section 2.7 concludes.

2.2 Introducing The Productivity Regime

The Goodwinian line of thinking about the intersection of demand, productivity and employment regimes was at the centre of a group called the 'Social Structures of Accumulation' (SSA) school. The SSA school shared several arguments with the French Regulation School, especially when trying to explain the long-term decline in growth rates and high inflation in rich countries. The result of this intellectual joint-venture can be seen in collaborations between its leading members, such as Bowles and Boyer (2015).

Here, a wage-led policy might lead to a rise in demand and productivity growth. The rise in productivity itself will lead, however, to a decrease in employment, i.e. demand and productivity would be wage-led, while employment is profit-led (Boyer and Petit 1981; Boyer and Petit 1988). In this thesis, we will focus on the relation between the demand regime and the productivity regime, while only briefly mentioning the employment regime.

Storm and Naastepad (2013) [1] offer a very interesting way to look at the interactions between wages and demand on one side, and technological advancement on the other hand. Here, changes in demand can have long-lasting effects on economic growth. The authors however include a function for employment growth in their model, pointing at potentially concerning effects for the distribution of higher wages amongst workers. Finally, their conclusions indicate that, while during most of the twentieth century the introduction of new machinery induced a 'hollowing out' of the middle class and a polarisation of incomes, there is a return to the use of machinery as was the case during the nineteenth century: to the substitution for skilled labour through the simplification of tasks.

The model builds on the following three growth equations.

$$\dot{y} = y_0 + y_q\dot{q} + y_w\dot{w} \qquad \text{(Labour Productivity) (1)}$$

$$\dot{q} = \tau_0 + \tau_1[\dot{w} - \dot{y}] \qquad \text{(Demand) (2)}$$

$$\dot{e} = \dot{q} - \dot{y} \qquad \text{(Employment) (3)}$$

Verdoorn effect describes the Verdoorn effect: higher demand gives incentives to increase productivity growth. Marx-Webb effect stands for 'Marx-biased technological change' or the 'Marx-Webb effect'(Hein and Tarassow 2010; Lavoie 2017b) - an increase in the growth rate of wages $\dot{w}$ gives capitalists incentives to obtain labour-saving

[1] Several other publications deserve to be mentioned here, amongst them Setterfield and Cornwall (2002), Naastepad (2006), Hein and Tarassow (2010), Hein (2014) and Lavoie (2014). All of them endogenise technical change via the use of either Verdoorn's law or the Marx-Webb effect, all of them differentiate between a demand regime and a productivity regime, even if there are some smaller differences. Because of this, the work by Storm and Naastepad (2013) will be explained in a notation used by Lavoie (2014), with additions by both Lavoie (2014) and Hein (2014).

technology, thereby increasing productivity. Lavoie (2017a) calls this effect the 'Marx-Webb effect'. This is a bit misleading, since the Webb effect is based on the effect of higher wages on workers' motivation - very similar to the 'efficiency wage' argument (Krassoi Peach and Stanley 2009). While the mechanisms between the Marx-Webb effect and the Webb effect are different, both effects assume a positive relation between real wage growth real wage growth and productivity growth. For this reason, in this thesis we use the term 'Marx-Webb effect' to explain the effect of an increase in wages on productivity.

demand regime depicts the actual demand-regime and is positive in a wage-led and negative in a profit-led case. $[\dot{w} - \dot{y}]$ describes unit labour cost growth.

$$(1) \rightarrow (3) : \dot{e} = (1 - y_q)\dot{q} - y_0 - y_w \dot{w} \tag{4}$$

Equilibrium growth rates are thus given by

$$\Rightarrow \dot{q} = \frac{\tau_0 - y_0 \tau_1 + (1 - y_w)\tau_1 \dot{w}}{1 + y_q \tau_1} = \tau_0 + \Xi \dot{w} \tag{5}$$

$$\dot{y} = y_0 + y_q \tau_0 + (y_w + y_q \Xi)\dot{w} \tag{6}$$

$$\dot{e} = -y_0 + (1 - y_q)\tau_0 + [(1 - y_q)\Xi - y_w]\dot{w} \tag{7}$$

(2.1)

The effect of a reduction in wage growth is explained by

$$\frac{\partial \dot{q}}{\partial \dot{w}} = \frac{(1-y_w)\tau_1}{1+y_q\tau_1} = \Xi. \tag{8}$$

With y_q and y_w being positive and y_w being smaller than 1[2], the overall effect depends on τ_1, i.e. the overall demand-regime. Given that the stability condition $1 + y_q\tau_1 > 0$ holds, the introduction of endogenous changes in productivity don't change the overall nature of the demand-regime for $0 < y_w < 1$. However the overall effect of the regime weakens in both cases the more y_w approaches a value of 1.

$$\lim_{y_w \to 1} \frac{\partial \dot{q}}{\partial \dot{w}} = \lim_{y_w \to 1} \frac{(1-y_w)\tau_1}{1+y_q\tau_1} = 0$$

This means that the standard Neo-Kaleckian model is overestimating the effect of a change in wages on overall growth of output. The reason for this is as follows.

1. Given a wage-led demand regime, an increase in wage growth increases the wage share wage share, thus increasing effective demand and output growth, following the canonical Neo-Kaleckian model.

2. The increase in aggregate demand fuels productivity growth, thus increasing the profit share and thus reducing the initial gains obtained via the rise in wage growth.

3. Finally, the increase in wages also has direct effect on productivity since with higher wages it becomes more interesting for capitalists to use labour-saving technology, thus reducing the gains from wage-led growth again.

[2] Storm and Naastepad (2013) give empirical evidence that this is generally the case.

The effect of a change in wage growth on productivity growth can be split into a direct effect caused by the change in wages and the indirect effect of changes in effective demand. We can see from the following equation that changes in wage growth affect productivity more dramatically than output.

$$
\begin{aligned}
\frac{\partial \dot{y}}{\partial \dot{w}} &= y_w \Delta \dot{w} + y_q \frac{\partial \dot{q}}{\partial \dot{w}} \\
\Rightarrow \frac{\partial \dot{y}}{\partial \dot{w}} &> \frac{\partial \dot{q}}{\partial \dot{w}}, \quad \forall y_w > 0
\end{aligned} \tag{9}
$$

This last point means that higher wage growth reduces employment growth as shown in equation (3). Conversely, lower wage growth implies higher employment growth, even though output growth can still vary depending on the demand-regime.

$$
\begin{aligned}
\frac{\partial \dot{e}}{\partial \dot{w}} &= \frac{\partial \dot{q}}{\partial \dot{w}} - \frac{\partial \dot{y}}{\partial \dot{w}} \\
\Rightarrow \frac{\partial \dot{e}}{\partial \dot{w}} &= (1 - y_q)\frac{\partial \dot{q}}{\partial \dot{w}} - y_w \\
\Rightarrow \frac{\partial \dot{e}}{\partial \dot{w}} &= \frac{(1 - y_q - y_w)\tau_1 - y_w}{1 + y_q \tau_1}
\end{aligned} \tag{10}
$$

Again, the overall effect of a change in wages on employment can be split in one direct and two indirect effects.

1. Given a wage-led demand regime, an increase in wage growth increases effective demand and thus employment, following the canonical Neo-Kaleckian model.
2. The increase in aggregate demand fuels productivity growth, thus putting negative pressure on employment as explained by Verdoorn's law.

3. Thirdly, via the Marx-biased technological change channel the increase in wages is also fueling productivity growth, thereby decreasing emplyoment as well.

Which of these two channels dominates is not clear *a priori*. If $\tau_1 > \frac{y_w}{1-y_q-y_w}$, then the overall effect of an increase in wages on employment is always positive. In a world with exogenous technological change, this is always the case under a wage-led regime.

Storm and Naastepad (2013) continue by giving estimations as to how big τ_1 would have to be in order to enable a successful long-term wage-term strategy. In order for an increase in wages to affect employment positive, equation (10) has to be positive. Given that the stability condition $1 + y_q\tau_1 > 0$ holds, equation (10) can only be positive if $(1-y_q-y_w)\tau_1 - y_w > 0$. It is then possible to obtain the necessary size of τ_1 in order to empower a successful wage-led policy.

$$\begin{aligned}(1-y_q-y_w)\tau_1 - y_w > 0 \\ \Leftrightarrow \tau_1 > \frac{y_w}{1-y_q-y_w}\end{aligned} \tag{11}$$

The authors then estimate y_q and y_w, concluding that it is reasonable to assume coefficients of $y_q = 0.38$ and $y_w = 0.46$ respectively. Given those estimates, one would need coefficients of $\tau_1 > 2.37$ to fulfil these criteria, something 'totally unrealistic' according to Lavoie (2014, p. 434). Storm and Naastepad (2013) conclude that with the introduction of technological change, cooperative capitalism's big dilemma becomes clear: Wage-led-oriented policies might be able to boost economic growth and increase productivity. But it is exactly those increases in productivity that put pressure on employment, thereby making it impossible to let everybody obtain the gains without reducing the overall amount of hours worked.

Storm and Naastepad (2013), by using the literature on Verdoorn's law and the Marx-Webb effect try to combine two different approaches to post-Keynesian endogenous growth with its effects on long-term employment. If there is any consensus amongst the different Keynesian schools that can be agreed upon, it might very well be the notion that an equilibrium in both the goods market and the money market might not yet imply full employment. Indeed, there usually might (and will) exist involuntary unemployment. Yet even if this seems to be one of the most fundamental claims of any Keynesian approach, it is interesting that most post-Keynesian long-run analysis do not offer a special employment function. Usually in neo-Kaleckian models, the rate of capacity utilisation is used as both a proxy for aggregate demand and employment. However this is not enough to explain long-term trends in employment. Some post-Keynesians like Stockhammer (2008) use an endogenous NAIRU to explain long-term employment growth, but this has not proven to become a consensual view in post-Keynesian theory. Storm and Naastepad (2013) offer a different way in that they explain growth in employment as the difference between demand and productivity growth, which enables them to look deeper into the overall effect of technological change. There are however some open questions to answer, which shall be presented in the following.

As Hein (2014) points out, the authors seem to implicitly assume that wages increase faster than productivity to have any effect similar to the one described by the 'Marx-biased technological change' literature, which does not necessarily always have to be the case. It might thus be helpful to look into the other two possible cases – productivity growth being higher than wage growth and the two being equal. Another critique concerns the nature of the aggregate demand growth/capital accumulation function used by Storm and Naastepad (2013). As Hein and Tarassow (2010, p. 729) argue, in Storm and Naastepad 2013's model with an exogenous growth in real wages, '*[...] productivity growth only feeds back on output growth through its effects on the profit share, but has no direct effect on investment*'. Thus, one should consider adding productivity growth directly into the capital accumulation function, while exchanging real wage growth for the wage/profit share. Lavoie (2014) gives another reasoning for adding productivity growth directly into the demand growth/capital accumulation function via referring to the Schumpeterian argument that productivity growth '*[...] should be included in the investment function and hence in the equation determining output growth*' (Lavoie 2014, p.435). He then continues modifying equations (1) and (2) as explained, but instead of replacing real wage growth $\dot{w}$ with the wage/profit share uses the difference between real wage growth $\dot{w}$ and productivity growth $\dot{y}$.

$$\dot{y} = y_0 + y_q\dot{q} + y_w(\dot{w} - \dot{y}) \qquad \text{(Labour Productivity) (1')}$$

$$\dot{q} = \tau_0 + \tau_1(\dot{w} - \dot{y}) + \tau_2\dot{y} \qquad \text{(Demand) (2')}$$

By assuming a coefficient of 0.2 for τ_2, Lavoie obtains values for a necessary τ_1 of around 0.65, showing that the direct inclusion of labour-saving technology in the capital accumulation equation yields less harsh results for wage-led policies than in the original model by Naastepad and Storm (2010).

The Bhadhuri-Marglin model has been tested countless times in the past decades. Similarly there exists a growing literature of empirical studies concerning technological change in the post-Keynesian literature. The biggest part of those studies focus on the Verdoorn effect and its coefficient in different countries. McCombie, Pugno, and Soro (2002) offer a detailed survey of more than 80 studies concerning the Verdoorn effect, from the original study by Verdoorn (1949) until 2001. They show that the Verdoorn effect has been confirmed in the overwhelming majority of these studies with different methods and data, with an average coefficient between 0.64 and 0.67. This is true for cross-section estimations for countries or regions (US, UK and countries of the European Union, among others), or for industry branches (US, UK, France and Germany, among others), but also for time series econometrics for single countries or regions (US, UK and Germany, among others).

Marquetti (2004) tests the relationship between wages and productivity in a very detailed manner. Starting from one of Kaldor’s ’stylised facts’, the constancy of the wage and the profit shares, Marquetti (2004) tests both variables for co-integration, using a data set ranging from 1869-1999 which was already used before by Duménil and Lévy (1995). The author further uses a two-step procedure suggested by Engle and Granger (1987) indicating that wage growth Granger-causes productivity growth, but not the other way around. Thus, he concludes, wages and productivity have a long-lasting relationship. He further explains the possible reason for this as follows: ’*In this framework, an increase in real wages intensifies the search for and adoption of labor-saving technical change. On the other hand, a decline in the growth rate of real wages reduces the incentives to search for and adopt technical innovation, causing a slowing in the growth rate of labor productivity*’ (Marquetti 2004, p. 434). This relationship seems the be of one-to-one and is consistent with Kaldor’s ’stylised fact’.

Starting from the stylised fact that GDP growth in the Anglo-Saxon countries was smaller than in Europe during the 1960s until the 1990s, even though the latter had ’more rigid labour markets’, Vergeer and Kleinknecht (2007) use panel-data regression of 19 OECD countries from 1960 to 2004 to estimate both the effects of aggregate demand and real wage growth on productivity growth, using the ’Total Economy

Database (May 2006) of the Groningen Growth and Development Centre' The dependent variable is growth in value added per labour hour while the key independent variable is annual percentage growth of the real wage. Other control variables include the relative difference between the labour productivity level of a country and that of the country with the highest level of labour productivity in the sample, past labour productivity, country as well as year dummies and service sector shares in total value added, following the Baumol argument that technological gains in the service sector are smaller than in the manufacturing sector. The authors find that

> *Apart from the inclusion of GDP growth in the year when labour productivity growth was measured (the most frequent specification in the literature), significance tests showed that GDP growth with a one-year lag should also be included. The immediate effect of this Verdoorn coefficient is 0.55 while the long-run effect (including the higher order effects through the lagged Verdoorn coefficient and the lags of labour productivity growth) equals 0.25*

.

The estimated Marx-Webb effect lies between 0.24 and 0.34. Hein and Tarassow (2010) follow Vergeer and Kleinknecht (2007) in their methodology with the aid of an error-correction-model (
acrshortecm), but replace real wage growth as the variable describing the wage push explanation by the profit share. Using the database of the Annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs (AMECO) which covers a time frame from 1960 to 2007, the authors estimate the growth of real output per person employed (full-time equivalents). Explanatory variables include real wage growth in a first round, followed by the change in the

profit share in a second. Other variables are the share of manufacturing output in total GDP and catching up processes with the technology leader, similar to Vergeer and Kleinknecht (2007). The results coincide with most of the studies mentioned before. The strongest influences of output growth on productivity growth were found for France (0.54%) and the lowest for the US (0.11%), while the wage push coefficient experienced the strongest increase in Austria (0.67%), and showing the lowest value in the UK (0.25%). However, in the first time sub-group several European countries experience significant positive correlation between a rise in the profit share and productivity growth. One possible explanation for this phenomenon might be non-linearities in the relationship between wage growth and productivity growth.

As Lavoie (2014) points out however, one has to treat the empirical results concerning the Verdoorn effect on productivity with great care. Kaldor's version of Verdoorn's law shows no difference to neither the dynamic version of the Cobb-Douglas production function nor the dynamic version of the national accounts. This could mean that in the end the Verdoorn effect might not be anything else than a statistical artefact, especially since all too often the coefficients share an uncomfortable similarity with the wage/profit shares (Lavoie 2014, p.429).

2.3 Wages and Productivity: Empirical Studies

Studies dealing with the fall in productivity are not new. Especially in recent years, some studies have attempted to analyse this decay using micro-econometric methods (Autor et al. 2017; Böckerman and Maliranta 2012; IMF 2017). Most of these studies link the fall in the wage share to changes in productivity or the terms of trade and to rigidities in access to financial markets. Another group of studies explains the fall in productivity by a sub-optimal allocation of foreign excess capital and models these relationships with so-called credit friction models (Benigno and Fornaro 2014; Grjebine, Héricourt, and Tripier 2019; Piton 2019; Reis 2013). The inflow of foreign capital thus finances the less productive firms in the non-tradeable goods sector instead of the more productive ones, the result being a decline in average productivity. In the case of Portugal, Reis (2013) concludes that a further opening of the financial market without financial deepening can thus have counter-intuitive effects.

However, we are interested in analysing the sectoral dynamics between the wage share productivity from a macroeconomic perspective, which may have completely different effects than at the purely corporate level. Productivity changes cannot be explained solely by miss-allocation of capital from abroad, but must rather be understood as a link between employment and the distribution of wages and profits.

Taylor and Ömer (2019a) use a self-constructed database to conduct a meso-economic analysis of 16 sectors of the US economy, examining employment, productivity levels and growth rates, real wage growth rates and inter-sectoral terms of trade between 1990 and 2016. The authors conclude that the 16 sectors can be divided into a group of seven 'stagnant' sectors with little or no wage and productivity growth but high employment growth. At the same time, there are nine 'dynamic' sectors with high rates of productivity growth in wages but deteriorating employment and sectoral terms of trade. Similarly, Taylor and Ömer (2019b) use growth decompositions for the same period and the same sectors to show that employment reacts positively to increases in output and negatively to increases in productivity over the period observed. The authors also show that the change in employment away from dynamic to stagnant sectors explains the general decline in the US wage share.

The database we use (EU-KLEMS) can only cover the period from 1995 to 2017, with a few countries only providing observations over a smaller sub-period. At the same time, the ones available to us allow a more detailed analysis covering 19 sectors instead of the 16 sectors of Taylor and Ömer (2019a) and Taylor and Ömer (2019b).

Grjebine, Héricourt, and Tripier (2019) use the Total Factor Productivity (TFP) database of the EU KLEMS database and show, using Germany, France and Spain as examples, a divergence in the European Monetary Union (EMU) between the "core countries" with high productivity growth and the "peripheral countries" with low productivity growth. While property prices in Germany fell between 2000 and 2008, the experience in Spain and France was contrary, as both countries experienced a property boom. While prices in Spain fell sharply with the outbreak of the financial crisis, they fell only very slightly in France. According to Grjebine, Héricourt, and Tripier (2019), sectoral re-allocations are at the centre of this divergence. They argue that the divergence in property prices between core and periphery can explain most of these sectoral re-allocations, not only in construction but in every sector of the economy. Grjebine, Héricourt, and Tripier (2019) examine how changes in the value of real estate assets affect investment, total factor productivity and gross value added at the level of individual countries and sectors through a coverage mechanism. If capital markets are imperfect, companies in financially distressed sectors will start to use the real estate they own as garnish-able assets as collateral. As property prices rise, the value of these securities will also increase and therefore companies in this sector can benefit from additional funding. The results of Grjebine, Héricourt, and Tripier (2019) suggest that the rise in real estate prices correlates with higher investment and a higher sectoral share in value added, but not with total factor productivity. The authors therefore conclude that property shocks do not have a significant impact on total factor productivity at the sectoral level, but rather affect total productivity through the redistribution of resources between sectors (Grjebine, Héricourt, and Tripier 2019, p.8).

Our own analysis differs in that we use 23 of the former EU28 members rather than just Germany, France and Spain. We hope that this broader selection will enable us to make a more detailed analysis of the underlying macroeconomic dynamics. Second, while Grjebine, Héricourt, and Tripier (2019, p.3) argue that 'it is widely recognised that the dynamics of total factor productivity drive long-term economic growth (and thus GDP per capita)', there are a significant number of researchers who criticise the use of total factor productivity as a purely artificial construct with no clear link to reality. Even if total factor productivity is more than a residual of a Cobb-Douglas production function, it cannot measure productivity but can only reflect a weighted average of the growth rates of wages and profits (Shaikh 1974; Felipe and McCombie 2003; Carter 2011; Felipe and McCombie 2013). To avoid these debates, which go back to the so-called Cambridge Capital Controversies, our analysis differs from Grjebine, Héricourt, and Tripier (2019) in that it uses GDP per worker and GPD per hour as measures of productivity instead of total factor productivity.

Mendieta-Muñoz, Rada, and Arnim (2019), similar to Taylor and Ömer (2019a) and Taylor and Ömer (2019b), analyse changes in the functional distribution of income in the US post-war economy from 1948 to 2017. By breaking down the changes in the US wage share in 14 sectors into changes in real compensation, labour productivity, employment shares and relative prices, the authors divide the period covered into a 'golden age' (1948 to 1979) and a 'neo-liberal era' (1979 to 2017). According to the authors, the manufacturing sector remains the key to understanding the changes in the wage share in the post-war period. Whereas in the early 1950s wages grew faster than productivity, allowing the wage share to grow, in recent decades productivity has grown faster than wages, resulting in a lower wage share. Like Taylor and Ömer (2019a) and Taylor and Ömer (2019b), Mendieta-Muñoz, Rada, and Arnim (2019) note that employment seems to have shifted to stagnating sectors. With reference to Baumol's cost sickness (Baumol and Bowen 1965; Baumol 1967; Baumol, Ferranti, et al. 2013) and the dual development model of Lewis (1954), the authors argue that while evidence of cost sickness can be found, there is no upward convergence of real wages. Instead, a "reverse Lewis shift", the authors argue, may explain the role of stagnating sectors as places of absorption of excess labour.

Hein and Tarassow (2010) use AMECO data for Austria, France, Germany, the Netherlands, the UK and the US to test for Verdoorn's law for a period of 1960 to 2007. Following Naastepad (2006), they include the Marx-Webb effect[3] into their estimation equation. The Marx-Webb effect states a positive relationship between wage growth and productivity growth, with causality running from the former to the latter. The general idea is that higher costs of production in form of higher wages incentivise capitalists to invest more into labour-saving technology, therefore increasing labour productivity. In the case of Hein and Tarassow (2010), however, the argument is directly tied to the increase in demand which triggers Verdoorn's law as well. In the case of the Marx-Webb variable though, it is lower unemployment and the resulting increase in bargaining power of workers and trade unions that lead to the increase in real wage growth. Contrary to Naastepad (2006), Hein and Tarassow (2010) suggest to use the wage share instead of real wage growth as independent variable. The reasoning here is that capitalists would only be incentivised to innovate if real wages rise faster than productivity, thus increasing the wage share. The authors use error-correction models (ECM) to distinguish between a short-run and a long-run effect. While this distinction

[3] Hein and Tarassow (2010) call this the 'wage-push effect'.

yields lower overall effects than commonly found in the literature on Verdoorn's law, it provides another buffer of security against the trap of confusing Verdoorn's law (a long-run phenomenon) with Okun's law (a short-run phenomenon). They do however not control for the static-dynamic paradox which is well-documented in the literature on Verdoorn's law. As the use of logarithmic levels usually leads to lower estimates of Verdoorn's law, the passionate reader might be equally interested in the 'upper bound' commonly found in estimation specifications using growth rates.

2.4 Methodology

There exist four different ways to measure Verdoorn's law. The simplest way is the one shown by Verdoorn (1949) himself. Here, productivity growth in sector j of country i ($\dot{y_{ij}}$) is being regressed on output/demand growth $\dot{q_{ij}}$. Most of the literature assumes Verdoorn's law to be valid only for manufacturing. The meta-regression analysis conducted in chapter I most of the time does not find statistically significant differences between manufacturing and non-manufacturing. Even if it finds differences, the results for non-manufacturing show lower Verdoorn effects than for manufacturing.

$$\dot{y_{ij}} = \alpha + \beta_1 \dot{q_{ij}} + \epsilon_{ij} \tag{2.2}$$

Equation 2.2 suffers from possible simultaneity bias. As output/demand growth is influenced by productivity growth, it might be preferrable not to use productivity growth. Hence Kaldor (1966) proposes a different econometric specification, using the fact that by definition productivity growth is defined as the difference between output/demand growth and employment growth $\dot{e}$, or $\dot{y} \overset{!}{=} \dot{q} - \dot{e}$.

$$\dot{q}_{ij} = \gamma + \beta_2 \dot{q}_{ij} + \epsilon_i \tag{2.3}$$

which is equal to

$$\dot{e}_{ij} = -\alpha + (1 - \beta_1)\dot{q}_{ij} + \epsilon_{ij}$$

Kaldor (1966) stressed the importance of aggregate demand in determining the long-run rate of growth via cumulative causation and increasing returns to scale. However, Rowthorn (1975) argued that Kaldor's (1966) specification was flawed, as the economy is ultimately supply-constrained, and thus output growth should be regressed on employment growth - precisely the inverse of what Kaldor (1966) was arguing.

$$\dot{q}_{ij} = \delta + \beta_3 \dot{q}_{ij} + \epsilon_{ij} \tag{2.4}$$

or

$$\dot{q}_{ij} = \frac{\alpha}{1 - \beta_1} + \frac{1}{1 - \beta_1}\dot{q}_{ij} + \epsilon_{ij}$$

Rowthorn's (1975) contribution also gave way to a second, less often quoted interpretation, where instead of regressing output growth on employment growth, we exchange output growth for productivity growth. Both versions of Rowthorn's specifications by definition need to yield the same implied results for Verdoorn's law, hence for econometric estimation of Rowthorn's specification we will only use equation 2.4.

$$\dot{y}_{ij} = \delta + \beta_4 \dot{q}_{ij} + \epsilon_{ij} \tag{2.5}$$

or

$$\dot{y_{ij}} = \frac{\alpha}{1-\beta_1} + \frac{\beta_1}{1-\beta_1}\dot{e_{ij}} + \epsilon_{ij}$$

As was already argued in chapter I, there is no objective way to determine which of the four specifications should be used to properly estimate Verdoorn's law. Rather this decision comes down to the researcher and her views on how the economy operates. If one believes that the economy ultimately is demand-led, then one of Rowthorn's two specifications will be seen as the correct one. If however one is convinced that demand-side variables are the real constraint, then Kaldor's interpretation of Verdoorn's law makes more sense.

Another important subject of discussion includes the question whether or not to include growth rate of the stock of capital into the regression specification. Not doing so might lead to omitted variable bias, as the stock of capital correlates with productivity growth. One might refrain from including capital stock growth however, as *capital accumulation is a symptom rather than cause of growth*' (Kaldor 1968, p.390). Again this debate is tightly linked to one's belief whether the economy is ultimately supply- or demand-led.

Rowthorn (1975) argued that in the case of Japan's growth experience after world war II, most of the increase in productivity could be explained by its' technological catching-up to other more advanced countries. In this case, Japan's experience would not be an occurrence of Verdoorn's law. Hence, one should add as a control variable the initial level of productivity relative to that of more advanced countries (for example the US) when estimating Verdoorn's law. As different countries will have different levels of economies of scale, even with the same starting technologies countries will experience different levels of productivity.

Finally, there exists a paradox in the literature, where using growth rates or logarithmic levels yields different results, something which *a priori* should not happen. Typically speaking, the use of growth rates yields increasing, statistically significant returns to scale while using logarithmic levels yield either no statistically significant or constant to scale.

Basu and Budhiraja (2020) argue that while an empirical estimation of Verdoorn's law might be relatively straightforward, its interpretation is much harder. The authors argue that this is because Verdoorn's law is representing deeper mechanisms found in the sphere of production as well as the labour market. While proponents of demand-side explanations see Verdoorn's law as a proof for increasing returns to scale and demand-induced technical progress, supply-side proponents tend to find results in favour of constant returns to scales instead. Basu and Budhiraja (2020) propose a theoretical framework for such interpretation, using a formal model via which Verdoorn's law is derived. The model itself is based on a general constant elasticity of substitution production (CES) function and can be derived from both a Cobb-Douglas or Leontief production function as special cases. The resulting model suggests that the coefficient representing Verdoorn's law is a product of returns to scale, the elasticity of factor substitution, the profit share and the elasticity of the labour supply. Following this result, a 'well-behaved' Verdoorn's law-coefficient cannot be directly translated into proof of increasing returns to scale without knowing the size of the other parameters.

A shortened version of the model proposed is as follows. Using a standard CES production function and deriving for productivity growth $\dot{y}$, the resulting relationship becomes

$$\dot{y} = \dot{b} + \pi(\dot{k} - \dot{e}) \tag{2.6}$$

1793 where $\dot{b}$ stands for technological change, π for the profit share, $\dot{k}$ for the growth
1794 in the stock of capital and $\dot{e}$ or employment growth. Depending on how one believes
1795 technological change to happen (via economies of scale external to the firm or dynamic
1796 economies of scale), the assumption of labour market equilibrium and either external or
1797 dynamic economies of scale, Basu and Budhiraja (2020) find a relationship between the
1798 growth rates of the capital stock and employment that is consistent with labour market
1799 equilibrium. Combining this market equilibrium condition, one finds two different
1800 Verdoorn coefficients, namely

$$\beta = \frac{\mu\pi(1-\sigma) + \frac{\sigma}{\eta}\pi + \mu}{\pi + \mu\sigma + \mu\pi(1-\sigma) + \frac{\sigma}{\eta}(\pi + \mu)} \tag{2.7}$$

1801 in the case of economies of scale external to the firm, often assumed in the economic
1802 mainstream, and

$$\beta = \frac{\sigma + \xi\eta(1-\sigma)}{\eta + \sigma} \tag{2.8}$$

1803 in the case of dynamic economies of scale, as commonly used in heterodox eco-
1804 nomics. β represents the Verdoorn coefficient, μ the returns to scale, profit share the
1805 profit share, elasticity of labour supply with respect to the real wage the elasticity of
1806 labour supply with respect to the real wage, elasticity of substitution between labour
1807 and capital the elasticity of substitution and effect of demand-induced technical change
1808 the effect of demand-induced technical change.

1809 If, for example, one can estimate β, σ, π and η, then one could directly calculate the returns to scale μ.

Basu and Budhiraja (2020) provide value added in that they emphasise the limits of directly inferring increasing returns to scale from Verdoorn effects between 0 and 1, something proposed very often in the literature on Verdoorn's law. They also show that 'on pure theoretical grounds, a Cobb-Douglas production function seems to be ruled out as a good characterisation of technology in a labour surplus economy undergoing structural change' (Basu and Budhiraja 2020, pp.14).

While Basu and Budhiraja (2020) make for an interesting thought experiment, the use of a Cobb-Douglas production function as a base for a formal model of Verdoorn's law is highly questionable. Time and again it has been argued that estimations of production functions merely capture an underlying accounting identity, and thus statistically significant results cannot be used to verify certain production functions (Shaikh 1974; Felipe and McCombie 2003; Felipe and McCombie 2011). Felipe and McCombie (2013) summarise the pre-existing critique of attempts at empirical verification of neoclassical production functions, namely the Cambridge Capital Controversies and the aggregation literature. The authors provide ample evidence that the apparently good fit of theory and economic data lies in the fact that relates value added with wages and profits. The perfect fit is therefore not the result of high theory but simply the result of regressing an accounting identity. This becomes even more important in the case of Basu and Budhiraja (2020). In chapter 11, Felipe and McCombie (2013) discuss empirical studies concerned with neoclassical labour market theory and show that due to accounting identity issues, labour demand curve estimations will always yield downward-sloping labour demand curves. In their own words, 'no reliance can be placed on estimates of the wage elasticities in formulating economic policy' (Felipe and McCombie 2013, p. 307).

Taking the issues raised in the previous paragraph serious, the only option left is to assume the underlying production function in Basu and Budhiraja's (2020) model of Verdoorn's law to be of the Leontief type. In the case of equations 2.7 and 2.8, this is equal to assuming that $\sigma = 0$ (in the case of a Cobb-Douglas production function, σ would be equal to 1). Doing so yields Verdoorn coefficients of

$$\beta = \frac{1 + \dfrac{1}{\pi}}{1 + \dfrac{1}{\mu}} \tag{2.7'}$$

in the case of economies of scale external to the firm. Here, for the economies of scale μ to be positive, the Verdoorn effect β needs to fulfil the two conditions $\beta > 0$ and $\beta < 1 + \frac{1}{\pi}$. Drawing from the results found in numerous literature surveys on Verdoorn's law as well as the results of our own meta-regression conducted in chapter I, we can safely assume these two conditions to hold. The heterodox representation of Verdoorn's law, assuming $\sigma = 0$, yields

$$\beta = \xi \tag{2.8'}$$

in the case of dynamic economies of scale. As we can see, in the case of dynamic economies of scale under a Leontief production function economy, the Verdoorn coefficient β equals the effect of demand-induced technical change ξ. Using these assumptions based on the critique of production functions presented above thus lets Basu and Budhiraja's (2020) argument vanish.

2.5 The Data

For our analysis, we use the EU-KLEMS data set provided by the Vienna Institute for International Economic Studies (WIIW). It contains the latest update of the EU KLEMS database, which is funded by the 'DG Economic and Financial Affairs' of the European Commission. To our knowledge, this is the first time the EU-KLEMS data set is used in order to estimate Verdoorn's law.

With the release of the 2019 version of EU-KLEMS, the database provides measurements of economic growth, productivity, employment, capital formation and technological change at sector level for all Member States of the European Union, Japan and the United States. The productivity measurements have been developed using growth accounting techniques. Furthermore, the EU KLEMS Release 2019 includes additional indicators on intangible assets. An overview and summary of design issues and methodology can be found in Stehrer et al. (2019). In total, the database covers 53 sectors and sub-sectors from 1998 to 2017 for Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom, the United States and Cyprus. In addition, several groupings have been created for European countries (EU15, EU27, EU28 and EA19 for the euro area).

First, we derive two different measures of productivity from the known ratio:

$$productivity = real\ output/employment$$

We start with productivity, since productivity is the link between production, employment and distribution (Taylor and Ömer 2019a). In theory, both productivity measures should produce similar results, so that one can be used as a control for the other.

We used the data provided by EU-KLEMS to calculate by country and year the manufacturing sector's share of total value added and the difference between productivity levels relatively to the US. We further create logarithms of all variables needed for the regressions. We also create growth rates for the same variables. This enables us to check whether the static-dynamic paradox holds for the area and periods covered in this study.

The KLEMS data set suffers from several omitted entries which are neither entirely random nor structured in nature. Some countries are not reporting any variable for one or multiple entire years, usually at the beginning the of the time period covered by EU-KLEMS. For example, data for Germany are missing for 1995. France, Italy and the UK do not report data for sector U in EU-KLEMS (defined as '*Activities of extraterritorial Organisations and bodies*'). Sometimes the problem lies in different reporting standards, where different countries reported at different sectoral levels. These problems render panel analysis difficult, as the negligence of missing entries could lead to emergent bias. In order to combat these limitations, several step where undertaken. First, only sectors which were equally reported across all member countries were used for our analysis. Second, the existing data set observations were used to interpolate and extrapolate values for the missing values which were used for the regressions. This procedure lead to a more balanced panel. Finally, we use the *xtbalance* command in STATA in order to create entirely consistent panel data without any missing entries at all. This gives us much better data quality at the cost of overall observations.

As a result of balancing our data, we unfortunately lose a few countries. After the necessary data processing, we are left with a data set of 17 aggregated industries for 23 countries for the period 1995 to 2017. The resulting strongly balanced data set leaves us with Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Livonia, Luxembourg, the Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden. We do believe that the information lost by not including the rest of the EU28 members is compensated by the consistency of the data from the remaining members.

For our first set of regressions we try to estimate an ECM model. Here, the first step is to rule out potential unit roots in our series, i.e. make sure that our series are stationary. The (non-)stationary of a series strongly influences its behaviour. If a series is non-stationary, then a shock to the system will persist forever in its effect. Equally, if two variables are co-integrated[4], the regression of one variable on the other would yield a higher R^2, even if there is no underlying relation between both variables. Most importantly, if any variables in our regression model are non-stationary, then standard assumptions for asymptotic analysis will not be valid. The usual t-ratios will not follow a t-distribution, so our hypothesis tests about the regression parameters would not be valid.

There exist a variety of tests for unit roots (or stationarity) in panel data sets. The tests by Levin, Lin, and James Chu (2002), Harris and Tzavalis (1999), Breitung and Das (2005), Im, Pesaran, and Shin (2003), and Choi (2001) tests all have as the null hypothesis that all the panels contain a unit root. Since our data set has a large number of observations but a fixed amount of time periods, we identify possible unit roots with unit root tests following Harris and Tzavalis (1999). The Harris–Tzavalis test

[4]if (X,Y,Z) are each integrated of order d, and there exist coefficients a,b,c such that $aX + bY + cZ$ is integrated of order less than d, then X, Y, and Z are co-integrated

assumes that all panels have the same auto-regressive parameter ρ under the alternative hypothesis of stationarity. In the case of non-stationarity, we take the first difference and test again. If one differentiation is required to obtain a co-variance-stationary series, then the variable is known to be integrated of the first order (also known as 'I(1)'). None of our variables is integrated of a higher order than one, i.e. our variables are I(1) at most.

Next we test the I(1) variables for co-integration. In other words, we test whether our I(1) variables share a long-run equilibrium relation. We do so using the '*xtcointtest*' command in STATA. The *xtcointest* command uses five different versions of the Dickey-Fuller test (normal, augmented, modified, unadjusted augmented and unadjusted modified) to test for co-integration. In all cases, our I(1) variables are found to be co-integrated.

We are interested in estimating Verdoorn's law, which is supposed to be more of a long-run relation. Most studies in the available literature do not differentiate between the long run and the short run. Estimating short-run relations between productivity and output could be an issue in that we might not estimate Verdoorn's law but rather Okun's law [5]. Okun's law is supposed to be a short-run phenomenon. Not differentiating between short run and long run might lead to inflated estimates of Verdoorn's law (Hein and Tarassow 2010). The immediate idea of estimating Verdoorn's law via the use of an error-correction model (ECM) cannot be realised. Error-correction models need all estimates to be integrated of the same order, and not more than (1). In none of our cases this is the case. We therefore would like to apply an auto-regressive distributed lag (ARDL) approach. ARDL models allow us to use I(0) and I(1) variables together in the same regressions while differentiating between long-run and short-run effects.

[5] see chapter I

With respect to the findings in our MRA, one needs to remind oneself that the use of ECM and ARDL models does not seem to be needed, as we found no difference between long-run and short-run regression specifications[6].

However, given our data set, there are issues of possible cross-sectional dependency and multicollinearity that need to be addressed. These issues are not taken into account in normal ARDL models. Also, we argue that while the countries in our data set all harbour manufacturing sectors, there is substantial heterogeneity among them. Some countries run current account surpluses while others run current account deficits; some countries might have a high share of manufacturing in value added while others have experienced prolonged periods of de-industrialisation. In order to take into account the possibility of these unobserved common factors between units, our first specification consists in a 'dynamic common correlated effects' (DCCE) model. To do so, cross sectional averages are added in the fashion of Pesaran (2006). Normal pooled CCE models keep the parameters constrained in such a way that they are the same across units. In case of a pooled estimation, the standard errors are obtained from a mean group regression run in the background (Pesaran 2006). The pooled CCE model however differentiates only between homogeneous long-run and heterogeneous short-run effects. DCCE models are able to work with heterogeneity in both the short run and the long run.

For our model we are using the $xtdcce2$ STATA package (Ditzen 2021). The documentation can be found in STATA as well as in the package's GitHub-page. Following Levin, Lin, and James Chu (2002), for each time period we first compute the mean of the series across panels and then subtract the cross-sectional averages from the series. Levin, Lin, and James Chu (2002) suggest this procedure to mitigate the impact of

[6] again, see chapter I

cross-sectional dependence.

The results of our DCCE model need to be interpreted as short-run phenomenon. We are however interested in long-run relations in order to properly differentiate between Okun's law and Verdoorn's law. As was explained before, traditional ARDL models are not able to take into account possible cross-sectional dependence. Fortunately, the $xtdcce2$ STATA package provides the possibility of an augmented ARDL model which takes into account cross-sectional dependence. This 'cross-section augmented ARDL' (CS-ARDL) model is our ideal candidate to estimate Verdoorn's law in our panel model and thus represents our second specification. The CS-ARDL model estimates both short-run and long-run coefficients, taking into account cross-sectional dependence. For these reasons, we will recommend the reader to use the second specification as baseline scenario. The 'Cross-Section Augmented ARDL' (CS-ARDL) model developed by Chudik and Pesaran (2016) works with heterogeneous effects both in the short as well as in the long run, controlling for cross-sectional dependence and multicollinearity. All variables are treated as long run coefficients. $xtdcce2$ first estimates the short run coefficients and the calculates then long run coefficients. Furthermore, $xtdcce2$ checks for collinearity in three different ways (Ditzen 2021).

We are regrettably rather limited in our possibilities to properly use CS-ARDL to its fullest. The short time span of 20 years provides a natural limit of degrees of freedom. The combination of four long-run independent variables eight cross-sectional means (including the one-period lags) already uses twelve of our degrees of freedom. Including the same four variables as short-run variables would double the amount of degrees of freedom needed for the estimation of cross-sectional means. The four short-run variables then increase the absolute number of degrees of freedom needed by four more. In total the amount of degrees of freedom needed would be more than is available in our case. Our analysis is thus constrained by the consistent time periods available in our data set. It would make sense to repeat it once the EU-KLEMS data are updated, so that hopefully more time periods become available. This would also allow us to include more lags for the computation of cross-sectional means.

For our regressions we will use equation 2.2. The results for the other specifications are available in the appendix. Our baseline scenario is using the dynamic version of Verdoorn's law in growth rates, rather than the logarithmic levels of output and productivity. We choose this approach because first it is the original approach used by Verdoorn (1949), Kaldor (1966) and Rowthorn (1975) and secondly because the use of logarithmic levels is tied to the idea of a Cobb-Douglas production function, which we avoid to use for the weak theoretical grounds on which it stands (Shaikh 1974; Felipe and McCombie 2003; Carter 2011; Felipe and McCombie 2013). We do not include the growth in the stock of capital in our reference specification as '*capital accumulation is a symptom rather than cause of growth*' (Kaldor 1968, p.390). Additionally, we follow Hein and Tarassow (2010) in that we control for the change in the wage share as an alternative to the change in real wages. Further control variables include a) the value added share of the respective country's manufacturing sector in order to control for structural change and b) the difference in the productivity level with regards to the US to control for a potential technological catching-up process. All regressions were made using STATA 16.

2.6 Results

Verdoorn's law is supposed to be valid for manufacturing only, which is why we start with our analysis with manufacturing sectors from our 23 countries. Following Stehrer et al. (2019), we use the 'NACE Rev. 2 one-digit industry classification' for our sector classification. Table 2.1 reports the results for Verdoorn's specification of Verdoorn's law (equation 2.2) for total manufacturing, once with real wages and once with the wage share instead. Both variants are being estimated first using a dynamic CCE model, with the CS-ARDL model second. Sadly, STATA only reports the normal R2 and not the R2 of the mean groups, which is much higher (in the case of the Verdoorn specification , the mean group R2 lies between 0.78 and 0.98). All significance stars start at the 10% level.

Let us start by looking at the results using real wages in column 1. First, we used the DCCE model which takes into account cross-sectional dependence but only represents a short-run relationship. Hence, we are unable to distinguish between Okun's law and Verdoorn's law. We find a statistically significant effect of output growth of 0.631, represented by 'value added growth'. This result is close to the average value found in the Verdoorn literature (McCombie, Pugno, and Soro 2002). All our other control variables however are not to be found statistically significant. This includes real wage growth, which is supposed to embody Marx-Webb effects associated with capitalists incentives to use labour-saving machinery to increase labour productivity, higher motivation of workers from higher salaries and political bargaining which includes a power struggle argument.

As we argued, the results obtained from the DCCE estimation can only be interpreted as a short-run perspective. The CS-ARDL estimation method manages to differentiate between short-run and long-run effects just like normal ARDL models, while also taking into account cross-sectional dependence. Its results can be seen in column 2. The short-run Verdoorn effect is 0.863 now, higher than in the DCCE estimate. This time, real wage growth are statistically significant as well, with a coefficient of 0.198.

ARDL models also include long-run versions of the independent variables. Here, three variables are found to be statistically significant. First, $l\_g\_VA\_Q$, the long-run version of value added is very close to one, at a level of 0.966. This is an interesting find, as while it still implies increasing returns to scale, the resulting returns to scale are very close to constant returns to scale, which is at odds with the usual assumptions made in the literature on Verdoorn's law. Second, real wage growth does seem to have a positive long-run effect here, with a value of 0.235. Hence, our CS-ARDL model using real wages suggests that real wage growth is productivity-enhancing in both the short as well as the long run.

Let us now look at the same estimation specification, this time using the wage share instead of real wage growth. Hein and Tarassow (2010) argued that productivity growth should be regressed on the wage share instead of real wage growth, as capitalists will only be incentivised to invest in labour-saving technology if real wages grow faster than productivity, thereby increasing the wage share. In the DCCE estimation in column 3, both output growth and the wage share do have statistically significant coefficients (0.839 and 0.310), suggesting that both the combination of Okun's and Verdoorn's law and the Marx-Webb effect play a role, at least in the short run. Notably, the combined Okun/Verdoorn effect is higher than using real wages. Using the CS-ARDL approach in column 4 instead, the short-run Verdoorn effect stays approximately the same (0.859). There are however no long-run effects to be found. In short, using the wage share in this specification, we cannot find any sign for neither Verdoorn's law nor the Marx-Webb effect to be at work.

Table 2.2 shows us the results for total manufacturing, this time using levels in logarithms instead of growth rates. We do use both measures because of the 'static-dynamic paradox' frequently found in the literature(McCombie, Pugno, and Soro 2002).

Table 2.1 – Verdoorn's Law in Total Manufacturing (Verdoorn specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
value added growth	0.631+	0.863+	0.839+	0.859+
	(0.124)	(0.088)	(0.147)	(0.092)
real wage growth	0.048	0.198+		
	(0.068)	(0.048)		
productivity difference growth	−0.112	−0.115	−0.185**	−0.177
	(0.112)	(0.129)	(0.092)	(0.108)
L.g_gdpperworker	−0.013	0.027	−0.030	−0.043
	(0.045)	(0.052)	(0.065)	(0.082)
D.Manufacturing share of value added	0.017		0.005	
	(0.011)		(0.011)	
Manufacturing share of value added		−0.013*		0.003
		(0.007)		(0.006)
lr_VA_share_manuf		−0.015*		0.002
		(0.009)		(0.006)
lr__cons		−0.041		1.473
		(0.160)		(1.877)
lr_g_GAP		−0.093		0.038
		(0.137)		(0.182)
lr_g_VA_Q		0.966+		0.456
		(0.123)		(0.391)
lr_g_gdpperworker		−0.973+		−1.043+
		(0.052)		(0.082)
lr_g_real_wages		0.235+		
		(0.062)		
wage share by industry			0.310**	0.178
			(0.125)	(0.130)
lr_wshare_by_industry				−0.230
				(0.359)
Constant	−0.032	−0.052	−0.955	−0.974
	(0.115)	(0.143)	(0.783)	(0.776)
Observations	437	437	437	437
R2	0.04	0.05	0.02	0.03

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

The paradox consists in that Verdoorn effects are often found using growth rates, but much less often when using logarithms. Verdoorn effects found using logarithms are usually finding results implying constant returns to scale, while estimations using growth rates typically find results consistent with increasing returns to scale.

As both value added and real wages where found to be non-stationary, we had to estimate this DCCE specification using first differences. Here, we find a combined Okun/Verdoorn effect of 0.560, close to the result obtained using growth rates. Hence, a one percentage-increase in value added implies a 0.560%-increase in productivity growth. This time, real wage growth is found to be statistically significant as well, with a coefficient of 0.181. Again, these results are only representing the short run. Taking into account the long-run effects with our CS-ARDL estimate, we find a (long-run) Verdoorn effect of 0.359. The short-run effect of value added on productivity - possibly representing Okun's law - yields a value of 0.325. Real wages do not have any impact, neither in the short run nor in the long run when using logarithmic real wages. In the case of the wage share as measurement for Marx-Webb effects, no Okun/Verdoorn effect combination nor wage push effect can be found. Using the CS-ARDL approach, we find a short-run effect of 0.378, consistent with Okun's law, and a long-run Verdoorn effect of 0.392. We also find statistically significant wage share coefficients which are negative and very close in size in both the short and the long run (-0.533 and -0.504). This result seems to be hard to explain with theory and is similar to some of the results found in Hein and Tarassow (2010). Also, in all results for total manufacturing, the constant representing the autonomous growth in productivity is negative. This means that absent any demand- or wage-induced technical change, there would be an actual decrease in productivity happening.

The results for total manufacturing can be limiting regarding observations, as we

Table 2.2 – Verdoorn's Law in Total Manufacturing (Verdoorn specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
productivity difference (log)	−0.114	−0.262	−0.313*	−0.373
	(0.086)	(0.258)	(0.179)	(0.296)
LD.productivity (log)	−0.135+		−0.103	
	(0.038)		(0.078)	
L.productivity (log)		−0.018		−0.101*
		(0.058)		(0.060)
D.value added (log)	0.560+		0.510***	
	(0.134)		(0.153)	
value added (log)		0.325***		0.378***
		(0.113)		(0.112)
D.real wages (log)	0.181***			
	(0.065)			
real wages (log)		−0.017		
		(0.083)		
D.Manufacturing share of value added	0.019*		0.019	
	(0.010)		(0.012)	
Manufacturing share of value added		0.019**		0.009
		(0.009)		(0.009)
lr_VA_share_manuf		0.018**		0.010
		(0.008)		(0.008)
lr__cons		−1.168		−1.491
		(1.078)		(1.331)
lr_ln_GAP		−0.234		−0.285
		(0.253)		(0.241)
lr_ln_VA_Q		0.359***		0.392+
		(0.129)		(0.094)
lr_ln_gdpperworker		−1.018+		−1.101+
		(0.058)		(0.060)
lr_ln_real_wages		−0.003		
		(0.085)		
D.wage share by industry			−0.149	
			(0.137)	
wage share by industry				−0.533+
				(0.076)
lr_wshare_by_industry				−0.504+
				(0.079)
Constant	−1.268	−1.086	−1.377	−1.214
	(1.250)	(1.171)	(1.099)	(1.465)
Observations	342	360	342	360
R2	0.07	0.07	0.06	0.05

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

have only 20 years per country and our panel consists in 23 countries. Aside from total manufacturing, the EU-KLEMS data set does report values for manufacturing sub-sectors as well. This allows us to run the regression models on a bigger panel with 14 sub-sectors per country, representing 21 sub-sectors in total. This increases the number of observations from 342/360 to 5757. We hope to increase the statistical power of our findings this way.

The results for the manufacturing sub-sectors can be found in table 2.3. Our DCCE specification yields statistically significant and positive results for both output growth and real wage growth. Compared to the results in table 2.1, the results for output growth are higher (0.751 vs. 0.631). Our CS-ARDL model finds short-term effects for both output growth and real wage growth of the same magnitude. Additionally, we find a very high value for Verdoorn's law (0.755) and a slightly higher value for long-run real wage growth than in table 2.1 (0.259 vs. 0.235). Using wage shares instead of real wages, the short-run Marx-Webb effect ceases to exist while the high coefficient of output growth increases (0.808). Contrary to table 2.1, this time we do find a (long-run) Verdoorn effect of 0.782, but no Marx-Webb effect. The short-run effect of value added stays in line with the other specifications in table 2.3.

Table 2.4 shows the estimations for manufacturing sub-sectors using logarithms. Our DCCE specification finds statistically significant coefficients for value added (0.576) and real wages (0.249). The CS-ARDL specification yields short-run coefficients which are very close to the ones in the DCCE specification (0.600 and 0.261). Furthermore, we find long-run coefficients for value added (0.694) and real wages (0.315). Using the wage share instead of real wages, in the DCCE specification the value added coefficient stays roughly equal while the wage share coefficient is negative again. The CS-ARDL estimation presents short-run coefficients of 0.616 and −0.455 for value added and the

Table 2.3 – Verdoorn's Law in Manufacturing Sub-sectors (Verdoorn specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
value added growth	0.751+	0.725+	0.808+	0.777+
	(0.028)	(0.027)	(0.036)	(0.040)
real wage growth	0.215+	0.247+		
	(0.026)	(0.025)		
productivity difference growth	−0.101+	−0.110+	−0.146+	−0.155+
	(0.024)	(0.024)	(0.027)	(0.034)
L.g_gdpperworker	−0.025	−0.048***	−0.055***	−0.082+
	(0.015)	(0.015)	(0.019)	(0.020)
D.Manufacturing share of value added	−0.004		0.004	
	(0.007)		(0.013)	
Manufacturing share of value added		−0.003		−0.010***
		(0.003)		(0.004)
lr_VA_share_manuf		−0.004		−0.018***
		(0.003)		(0.006)
lr__cons		−0.175		−2.816*
		(0.359)		(1.700)
lr_g_GAP		−0.113+		−0.082*
		(0.027)		(0.048)
lr_g_VA_Q		0.755+		0.782+
		(0.030)		(0.129)
lr_g_gdpperworker		−1.048+		−1.082+
		(0.015)		(0.020)
lr_g_real_wages		0.259+		
		(0.028)		
wage share by industry			−0.032	−0.082
			(0.059)	(0.058)
lr_wshare_by_industry				−0.079
				(0.115)
Constant	−0.407	−0.337	0.238	−0.426
	(0.282)	(0.360)	(0.788)	(0.841)
Observations	5757	5757	5757	5757
R2	0.01	0.01	0.01	0.01

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

wage share. In the long run, we find a statistically significant Verdoorn effect of 0.644 and a Marx-Webb effect of −0.630.

Table 2.4 – Verdoorn's Law in Manufacturing Sub-sectors (Verdoorn specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
value added (log)	0.576+	0.600+	0.611+	0.616+
	(0.032)	(0.034)	(0.036)	(0.041)
real wages (log)	0.249+	0.261+		
	(0.032)	(0.030)		
productivity difference (log)	−0.192+	−0.181+	−0.204+	−0.182+
	(0.037)	(0.037)	(0.038)	(0.032)
L.productivity (log)	0.057***	0.029	0.066***	0.053**
	(0.021)	(0.022)	(0.021)	(0.023)
D.Manufacturing share of value added	0.009*		0.006	
	(0.005)		(0.005)	
Manufacturing share of value added		−0.001		−0.007
		(0.005)		(0.005)
lr_VA_share_manuf		−0.002		0.021
		(0.016)		(0.039)
lr__cons		2.722		0.769
		(2.865)		(3.277)
lr_ln_GAP		0.045		−0.115
		(0.264)		(0.154)
lr_ln_VA_Q		0.694+		0.644**
		(0.067)		(0.265)
lr_ln_gdpperworker		−0.971+		−0.947+
		(0.022)		(0.023)
lr_ln_real_wages		0.315+		
		(0.053)		
wage share by industry			−0.443+	−0.455+
			(0.066)	(0.069)
lr_wshare_by_industry				−0.630***
				(0.199)
Constant	0.296	0.148	0.258	−0.011
	(0.571)	(0.566)	(0.630)	(0.620)
Observations	4040	4040	4040	4040
R2	0.02	0.02	0.04	0.04

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

As was already mentioned before, Verdoorn's law is assumed to be existent in manufacturing only. The reasoning usually put forward lies in the increasing returns to scale which are assumed to be especially prevalent in manufacturing. Furthermore, our meta-regression analysis in chapter I finds no significant effect of estimating Verdoorn's law using non-manufacturing data or data of all sectors at once. We therefore run another set of estimations, this time including all economic sectors according to the NACE Rev. 2 one-digit industry classification.

Our DCCE estimation in table 2.5 finds value added growth and real wage growth coefficients consistent with our previous results (0.602 and 0.238). The CS-ARDL finds short-run coefficients close to our DCCE-specification and a long-run coefficient of value added growth of 0.781. Real wage growth, in this case, is not statistically significant in the long run. In the case of using the wage share, the results are similar. The DCCE specification finds a short-run coefficient of 0.649, without any statistically significant Marx-Webb coefficient. The CS-ARDL specification yields short run coefficients of 0.673 for value added growth and −0.302 for the wage share. The long-run coefficients, however, yield a Verdoorn effect of 0.753 and a Marx-Webb effect of −0.357.

Table 2.6 presents the results for all economic sectors, using logarithms instead of growth rates. The DCCE model finds statistically short-run coefficients for value added (0.504) and real wages (0.250). In the CS-ARDL specification, these stay nearly the same, while the Verdoorn effect is again close to one (0.923). While the first time this happened using growth rates, this time the result (and the implications of constant returns to scale) when using logarithms is in line with the so-called 'static-dynamic paradox'(McCombie, Pugno, and Soro 2002). The Marx-Webb coefficient in the long-run is 0.193. Using the wage share instead of real wages, we get different results. The DCCE results are smaller than in other specifications for both the value added as well as the wage share coefficients. In the CS-ARDL specification, we find a short-run coefficient

Table 2.5 – Verdoorn's Law in All Main Sectors (Verdoorn specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
value added growth	0.602+	0.583+	0.649+	0.673+
	(0.032)	(0.029)	(0.033)	(0.033)
real wage growth	0.238+	0.258+		
	(0.026)	(0.025)		
productivity difference growth	−0.148+	−0.146+	−0.182+	−0.179+
	(0.039)	(0.026)	(0.028)	(0.028)
L.g_gdpperworker	−0.041**	−0.050***	−0.056***	−0.071+
	(0.016)	(0.017)	(0.021)	(0.019)
D.Manufacturing share of value added	0.002		0.000	
	(0.003)		(0.005)	
Manufacturing share of value added		−0.007**		−0.002
		(0.003)		(0.003)
lr_VA_share_manuf		−0.001		−0.001
		(0.007)		(0.005)
lr__cons		0.573**		0.431
		(0.259)		(0.292)
lr_g_GAP		−0.293***		−0.110**
		(0.109)		(0.056)
lr_g_VA_Q		0.781+		0.753+
		(0.163)		(0.170)
lr_g_gdpperworker		−1.050+		−1.071+
		(0.017)		(0.019)
lr_g_real_wages		0.128		
		(0.179)		
wage share by industry			−0.193	−0.302**
			(0.130)	(0.128)
lr_wshare_by_industry				−0.357**
				(0.140)
Constant	0.106**	0.183***	0.031	0.224
	(0.042)	(0.056)	(0.173)	(0.176)
Observations	7106	7106	7106	7106
R2	0.05	0.05	0.08	0.09

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

of 0.533, roughly equally to the rest of the results in table 2.4. Contrary to previous results, we find no Verdoorn effect in this case.

2.7 Conclusion

In this study, we used yearly data from 23 EU countries to study the validity of Verdoorn's law and the Marx-Webb effect for the period of 1996-2017. We did so via using the EU-KLEMS data set, which allows us to distinguish at both a sectoral and sub-sectoral level. Our methodology is relatively novel in that 1) we use an ARDL methodology in order to distinguish between short-run Okun effects and long-run Verdoorn effects and 2) we use cross-sectional dependence-robust estimators. Especially the latter methodological change makes our results less prone to bias than the existing literature.

Comparing our results across different methods, sectors and specifications used, we can state the following.

First, apart from the estimations in the manufacturing sector using logarithms, all estimates yield statistically significant values for the the short run effects of output growth. These values are changing depending on the method used, the sector in question and the use of real wages or the wage share in the regression function. These short-run values range from 0.504 to 0.863. We do reckon however that we are not able to distinguish the short-run effects (which might represent Okun's law) from the long-run effects (which represent Verdoorn's law) in the case of the dynamic common correlated effects (DCCE) model. We therefore estimated a second model in an auto-regressive distributed lag (ARDL) model specification, taking into account potential cross-sectional dependence (hence CS-ARDL). This model specification enables us to differentiate between the short run and the long run. Here, the long-run effects of

Table 2.6 – Verdoorn's Law in All Main Sectors (Verdoorn specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wages (log)	0.254+	0.237+		
	(0.025)	(0.035)		
productivity difference (log)	−0.252+	−0.159***	−0.321+	−0.274+
	(0.040)	(0.054)	(0.044)	(0.039)
L.productivity (log)	0.407+		0.393+	0.031
	(0.032)		(0.035)	(0.022)
D.value added (log)	0.540+		0.469+	
	(0.040)		(0.040)	
value added (log)		0.561+		0.533+
		(0.044)		(0.041)
D.Manufacturing share of value added	0.002		−0.004	
	(0.003)		(0.004)	
Manufacturing share of value added		0.005		0.008*
		(0.006)		(0.004)
L.g_gdpperworker		0.012		
		(0.018)		
lr_VA_share_manuf		−0.083		0.004
		(0.091)		(0.009)
lr__cons		3.792		4.387
		(3.787)		(3.517)
lr_g_gdpperworker		−0.988+		
		(0.018)		
lr_ln_GAP		−0.288**		−0.330+
		(0.122)		(0.045)
lr_ln_VA_Q		0.923***		−0.097
		(0.320)		(0.743)
lr_ln_real_wages		0.193**		
		(0.080)		
wage share by industry			−0.297***	−0.329***
			(0.115)	(0.121)
lr_ln_gdpperworker				−0.969+
				(0.022)
lr_wshare_by_industry				0.398
				(1.114)
Constant	1.464**	0.305	2.373+	0.925
	(0.650)	(0.923)	(0.554)	(0.683)
Observations	4580	4580	4580	4580
R2	0.03	0.02	0.06	0.05

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

output growth (the Verdoorn effect) ranges are significant in all but three cases: once using real wages in the static manufacturing specification; once using the wage share in the dynamic manufacturing specification; and once using the wage share in the static specification of all main sectors. Nevertheless, overall we find statistically significant effects of output growth in the long run. Here, the values range from 0.378 to 0.966. Our findings do therefore provide strong indication that Verdoorn's law is real.

The existence of Verdoorn's law is vital for demand-side economists across all schools of thought. Post-Keynesians use Verdoorn's law to emphasise the role of demand, which is affecting growth not only in the short run, but in the long run as well. Amongst post-Keynesians, Verdoorn's law is especially important for followers the Kaldorian school of thought, who use it to model structural change. In this way, they resemble the 'systems of innovations' approach (Mazzucato 2013; Lazonick 2016) and the (neo-)Schumpeterians (Reinert and Daastøl 2011). Indeed, prototypes of Verdoorn's law can already be found in the works of Giovanni Botero and Antonio Serra, centuries before the publication of Verdoorn (1949). Botero and Serra are not without good company. Adam Smith's argument 'that the division of labour increases with the size of the market' (Smith 1776), and the analyses into US manufacturing at the beginning of the 20^{th} century by Solomon Fabricant represent additional attempts at explaining the importance of manufacturing due to economies of scale. The analysis of demand-side effects on long-term growth from a macroeconomic perspective is therefore much older than most demand-led economists might believe.

Verdoorn's law, however, was originally supposed to be valid for manufacturing only. It was precisely the existence of Verdoorn's law, already present prior in the works of Alexander Hamilton (1791) and Friedrich List (1838) that led to the emphasis of development economists and political leadership in countries all over the world to focus on the development of a strong and independent manufacturing sector. Yet, in our analysis we find that Verdoorn’s law applies to all economic sectors. The immediate question arises whether this represents a statistical artefact generated by our peculiar data set, whether the macroeconomic dynamics underlying Verdoorn’s law changed or whether the available literature (especially the older one) failed to take into account issues like cross-sectional dependence and use strong enough measures to distinguish between Okun’s law and Verdoorn’s law. While output growth and productivity growth are stronger correlated in manufacturing or its sub-sectors in the case of our (short-run) DCCE models, this relation seems to switch once we look at the long run. In nearly all cases, the Verdoorn effects obtained for manufacturing or manufacturing sub-sectors using our CS-ARDL model are lower for manufacturing and manufacturing sub-sectors than for all sectors as a whole. The only exception here is one estimate of 0.966 when using real wages. Nonetheless, the question remains why Verdoorn’s law seems to be weaker in the manufacturing sub-sectors as a whole than in the rest of the economy - even weaker, in fact, than in manufacturing as a whole. This question is even more important given the fact that these results clash with the ones in the meta-regression analysis done in chapter I could not find a statistically significant difference in value for the Verdoorn effect between manufacturing and non-manufacturing either. Given that the estimates for the manufacturing sub-sectors use more than ten times as many observations as for manufacturing as a whole, one might lean towards the interpretation that manufacturing is not the engine of growth anymore (which then raises the question of what became the new engine instead?). A different interpretation might be that some deeper structural changes in how European economies work might be responsible for these results, sub-contracting might disguise manufacturing workers as service workers. Outsourcing and global value chains might play a role as well. Sadly, the resulting questions are out of scope of this study and will needed to be treated as research questions for the future.

Second, our analysis indicates that the Marx-Webb story might have some truth to it. with some exceptions, most of our estimates of real wage growth or the wage share are statistically significant. That being the case, the choice of proxy for the Marx-Webb effect seems to be crucial. While all real wage specifications find positive values, ranging from 0.193 to 0.315, wage share coefficients are all negative, with one exception.

The negative effect of the wage share on productivity might be because of non-linear dynamics, as argued by Lima (2004). In his model, a smaller profit share diminished the motivation to increase labour-saving technology. It does, however, decrease the available financial funds to innovate as well[7]. Another possible reason might be the presence of unidentified structural breaks. Economic crises like the ones in 2000 and 2007 use to lead to an increase in the wage share, even though productivity goes down. While we did control for structural breaks, an unidentified one might lead to unexpected results.

Chapter II overall finds strong evidence for the existence of the Marx-Webb effect. Most of our long-run results in our CS-ARDL specification find statistically significant Marx-Webb effects. The range of this effect ranges from 0.19 across all sectors to 0.32 in manufacturing sub-sectors. An increase in real wages will always have a favourable effect on productivity growth via this effect, even if there is a negative effect on productivity growth via the Verdoorn effect. Since we provide ample evidence for the existence of the Marx-Webb effect, we reflect this in Figure 5 by giving the Marx-Webb effect in box number 7 a broad, green border, just like we did with the Verdoorn

[7]From a post-Keynesian point of view, this argument is unexpected, as capitalists as a whole can never be finance-constrained.

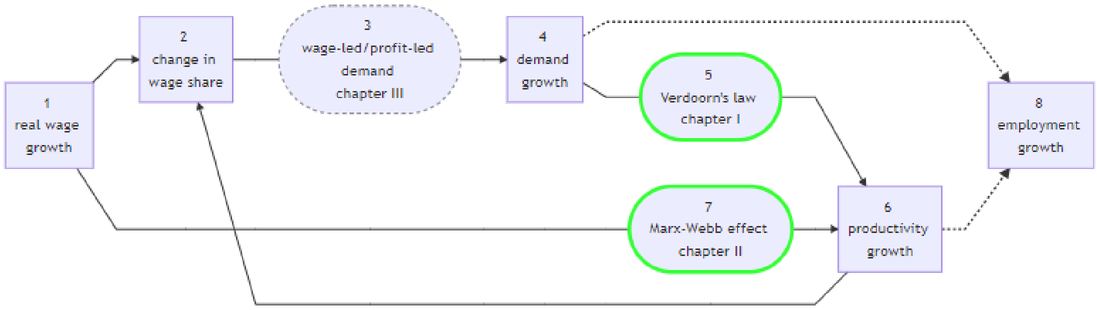

Figure 2.2 – The distribution-productivity-employment nexus, part II:

(a) Based on the present panel data analysis, the Marx-Webb effect is found to be real, with a range between 0.19 and 0.31.

before. The result can be seen in Figure 2.3a. Naturally, the question then arises in which cases an increase in real wages should lead to a decrease in aggregate demand and, in consequence via Verdoorn's law, to a counteracting influence on productivity growth. One explanation for such a case lies in differing demand regimes in different countries, for example in the case of a profit-led demand regime. Using meta-regression analysis again, in chapter III we will delve into the so-called 'Bhadhuri-Marglin' model or 'wage-led/profit-led model' and estimate average marginal effects of a change in functional income distribution on demand.

Part III

How does functional income distribution affect growth? - A meta-regression analysis of the wage-led/profit-led literature

Chapter 3

A meta-analysis of the wage-led/profit-led literature

3.1 Introduction

[1]

The economic consequences of shifts in the functional income distribution have recently gained interest as most industrial countries experienced a long-term fall in the wage share beginning in the 1970s up to the Great Recession in 2008 (Guschanski and Onaran 2016; Stockhammer 2017; Karabarbounis and Neiman 2014). The reasons behind the decline of the wage share is a mix of technological change, globalisation, financialisation, and the retrenchment of the welfare state (Stockhammer 2013). Given

[1]This chapter is based on a draft that I am currently working on together with Quirin Dammerer (Momentum Institute, Austria), Miriam Rehm (University of Duisburg-Essen, Germany) and Mathias Schnetzer (Austrian Chamber of labour, Austria). Quirin Dammerer and I are responsible for the literature search, the creation of the data set used for the meta-regression as well as control of each others coding work. Miriam Rehm and Mathias Schnetzer are responsible for the econometric estimation as well as in parts for the description of the methodology and the description of the results. All errors in this chapter, of course, are my own.

this shift in the functional distribution, the question arises how the distribution of national income between profits and wages relates to aggregate demand. The literature on the relation between functional distribution and GDP growth is commonly referred to as wage-led versus profit-led demand debate. If an increase in the wage share stimulates growth, aggregate demand is wage-led and vice versa. While the theoretical arguments have been exchanged between neo-Kaleckians and neo-Goodwinians, Bhaduri and Marglin (1990) have proposed a model to conciliate the rival ideas. This model has motivated a new and rich strand of literature that empirically assesses the nexus between functional inequality and economic growth, however, the schools of thought have used the model differently (Stockhammer 2017). This paper provides an overview of this literature and adds new insights from a meta regression analysis (MRA).

Existing empirical research shows conflicting results for a number of countries which might also arise from a number of technical factors including variable definitions, estimation strategies, econometric methods, the choice of control variables, and so forth. Moreover, these results might underlie publication bias, since editors and referees may favour findings that are statistically significant, confirm prior beliefs, or are particularly surprising (Andrews and Kasy 2019). Researchers in turn face strong incentives to select findings in order to maximise publication chances (Brodeur et al. 2016). Thus, we conduct a meta regression analysis to study effect sizes in the wage-led/profit-led literature and to assess the impact of various moderator variables on the dispersion of elasticities between functional distribution and growth.

We include 34 studies with 494 estimates for total and domestic demand. Our results suggest that total demand tends to be largely profit-led and domestic demand is mainly wage-led across all countries. However, there is a small but statistically significant publication bias for total demand estimations in the direction of a wage-led demand regime. In contrast, there is little but again statistically significant profit-led publication bias for domestic demand estimations. We reason that both camps acknowledge research by the opposite view and might mitigate their results. In addition, our findings reveal an important impact of different estimation strategies and choice of variables on the results.

The findings of the wage-led/profit-led literature have important policy implications. Given the shift in the functional income distribution, countries have adapted their growth models in order to compensate for the income loss of the labour force. There is evidence of export-led and debt-led growth models which aim at stabilising growth through external demand or credit loosening respectively (Behringer and Treeck 2019). These growth regimes have contributed to the rising current account imbalances prior to the financial crisis in 2008 and the Euro-crisis thereafter. Thus, the relation between functional distribution and aggregate demand is of great relevance for economic policy.

The remainder of our paper is structured as follows. We provide an overview of the wage-led/profit-led debate and its origins in section **??**. In section 3.3, we introduce our data set based on 34 publications and show first descriptive results on the coverage and direction of the estimates. Section 3.4 presents the results of a meta regression analysis for total and domestic demand. Finally, section 3.5 draws conclusions from our results and suggests further research avenues.

3.2 The Bhaduri-Marglin Model - Origins, Current Debates and Extensions

The following section is based on parts of my master thesis (List 2015) and the contributions of Lavoie (2017a) and Stockhammer (2017)[2].

Questions about income distribution and its impact on economic growth long formed the foundation of what is called classical political economy. Since the rise of the supply-side paradigm and the displacement of other theories from mainstream academic debate, not much literature has been published on this 'oldest of topics'. Income distribution and its possible implications for economic growth are of concern to some mainstream publications. Yet, inequality was not perceived as something that needed to be addressed through active policy, but rather taken as a given, due to its role in standard neoclassical theory. With the occurrence of growing inequality in the US in the 21st century and the financial crisis from 2007 until the present day, inequality is back in the mainstream papers. Additionally, Piketty's 2014 perfect timing had an impact in promoting debate about rising inequality inmidst of the global financial crisis, the Greek sovereign debt crisis and the Occupy movement. Even though Piketty (2014) was not too concerned with the implications of the trend towards higher inequality that he so emphasised, it sparked a new political debate about inequality and its role in our society. Equally important, it also created the need in international decision-making institutions such as the International Monetary Fund (IMF) or the OECD for a theoretical reassessment of its potential impact on economic growth.

[2] In this section we will focus on the debate concerning *demand* and *productivity* regimes. That is, we discuss the available literature on how both aggregate and productivity react to a change in income distribution. We refrain from going into detail on the question of *employment* regimes

All these events opened up opportunities for heterodox ideas to influence the discussion within the mainstream, as can be seen for example in Kumhof, Rancière, and Winant (2015) and Dabla-Norris et al. (2015). However, most mainstream models still only offer pure supply-side explanations, which is not sufficient to represent the complexity of capitalism. Post-Keynesian models offer an alternative to mainstream general equilibrium models. Here, the 'wage-led/profit-led model' proposed by Bhaduri and Marglin (1990) is commonly used as a benchmark to analyse the impact of changes in functional income distribution on economic growth.

One aspect that deserves special attention is the different approach of the two schools of thought presented here. There exists a difference in the methodological approach, where mainstream analysis emphasises personal income distribution and post-Keynesian theory emphasises the importance of functional income distribution. This difference then logically leads to different outcomes in terms of policy proposals. furthermore, it leads to the question of whether there should not be an interaction between the two that further influences economic growth, as is proposed by Carvalho and Rezai (2015). Since in most mainstream publications, inequality tends to be a problem of inefficient markets or externalities, a viable mainstream solution would be to have the state intervene to internalise these effects, for example via taxes. Another option would be to further deregulate financial markets so that no one would have restricted access to credit and human capital accumulation could be pursued by everyone if it is their optimal choice. Some mainstream contributions, for example Kumhof, Rancière, and Winant (2015), argue that this could increase the likelihood of a future financial crisis. Instead, they would argue for an increase in minimum wages or fiscal redistribution from high-income groups to low-income groups.

3.2.1 Income Distribution and Growth in the Mainstream

Concerning the mainstream discussion on inequality and growth, we want to pay attention to some aspects that seem especially important to us.

First, almost all of the available literature has focused on the personal rather than the functional distribution of income when assessing changes in income inequality - with the exception of Kumhof, Rancière, and Winant (2015). The reason for this is the use of methodological individualism in neoclassical and other mainstream theories. After all, the only kind of income distribution that could matter in an atomistic world populated by representative agents must be personal income distribution. But overlying these micro-economic processes are some stronger dynamics that should not be ignored. Second, for most of the literature it is not so much a change in the distribution of income itself that has a direct impact on economic growth. Rather, the issue lies in imperfect markets and/or inefficient public policies. Examples for this are Persson and Tabellini (1994), Acemoglu et al. (2008), and Ostry, Berg, and Tsangarides (2014). For this reason, the focus of policy recommendations in mainstream literature does not lie in re-distributive measures, but rather in (capital) market liberalisation and further commodification of public services. The aim of this section is therefore to consider other paradigms that might think of income inequality as a problem in itself. Third, most theoretical explanations for such a relationship draw their conclusions from an exclusive supply-side view, ignoring interactions between changes in the distribution of income and the consequences for effective demand altogether.

3.2.2 Income Distribution and Growth in the (Neo-)Kaleckian Model

In contrast to the mainstream literature, distributional issues are at the centre of the post-Keynesian/(neo-)Kaleckian models. In contrast to the mainstream, however, it is the functional distribution of income that is the focus of attention in the post-Keynesian paradigm. This focus is already present in Keynes (1936) (on the concept of marginal propensity to consume and the idea that it declines as income rises) and can even be found in the work of Kalecki (especially in the assumptions of mark-up prices and excess productive capacity) and Kaldor (assuming an indexation of wages to productivity growth). Starting with the work of Kalecki (1971) and Robinson (1953), the newly emerging post-Keynesian tradition distanced itself from the neoclassical view with its recourse to the concept of effective demand, endogenous money and fundamental uncertainty (Lavoie 2014).

Kaldor (1957) tries to extend the theory of Keynes (1936) from the short to the long run. He also tries to explain what he calls the 'historical constants' of economic growth - these are the constant wage and profit ratio, the constant capital-output ratio and a constant rate of profit. He also assumes full employment in the long run – an assumption that earned him the name 'Jean-Baptiste Kaldor'. Nevertheless, Kaldor (1957) agrees with Keynes (1936) that investment-savings causality runs from the former to the latter, contrary to classical and neoclassical theory.

The following notation of Kaldor's model is taken from Hein (2014) . Since the saving-income ratio in an economy $saving - incomeratio = s_W \frac{W}{pY} + s_\Pi \frac{\Pi}{pY}$ depends on the weighted average of the marginal propensity to save of wages s_W and profits s_Π, any change in the functional income distribution - i. e. i.e. a change in both the wage share wage share= $\frac{W}{pY}$ and the profit share profit share= $\frac{\Pi}{pY}$ - necessarily provokes changes in aggregate saving. As long as the workers' marginal propensity to save propensity to save out of wages is smaller than that of the capitalists propensity to save out of profits s_W, this relationship holds in Kaldor (1957) model. If one balances investment aggregate private investment and saving aggregate private savings(= pI) and divides by national income pY, one obtains

$$\frac{pI}{pY} = \frac{S}{pY} = s_W + (s_\Pi - s_W)\frac{\Pi}{pY} \tag{3.1}$$

which can be rearranged to obtain the specific profit share $\pi^\star$ to be obtained at equilibrium in the goods market.

$$\pi^\star = \frac{\Pi}{pY} = \frac{1}{s_\Pi - s_W}\frac{I}{Y} - \frac{s_W}{s_\Pi - s_W} \tag{3.2}$$

With positive marginal propensities to consume (where s_W is smaller than s_Π), the profit share $\pi^\star$ - and thus the functional income distribution - is determined by investment. The exogenous investment-output ratio investment-output ratio is then determined as

$$\frac{I}{Y} = \frac{I}{K}\frac{K}{Y} = g_n\frac{K}{Y} \tag{3.3}$$

where the investment-output ratio $\frac{I}{Y}$ is a function of the natural growth rate 'natural' growth rate and the capital-output ratio capital-output ratio (where aggregate capital stock is the stock of capital) and must lie between the marginal propensity to save from wages s_W and profits s_Π.

The other influential tradition of post-Keynesian models was developed by Kalecki

(1971) and Steindl (1976). Kalecki, in particular, deserves mention because he published his theory of effective demand - the idea that it is the level of aggregate demand at current prices and incomes that determines the level of output and employment when aggregate supply is adjusted - three years before John Maynard Keynes. However, as his studies were originally published in Polish, his work was not recognised until the 1960s, when the first translations into English were published.

Kalecki's background, unlike Keynes', was informed by thorough Marxist studies, in particular by Rosa Luxemburg's work 'The Accumulation of Capital' (Luxemburg 1963). In Kalecki's view, capitalist economies are always subject to (productive) overcapacity, unemployment and monopolies or oligopolies, even in the long run. As Kalecki himself states: 'In fact, the long-term trend is only a slowly changing component of a chain of short-period situations; it has no independent unity. [...]' (Kalecki 1971, p.165). The normal monopolistic or oligopolistic markets mentioned earlier were subject to a price premium set by the capitalists on the basis of their market power - or their degree of monopoly, as Kalecki (1971) calls it. As a result, prices become cost-determined, not demand-determined.

A simple neo-Kaleckian model can be constructed under the following assumptions. Assuming that workers do not save, their consumption can be written as equal to their income, i.e. hours worked multiplied by wages received per hour. In other words, their propensity to consume out of wages propensity to consume out of wages is equal to 100% of aggregate income aggregate output/demand (assuming away the possibility to indebt themselves). Capitalists, on the other hand, base their consumption propensity to consume out of profits s_W on an autonomous part plus a part that depends on the profits aggregate profits received. The core of the neo-Kaleckian model consists in a partial goods market-equilibrium.

$$C_W = WL = c_W Y$$
$$C_\Pi = a + c_\Pi \Pi$$

Note that the workers' consumption function can be rearranged so that c_W equals the wage share $\frac{WL}{Y}$. Assuming that investment is exogenous, in equilibrium aggregate expenditure $Y = C + I$ must equal aggregate income $Y = WL + \Pi$. Resulting equilibrium profits are thus described by

$$C + I = WL + \Pi$$
$$\Leftrightarrow C_W + C_\Pi + I = WL + \Pi$$
$$\Leftrightarrow WL + a + c_\Pi \Pi + I = WL + \Pi$$
$$\Leftrightarrow a + c_\Pi \Pi + I = \Pi$$

$$\Leftrightarrow \Pi^\star = \frac{a + I}{1 - c_\Pi} \tag{3.4}$$

The profits in the aggregate are a residual of wages so that $\Pi = Y - WL$. If we equate with equilibrium profits, we can calculate equilibrium income.

$$\Pi = Y - c_W Y = (1 - c_W)Y$$
$$\Pi = \Pi^\star : \frac{a + I}{1 - c_\Pi} = (1 - c_W)Y$$

$$\Leftrightarrow Y^\star = \frac{1}{(1 - c_\Pi)(1 - c_W)}(a + I) \tag{3.5}$$

Differentiating the equilibrium income according to the wage share c_W, we find an effect of change in the functional income distribution on economic growth:

$$\frac{\partial Y\star}{\partial c_W} = \frac{1}{[(1 - c_\Pi)(1 - c_W)]^2}(a + I) \quad > 0 \text{ for } 0 > c_\Pi > 1 \tag{3.6}$$

An increase in the exogenous wage share in a neo-Kaleckian model thus has a positive endogenous effect on economic growth. The causality between income distribution and growth runs in the other direction than in the Kaldorian models, in which the endogenous functional income distribution was determined by exogenous economic growth. Earlier models by Kalecki (1971) and Steindl (1976) only permitted for positive growth effects from a rise in the real wage (ex-post termed 'wage-led' growth). Further 'Post-Keynesian/Kaleckian models regarding demand regimes and the effect of income distribution on demand have been formally modelled by Rowthorn (1981), Dutt (1984), Taylor (1985), Blecker (1989), and Blecker (2011) and extended by Bhaduri and Marglin (1990)' (Lavoie and Stockhammer 2013b, p.63). Indeed, Bhaduri and Marglin (1990), also known as the Bhadhuri-Marglin model opened up the possibility for the converse, 'profit-led' growth, that is, redistribution towards labour income leading to lower growth.

The Neo-Goodwinian View on Income Distribution and Growth

Parallel to the post-Keynesian/(neo-)Kaleckian models, there exists a second group of models that looks at the intersection between income distribution and economic growth. This group consists in the neo-Goodwinian models of a more Marxist background.

For neo-Kaleckians, the focus of the analysis rested on the effect of income distribution on economic growth in the long run, with a special interest in additional determinants of aggregate demand[3]. Meanwhile, the neo-Goodwinian literature focused on the analysis of income distribution and growth during business cycles around a certain growth path. Additionally, neo-Goodwinians, more so than their Kaleckian colleagues, were interested in possible feedback effects of economic growth on income distribution, an effect that would become known as the 'distributive curve' (Lavoie 2017a; Stockhammer 2017).

The classic Goodwin model is a supply-side model which assumes full capacity utilisation and no demand constraints on growth. Neo-Goodwinians consider the goods market to be centred around a labour market with an inherent self-adjustment mechanism. Say's law is supposed to be valid. Thus, savings determine investments, not the other way around. All wage income is used for consumption and all profits are used for investment. Hence, a change in income distribution affects growth via a supply-side channel. An increase in the wage share for example leads to decreases in investment. The result is a decrease in economic growth, due to a lower increase in the stock of capital, not due to lower aggregate demand as in neo-Kaleckian models (Stockhammer 2017, p.29).

Following Marx (1990), a recurring topic in neo-Goodwinian theory is the idea of

[3] There exist of course studies with stronger emphasis on the short run as well, as for example shown in Lavoie and Stockhammer (2013b)

a profit squeeze, where capitalists' profits are being squeezed between lower profit rates due to competition and higher wages due to lower unemployment and higher worker bargaining power (Boddy and Crotty 1975; Weisskopf 1979; Marglin 1984). From today's standpoint, the argument put forward by this strand of literature would be called the profit-led story.

The Bhadhuri-Marglin Model

The role of wages, both as a source of aggregate demand and as part of production costs, is at the centre of Bhaduri and Marglin (1990). The authors use an IS curve in which, unlike Keynes (1936), the real wage rate is treated as an exogenous variable rather than an endogenous one. The authors justify this step with the effect of a change in the exchange rate, which effectively changes the real wage. Furthermore, they assume a Kaldorian savings function in which workers have a lower marginal propensity to save than capitalists. In this way, the authors are able to present the underconsumptionist argument that redistributing income from capitalists to workers increases aggregate consumption while reducing aggregate saving. Price formation in the Bhadhuri-Marglin model is covered by a mark-up equation in which firms put a profit margin on their constant marginal costs - a procedure used mainly in the Kaleckian literature. The result is a positive relationship between the profit margin and the profit share and a 'distributional conflict between the profit margin/share and the real wage' (Bhaduri and Marglin 1990, p.378). Thus, an increase in the wage share would have positive consequences for aggregate consumption, but in certain cases negative consequences for aggregate investment. Whether total demand increases or decreases therefore depends on the countries demand-regime.

Thus, assuming that investment is an increasing function of the profit share, an upward or downward-sloping IS curve can be constructed depending on how sensitive investment is to a change in the profit share. An economy in which a decline in the wage share has a negative impact on aggregate demand is called a 'wage-led' economy and is represented by a downward-sloping IS curve. In such a case, the increase in private investment is not strong enough to make up for the decrease in private consumption. Conversely, if private investments react stronger than private consumption, a fall in the wage share has an expansionary effect and the economy is considered to be *profit-led*, which is represented by an upward-sloping IS curve.

The Bhaduri-Marglin model can thus represent both the neoclassical/Marxist notion of a profit-driven expansion through an increase in the profit share and the under-consumptionist view. The authors state: *'The 'two paths to output expansion' proposed by Keynes are analytically linked in our model by exogenous variation in the real wage and the distribution of income across classes'* (Bhaduri and Marglin 1990, p.379). It is also striking that the authors explain their investment function in terms of the profit margin rather than the rate of profit. This places them in a Kaleckian rather than a Robinsonian tradition, since the latter does not take into account the variability of capacity utilisation (Stockhammer 2004, pp.35-39).

Bhaduri and Marglin (1990) also point out that while they consider a distributional struggle between workers and capitalists possible, a lower profit share for the capitalists does not necessarily mean a loss of absolute profits for the capitalist class: '*Capitalism is not necessarily a zero-sum game*' (Bhaduri and Marglin 1990, p.382). So one could think about cooperative relations between workers and capitalists, both in wage-controlled and profit-controlled countries. These cooperative regimes can only exist if investors are more responsive to a variation in capacity utilisation than to a variation in the profit rate (Bhaduri and Marglin 1990, p.373). However, these cooperative regimes may run into difficulties in the long run. The wage-led regime could lead to an intra-capitalist struggle over profits in the medium term, while in the long run it creates an under-accumulation crisis leading to structural unemployment (ibid.). Such a growth strategy would therefore have to be restrained so that the difference between productivity growth and real wage growth does not become too large. The profit-oriented regime, on the other hand, implies very similar conclusions. In the medium term, a profit-oriented cooperative regime could lead to tensions within the working class, similar to the New Keynesian insider-outsider models, where the distributional struggle between workers and capitalists turns into a distributional struggle within the workforce. In the long run, such a regime runs the risk of entering an overaccumulation/underconsumption crisis in the Marxian sense. Moreover, as productivity grows faster than real wages, capitalists may have problems finding enough workers to utilise the increased capital stock, which in turn could lead to intra-capitalist tensions over available workers (Bhaduri and Marglin 1990, p.383-84).

The Bhaduri-Marglin model can be seen as a synthesis of both the neo-Goodwinians and neo-Kaleckian schools to combine different possible outcomes. A cooperative policy in a wage-led economy, which consists of real wages growing along with productivity increases, is close to neo-Kaleckian theory and is in fact what many European countries experienced between the 1940s and 1970s. This changed with the advent of neo-liberalism, which promoted a world of high growth based on profit increases and the resulting trickle-down effect (Lavoie and Stockhammer 2013a, p.41). The contradictory political regimes eventually lead to economic crisis, which according to Marx is inherent in capitalism. A prolonged policy of wage growth over productivity in a wage-driven economy leads to a crisis of under-accumulation in a conflictive regime. The Marxian crisis of under-accumulation will erupt in a profit-driven regime when real wage growth is kept below productivity growth for a considerable period of time. The introduction of the foreign sector into Bhaduri and Marglin (1990) leads us to somewhat different conclusions about the nature of the different regimes. Here, devaluation in a profit-driven regime has a clearly expansionary effect, whereas this is not so clear in a wage-driven regime. A domestically wage-led economy can take on a profit-led character when trading with the rest of the world if the trade effect becomes dominant (Bhaduri and Marglin 1990, p.388). Thus, a country could switch from a (domestic) wage-led cooperative regime to an (open economy) profit-led conflictive regime and experience fairly stable economic growth for some time. However, as the authors note, 'it is impossible for all countries to achieve a trade surplus at the same time' (ibid.). This argument connects to the one made by Onaran and Galanis (2012), namely that the world as a whole must necessarily be wage-driven. This is also of concern to Lavoie and Stockhammer (2013a, pp. 14-15, 19–21). The implication is the possible (symbiotic) existence of export-led and debt-led countries. For Lavoie and Stockhammer (2013a), this is a possible explanation for the supposed 'success' of neo-liberalism, profit-driven growth despite wage-led regimes. According to the authors, neo-liberalism has produced these two ultimately unsustainable regimes by creating increased and deregulated financial markets to promote higher - but ultimately unsustainable - growth, with the current economic crisis as a direct consequence (Lavoie and Stockhammer 2013a, p.24).

There is however a difference in scope that the Bhadhuri-Marglin model gets attributed by neo-Kaleckians and neo-Goodwinians, as explained by Stockhammer (2017).

> *For the neo-Kaleckians1 the Bhaduri–Marglin is a generalisation of the wage-led Kaleckian model. Kaleckians interpret the effects identified as partial-*

> *equilibrium, medium-term goods markets effects. The context in which the Bhaduri–Marglin model is used is best illustrated with respect to Keynes's discussion of the effect of wage cuts on employment in chapter 19 of The General Theory (Keynes 1973).* [...] *For the neo-Goodwinians, the Bhaduri–Marglin model has allowed a generalisation of the Goodwin model, which is a business cycle model. The original Goodwin model is a supply-side model of distributional cycles that assumes that Say's law holds: capacity is fully utilised and there are no demand constraints on output (Goodwin 1967).* (Stockhammer 2017, pp.28-29)

Neo-Kaleckians use the Bhadhuri-Marglin model as a growth model and are more interested in partial equilibrium goods market analysis. For them, the important part is the effect of a change in functional income distribution on the components of aggregate demand, consumption, investment and net exports - and, as a result of the partial effects, economic growth as a whole. On the other hand, neo-Goodwinians use the Bhadhuri-Marglin model as a business cycle model. Neo-Goodwinians also emphasise feedback effects back from economic growth on distribution, while the effects of income distribution on demand components are of secondary importance. The use of so-called 'distribution functions' is therefore much more frequent in the neo-Goodwinian literature on the Bhadhuri-Marglin model.

These differences in interpretation concerning the Bhadhuri-Marglin model have direct consequences for econometric estimation. Neo-Kaleckians estimate the Bhadhuri-Marglin model by estimating the marginal effects of a change in income distribution on consumption, investment and net exports in three different equations (we call this the additive approach). The marginal effect itself contains the mean values of the variables used for its estimation. Many studies therefore additionally use alternative mean values as controls (for example the value of the first and/or last year in the data set). The overall effect of a change in the wage share/profit share on economic growth is then given by the sum of the three partial effects. In some papers, a Keynesian multiplier is estimated as well and used together with the partial effects to obtain the final effect on economic growth. An advantage of this approach is the possible separation of domestic demand, consisting in the effects of income distribution on consumption and investment, and total demand, which is the sum of domestic demand plus the effect of income distribution on net exports. In tendency, consumption is found to be wage-led while net exports are found to be profit-led, with investment being the demand component most like to differ across countries. Countries with big domestic markets are usually found to be wage-led while smaller countries with a high share of imports and/or exports are found to be profit-led. As was already argued by Lavoie and Stockhammer (2013b), however, the world as a whole is likely to be wage-led. In this case, a world-wide increase in the wage share would benefit even countries under a profit-led demand regime.

The distinction between domestic demand and total demand can shed more light in the main drivers of a countries respective demand regime. As a result, policy recommendations might dramatically change depending on which demand component is found to be wage-led/profit-led. We will call this the 'additive approach' from now on[4] Neo-Goodwinians however estimate only a single reduced-form demand equation in the majority of all studies. Often they add another equation for the distribution function, however. We will call this approach the 'simultaneous approach' from now on.

[4] This type of estimation methodology is often called 'single equations estimation'.

3.3 Data

In order to compile our meta-data set, we comprehensively sampled JSTOR, EconLit, RePEc, and Google Scholar databases for publications empirically estimating the relationship between the functional income distribution and growth, which do not (implicitly) assume decreasing marginal returns of firms, also known as the "wage-/profit-led debate". In our search, we used the central keywords "wage-led”, "wage-led growth", "wage-led regime". All search phrases were repeated for profit-led, and without hyphen. We also searched for "stagnationist" and "exhilarationist", the terms for wage- and profit-led growth used in the older literature, and for "Goodwin cycle" (also with hyphen), which sometimes denotes profit-led growth. Furthermore, we snowballed from the surveys of the literature in Stockhammer and Onaran (2013), Lavoie and Stockhammer (2013b), Hein (2014), Yılmaz (2015), Lavoie (2017a), Álvarez, Uxó, and Febrero (2019), Oyvat, Öztunalı, and Elgin (2018), and Stockhammer, Rabinovich, and Reddy (2018) and included the papers citing the seminal paper by Barbosa-Filho and Taylor (2006). Studies published after October 1st, 2019 were excluded.

The consistent effect measured for our analysis is the marginal effect of the wage share on growth. For papers measuring the functional distribution as the profit share, we invert the estimates by multiplying them by -1, since the profit share is by definition the inverse of the wage share. To be included in our data set, studies must report (1) the marginal effect of the wage (or profit) share on (total or domestic) growth, (2) the standard error or at least the number of observations (or make it possible to compute the latter).

In estimating these marginal effects, the literature uses either additive or simultaneous estimation strategies. The former estimates the following equation:

$$g = f(d, X), \tag{3.7}$$

where g is some measure of growth, d is the functional income distribution (typically the wage share), and X is a vector of controls. In the additive strand of the literature, the channels through which distribution affects growth are often estimated explicitly in a two-stage approach:

$$g = f(y, X)$$
$$y = f(d),$$

where y are typically measures of domestic and/or external demand (that is, private or government consumption and investment, imports, and exports). For simultaneous estimations, papers are included when they report the marginal effects of the equations:

$$\begin{aligned} \dot{g} &= f(g, d, X) \\ \dot{d} &= f(g, d, X). \end{aligned} \tag{3.8}$$

We sample all marginal effects reported in individual primary studies, that is, we do not sample selectively. This yields our database comprising 218 estimates for total demand and 276 estimates for domestic demand from 34 studies. Our total number of 494 observations is thus somewhat above the average 400 estimates reported by Ioannidis, Stanley, and Doucouliagos (2017) for meta analyses.

The variables covered, their definitions, mean and standard deviation are presented in Table 3.1. The dependent variables are the marginal effect between the functional income distribution and either total or domestic growth (that is, the change in private consumption plus investment). We group control variables into estimation methods, meta-regression controls for time and space, controls used by the studies in the investment or net export functions, and controls for government and inequality. All meta-regression controls are coded as dummies, where 0 is defined as the "best case" wherever possible.

Estimation methods include whether the study was published recently and whether it is unpublished, both of which may allow for lower quality control. It also covers whether the study uses estimations other than least squares, whether the estimation method is simultaneous (rather than additive), whether the data is quarterly, whether the dependent variable is capacity utilisation (rather than GDP growth), and whether real wages (rather than wage or profit share) are used to measure the functional income distribution.

Meta-regression controls of time and space attempt to control for potential changes in regimes – that is, whether economies were more wage- or profit-led at a certain point in time – by controlling for an "early observation period", i.e. whether the average year of the period covered in the estimates is before 1990. We also control for possible differences between higher- and lower-income regions by including dummies for whether a country is non-OECD, and whether it is located in a low-income region.

Finally, two blocks of controls take the covariates of the studies covered in our meta-regression into account, which may approximate their quality. These are whether the investment and export functions include controls for demand and profits (including gross profits), and the interest rate; and whether the export function controls for demand, profits (again including gross profits), competitiveness, and the exchange rate. Second, we control for studies' government and inequality covariates. These include public

Table 3.1 – Meta-Regression Variable Definitions

	Description	Mean	S.D.
Dependent variable			
Effect size (total)	Marginal effect between the functional income distribution and growth (change in private consumption and investment, and net exports)	−0.177	0.52
Effect size (domestic)	Marginal effect between the functional income distribution and domestic growth (change in private consumption plus investment)	0.265	0.51
Estimation methods			
Recent publication	D = 1: Study published in the past 5 years (after 2014)	0.408	0.49
Unpublished	D = 1: Study not published in peer-reviewed journal	0.255	0.44
Non-LS	D = 1: Estimation strategy is not standard least squares (LS) regression	0.810	0.39
Simultaneous estimation	D = 1: Simultaneous estimation (D = 0: Additive estimation)	0.195	0.40
Quarterly data	D = 1: Estimate is based on quarterly data	0.465	0.50
Capacity utilization	D = 1: Dependent variable is capacity utilization (D = 0: GDP)	0.062	0.24
Real wages	D = 1: Real wages are used as measure of functional distribution	0.042	0.20
Meta-regression controls for time and space			
Early observation period	D = 1: Average year of observation period is before 1990	0.771	0.42
Non-OECD	D = 1: Estimate is for non-OECD country	0.167	0.37
Low-income region	D = 1: Estimate is for a country or a region in Africa, South America, or Asia	0.224	0.42
Studies' controls in investment (I) or net export (X) functions			
Demand (in I)	D = 1: Estimation does not control for demand in I function	0.014	0.12
Profits (in I)	D = 1: Estimation uses no or gross profits as control in I function (D = 0: profit share or profit rate)	0.142	0.35
Interest rate (in I)	D = 1: Estimation does not control for interest rate in I function	0.813	0.39
Demand (in X)	D = 1: Estimation does not control for demand in X function	0.442	0.50
Profits (in X)	D = 1: Estimation does not control for profits in X function	0.739	0.44
Competitiveness (in X)	D = 1: Estimation does not control for competitiveness in X function	0.663	0.47
Exchange rate (in X)	D = 1: Estimation does not control for the exchange rate in X function	0.754	0.43
Studies' controls for government and inequality			
Public investment	D = 1: Estimation does control for public investment	0.915	0.28
Government spending	D = 1: Estimation does not control for government spending	0.810	0.39
Financialization	D = 1: Estimation does not control for measure of financialization	0.671	0.47
Personal inequality	D = 1: Estimation does not control for measure of personal inequality	0.748	0.43
Wealth inequality	D = 1: Estimation does not control for measure of wealth inequality	0.768	0.42

investment, government spending, financialisation, personal inequality, and wealth inequality.

(a) Observation period by study (b) Estimates

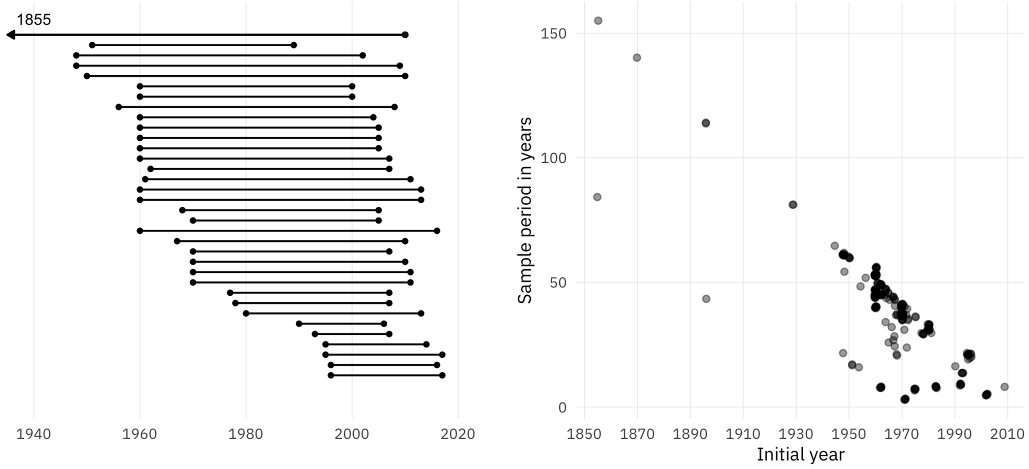

Figure 3.1 – Start year and sample period of estimates and studies

The estimates in our database cover a time span of 164 years, as Figure 3.1a shows. While most of the 34 studies use data beginning in the 1960s, one article relies on data going back to the 19th century for the UK, France, Germany, and the US (Stockhammer, Rabinovich, and Reddy 2018). The distribution of initial years and sample periods for the individual estimates is shown in Figure 3.1b. Most estimates are based on an observation period of around 50 years beginning between 1960 and 1970. Only a few estimates include very long-term data and some studies provide estimates for rather short periods starting in the 1990s, as can be seen in the right-hand side panel of Figure 3.1b.

The studies in our sample cover a wide regional variation. In total, there are estimates for 57 countries and regions in our database. Figure 3.2 shows that most research focuses on Europe and the United States, but Latin America, South and South-East Asia, and the Middle East are also covered. The most notable global gaps are Africa and the former Soviet Union where almost no estimates are available. There is thus a remarkable overhang of estimates for OECD (83%) versus non-OECD (17%) countries.

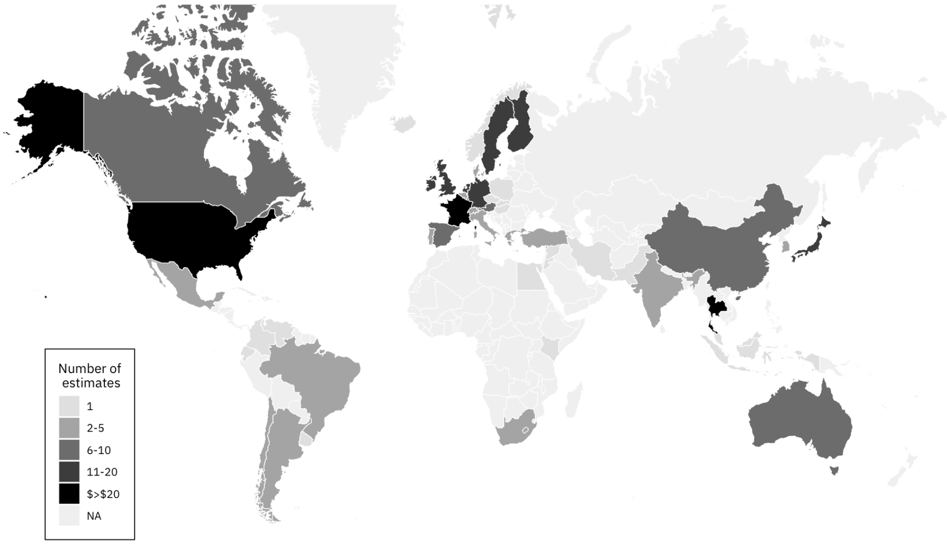

Figure 3.2 – Countries covered by our database

Finally, Figure 3.3 shows the distribution of effect sizes for total and domestic demand. The distribution for total demand is somewhat left-skewed, with more estimates that imply a negative relationship between redistribution towards wages and growth. The sample mean for all estimates (−0.177) given in Table 3.1 supports this observation. The bulk of estimates clusters around zero with only small positive or negative effects. In contrast, there is one notable outlier with a very large positive effect for Norway 1962–2011 (Oyvat, Öztunalı, and Elgin 2018). For domestic demand, the histogram shows a right-skewed distribution of estimates. The figure suggests that domestic demand is rather wage-led with a sample mean of 0.265 across all studies.

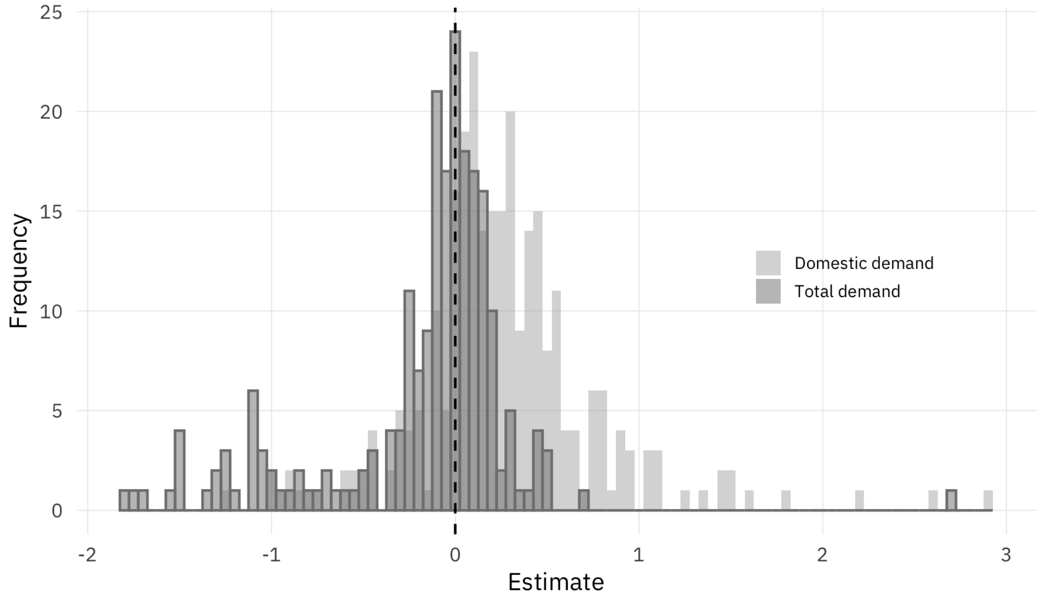

Figure 3.3 – Histogram of estimates for total and domestic demand

3.4 Results

We first focus on the effects of functional inequality on total demand. Figure 3.4 shows the funnel plot of estimated effect sizes. As a significant number of papers do not provide standard errors for the estimates, (Stanley and Doucouliagos 2012) suggest to use the square root of the number of observations as an alternative measure of precision. While less accurate than the standard error, the square root of the sample size is considered a feasible proxy for precision in the literature (Begg and Berlin 1988; Rosenberger and Stanley 2009). This method promotes studies with a very large number of underlying observations like the paper by Kiefer and Rada (2015) that uses quarterly data for a period of 40 years and 13 OECD countries. Another study is based on 34 countries and an observation period of 41 years (Hartwig 2014). The figure shows those estimates with a higher precision, or a large number of observations respectively, centering around zero. Since estimates at the bottom obtain lower precision, they are widely dispersed. In contrast, the more precise estimates are more compactly distributed (Stanley and Doucouliagos 2012). As can be seen, there is a notable overhang in the negative area (59%) indicating a profit-led total demand. Nevertheless, there is a considerable number of estimates above zero (41%). The lack of symmetry in the funnel plot is a first indication of publication bias.

In a next step, we conduct meta regression analysis to identify potential publication bias. Typically, meta regression analysis involves FAT-PET (funnel-asymmetry precision-effect test) and PEESE (precision-effect estimate with standard error) regressions. These models regress the effect size on measures of precision and a set of control variables. The rationale is that the reported effect is positively correlated with its standard error when publication selection is present. The coefficient of the precision

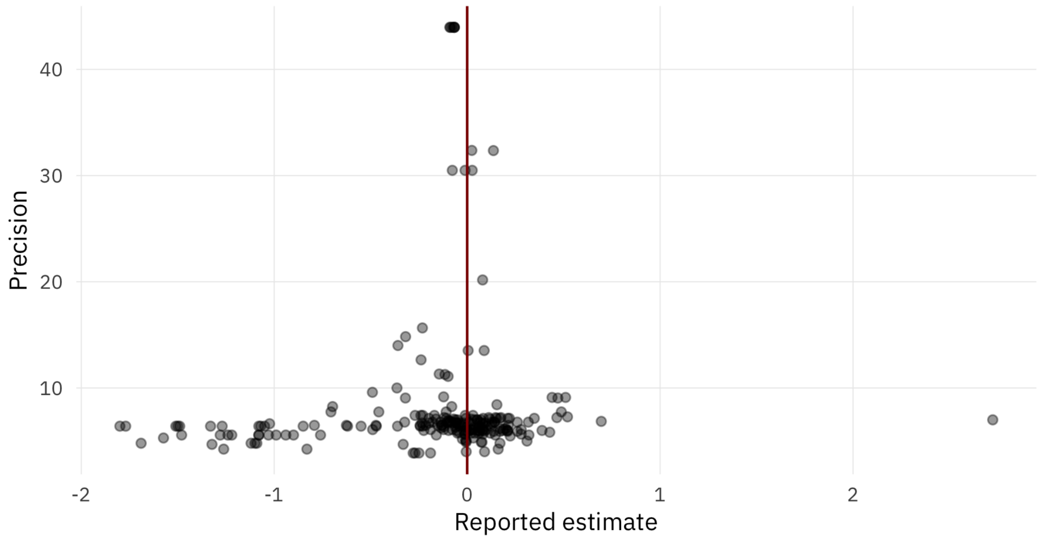

Figure 3.4 – Funnel plot: Total demand

measure thus models publication bias, while the coefficient for the intercept serves as corrections for publication bias (Stanley and Doucouliagos 2012). The difference between FAT-PET and PEESE regressions is that the former uses the standard error and the latter takes the variance, i.e. squared standard errors. It has to be noted that the error term in such regressions is not expected to be i.i.d. and thus weighted least squares (WLS) is routinely employed. This way, more weight is assigned to those estimates with more precision. Finally, we perform stepwise model selection by using the Akaike information criterion (AIC) and keep the statistically significant covariates only.

Table 3.2 contains our regression results for total demand. We add moderator variables in blocks as described above and conduct FAT-PET and PEESE regressions with the root of the number of observations as measure of precision. In general, we do find a small publication bias but surprisingly in favour of wage-led coefficients, as is indicated by the positive coefficient for the precision measures. The negative

Table 3.2 – Regression results: Total demand

	Dependent variable:					
	Marginal effect b/w functional distribution and growth					
	FAT-PET	PEESE	FAT-PET	PEESE	FAT-PET	PEESE
	(1)	(2)	(3)	(4)	(5)	(6)
Precision	0.009^{***}		0.016^{***}		0.007^{***}	
	(0.002)		(0.003)		(0.002)	
Number of observations		0.0002^{***}		0.0003^{***}		0.0001^{***}
		(0.00004)		(0.00005)		(0.00003)
Recent publication	-0.150^{**}	-0.183^{***}				
	(0.063)	(0.067)				
Unpublished			-0.127	-0.129	-0.249^{***}	-0.286^{***}
			(0.083)	(0.088)	(0.063)	(0.062)
Non-LS	0.578^{***}	0.609^{***}	0.418^{***}	0.522^{***}		
	(0.081)	(0.080)	(0.082)	(0.097)		
Simultaneous estimation	0.172^{**}	0.166^{**}	0.281^{***}	0.227^{**}	-0.189^{***}	-0.171^{***}
	(0.069)	(0.068)	(0.072)	(0.096)	(0.055)	(0.057)
Quarterly data	0.155^{*}	0.132	0.164	0.181	0.340^{***}	0.351^{***}
	(0.080)	(0.082)	(0.113)	(0.111)	(0.102)	(0.110)
Real wages	0.318^{***}	0.329^{***}		0.246^{*}		
	(0.117)	(0.114)		(0.141)		
Capacity utilization			-0.506^{***}	-0.352^{**}	-0.559^{***}	-0.592^{***}
			(0.130)	(0.177)	(0.118)	(0.128)
Early observation period			0.236^{***}	0.223^{***}		
			(0.075)	(0.073)		
Non-OECD			-0.265^{***}	-0.192^{***}	-0.267^{***}	-0.250^{***}
			(0.052)	(0.066)	(0.042)	(0.044)
No personal inequality					-0.608^{***}	-0.608^{***}
					(0.091)	(0.095)
No wealth inequality					0.890^{***}	0.911^{***}
					(0.078)	(0.081)
Constant	-0.657^{***}	-0.595^{***}	-0.691^{***}	-0.682^{***}	-0.272^{***}	-0.226^{*}
	(0.098)	(0.095)	(0.092)	(0.103)	(0.101)	(0.117)
Observations	218	218	218	218	218	218
Method	X	X	X	X	X	X
Time/Space			X	X	X	X
Controls					X	X
Note:						*p<0.1; **p<0.05; ***p<0.01

coefficient for the constant suggests that the effect size would be even more negative when corrected for publication bias. These results imply that total demand in an overall perspective is largely profit-led.

Among the moderator variables, we find some consistent coefficients across the estimations. For instance, results for total demand are more profit-led when estimations use capacity utilisation rather than GDP, when studies are not published in peer-reviewed journals, and when the observed country is not an OECD member. In contrast, using quarterly data, taking real wages as measure of functional distribution, and applying other methods than standard least squares regression tend to generate more wage-led results. The inequality variables, however, are not conclusive. While the absence of personal income inequality measures is rather present in papers that find profit-led total demand, the exclusion of wealth inequality is associated with more wage-led results. Interestingly, the coefficients for simultaneous rather than additive estimation strategy turns negative when including all control variables. Thus, simultaneous estimation strategies are rather associated with profit-led total demand. Other controls like the inclusion of measures for public investment, government spending, and financialisation do not show statistically significant effects in either direction.

Turning to the relationship between functional inequality and domestic demand, figure 3.5 provides the funnel plot of all effect sizes. Previous literature studies have shown that a majority of countries feature wage-led domestic demand (Stockhammer and Onaran 2013; Stockhammer 2017). The funnel plot supports these findings as the reported estimates for domestic demand are largely above zero. In fact, some 79% of all estimates are above and only 21% of estimates are below zero. Moreover, also the more precise estimates feature wage-led domestic demand. However, the funnel plot looks much more symmetric around the sample mean, indicating a smaller publication bias

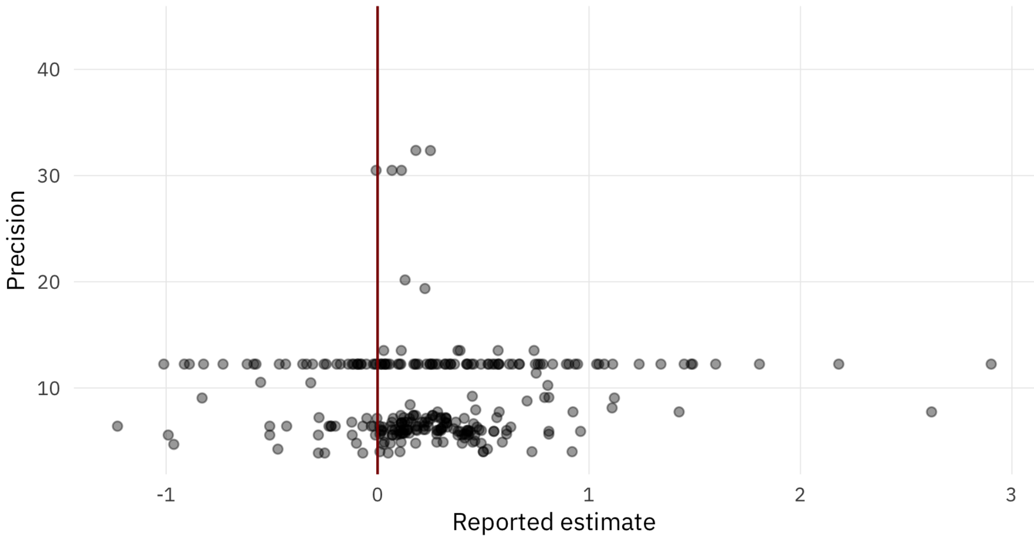

Figure 3.5 – Funnel plot: Domestic demand

than for total demand.

Table 3.3 presents our regression results for domestic demand. Again, only statistically significant results are kept due to the stepwise estimation strategy. With respect to our precision measure, the FAT-PET model only shows publication bias in specification (5). We find a small profit-led publication bias that is also present in all the PEESE specifications. When correcting for publication bias, the estimates would be even more wage-led, as the positive coefficients for the constant suggest. However, the wage-led correction is considerably smaller than the profit-led correction for total demand. Some covariates help explain the variation in the effect sizes. For instance, using methods other than standard least squares regression and simultaneous estimation positively correlate with the effect size. Estimates for non-OECD countries are more profit-led than for OECD countries. The controls in the net export function yield opposing results.

To sum up the results from the meta regression analysis, we find small but sta-

Table 3.3 – Regression results: Domestic demand

	Dependent variable:							
	Marginal effect b/w functional distribution and growth							
	FAT-PET	PEESE	FAT-PET	PEESE	FAT-PET	PEESE	FAT-PET	PEESE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Precision					−0.017***			
					(0.005)			
Number of observations		−0.0004***		−0.0004***		−0.0005***		−0.0005***
		(0.0001)		(0.0001)		(0.0001)		(0.0001)
Non-LS		0.285***		0.285***				
		(0.087)		(0.087)				
Simultaneous estimation		0.614***		0.614***	0.620***	0.652***	0.238**	0.652***
		(0.149)		(0.149)	(0.169)	(0.176)	(0.103)	(0.176)
Quarterly data	0.162**							
	(0.066)							
Capacity utilization		−0.814		−0.814	−0.834	−0.893		−0.893
		(0.717)		(0.717)	(0.735)	(0.740)		(0.740)
Early observation period							0.267***	
							(0.062)	
Non-OECD			−0.297***					
			(0.054)					
No demand (in X)					0.323***	0.279***		0.279***
					(0.068)	(0.065)		(0.065)
No exchange rate (in X)					−0.300***	−0.300***		−0.300***
					(0.091)	(0.092)		(0.092)
Constant	0.176***	0.091	0.316***	0.091	0.509***	0.425***	0.059*	0.425***
	(0.031)	(0.070)	(0.043)	(0.070)	(0.115)	(0.092)	(0.036)	(0.092)
Observations	276	276	276	276	276	276	276	276
Method	X	X	X	X	X	X	X	X
Time/Space			X	X	X	X	X	X
Controls in I/X					X	X	X	X
Controls							X	X

Note: *p<0.1; **p<0.05; ***p<0.01

tistically significant publication bias in the wage-led/profit-led literature. However, the direction of the publication bias is surprising. For total demand, where published results largely point to profit-led effects, the publication bias is wage-led. This means that the results are even more profit-led when accounting for this bias. In contrast, the publication bias for domestic demand indicates that the effects would be even more wage-led than they actually are. In general, our results bolster the evidence from existing literature reviews that generally find domestic demand to be wage-led and total demand to be profit-led. This conforms to the view that smaller and more open economies tend to be profit-led. While there are country-specific idiosyncrasies and some studies in our sample even find opposing results for the exact same countries, our findings give a general intuition of the relationship between functional inequality and economic growth as provided by the literature.

3.5 Conclusion

This paper has analysed the current state of the empirical literature on the relationship between functional distribution and economic growth. The theoretical arguments of this strand of literature mainly origin from a controversy between post-Kaleckians and post-Goodwinians. If a rise in the wage share benefits growth, the demand regime is called wage-led and profit-led otherwise. As these theories promote opposing views, empirical studies tried to shed more light on the demand effects of shifts in the functional distribution. A cursory finding of literature reviews is that in many small open economies, domestic demand is wage-led and total demand is profit-led.

We review 34 studies with almost 500 empirical estimates for domestic and total demand and conduct a meta regression analysis to systematically assess the literature.

We support previous findings that a general survey of the literature results in wage-led domestic demand and profit-led total demand. While there are naturally country-specific idiosyncrasies, our results for a large set of countries provide a general intuition of the mechanisms between the wage share and growth. Concretely, it indicates consumption and investment to be overly wage-led, and incorporating net exports mostly turning results profit-led. In this sense, our results coincide more with the neo-Goodwinian literature than the neo-Kaleckian.

We find little but statistically significant publication bias in this strand of literature. Surprisingly, the publication bias points to the opposite direction of the results. Thus, total demand would be even more profit-led and domestic demand would be even more wage-led when taking publication bias into account. These results are robust with respect to FAT-PET or PEESE regressions. We identify several methodological and moderator variables that are able to explain a share of the variation in the empirical estimates. For instance, results for total demand are more profit-led when estimations use capacity utilisation rather than GDP, when studies are not published in peer-reviewed journals, and when the observed country is not an OECD member.

While this paper aims at summarising what we know about the relation between functional distribution and growth, these insights might also be of interest for economic policy. The long-term fall in the wage shares in many industrialised countries has entailed challenges to stabilise aggregate demand. While some countries have been able to increase their international competitiveness and pursue a export strategy, others have compensated falling wage shares with a rise in private debt-levels to maintain demand. Particularly prior to the financial crisis in 2008, this has led to unsustainable current account balances and was a contributory cause of the crisis (Behringer and Treeck 2019). Thus, the relation between functional distribution and growth should be

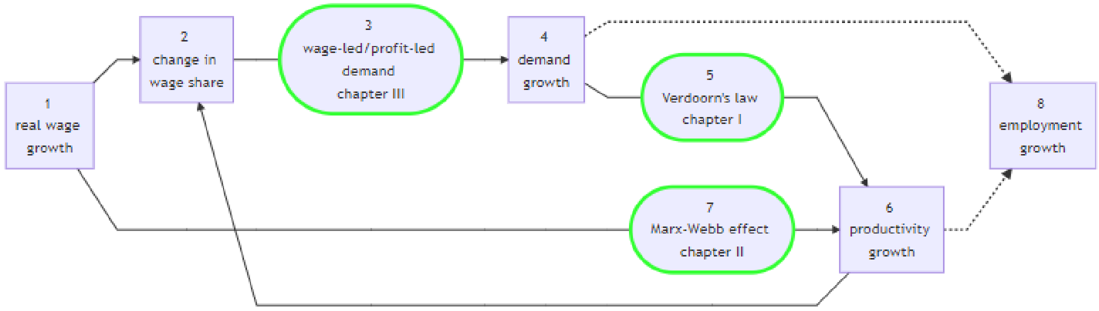

Figure 3.6 – The distribution-productivity-employment nexus, part III:

(a) Based on the present meta-regression analysis, there is a clear link between functional income distribution and aggregate demand. In the case of total demand, the average economy is found to be profit-led, with a meta-average of −0.6. This finding does not take into account that the world as a whole needs to be wage-led.

key for policy makers with a focus on economic stability.

In this chapter, we gave a thorough overview of the literature on the Bahdhuri-Marglin model, commonly known as the 'wage-led/profit-led' model. We did so using yet again meta-regression analysis as our method. Our results of the average country being profit-led can be directly transferred to our model in Figure 5. Figure 3.7a thus puts the demand regime in box number 3 in broad, green borders. With this chapter, we did provide ample evidence for all three economic effects present in the model: first the Verdoorn effect, discussed in chapter I; second, the Marx-Webb effect which was the subject of chapter II together with Verdoorn's law again; and finally the existence of demand regimes discussed in the present chapter.

Part IV

Conclusion

Conclusion

The Main Findings Of The Present Thesis

The fall of world-wide average GDP growth rates since the Global Financial Crisis 2007 is only the latest decrease in a steady fall of GDP growth rates everywhere since the 1980s. This development nourished the fears of secular stagnation amongst mainstream economists. While the possible reasons for secular stagnation are energetically discussed, we tried to show in the present thesis that there exists a much more straightforward explanation for sustained low growth rates than imperfect capital markets, demographic change or less innovative innovations. Rather, the explanation that we put forward finds the source of growth rates in two economic mechanisms linking real wage growth to productivity growth.

One such mechanism is Verdoorn's law, the effect of output/demand growth on productivity growth. This mechanism is typically assumed to be positive and smaller than 1, indicating increasing returns to scale. Most of the literature on Verdoorn's law finds values between 0.30 and 0.60. Using a newly constructed data set, in chapter I we use meta-regression analysis to analyse the available literature on Verdoorn's law for signs of publication bias, i.e. systemic distortions of the reported effects due to unpublished estimates, selection bias and (possibly) counter-intuitive results. To our knowledge, this is the first meta-regression analysis conducted on Verdoorn's law. we do find that the literature on Verdoorn's law as a whole offers no indications for publication bias. In addition, we construct meta-averages (also known as 'true values' in the meta-regression literature) which pool all the available estimates in the literature on Verdoorn's law. Our study finds meta-averages of the Verdoorn effect between 0.44 and 0.69, depending on the specification and control variables chosen to estimate Verdoorn's law. Hence, compared to the articles trying to summarise the available literature we find that on average, the Verdoorn effect is higher than commonly assumed.

In order to explain low productivity growth via Verdoorn's law, we need a further economic mechanism explaining GDP growth via real wage growth. The Bhaduri-Marglin model or profit-led/wage-led model provides such a mechanism, explaining GDP growth via the functional distribution of income. In our example, we use the change in the wage share, which by definition is the result of real wage growth and productivity growth. Our contribution to the available literature consists in a second meta-regression analysis conducted in chapter III, this time using the available empirical literature on the Bhaduri-Marglin model. The Bhaduri-Marglin model is used to estimate a country's demand regime. Typically, neo-Goodwinians find profit-led demand regimes while neo-Kaleckians tend to find wage-led demand regimes. Our meta-regression analysis tests for common estimation controls as well as paper-specific characteristics and find a meta-average of -0.6. This result indicates that the average country is found to be profit-led – even though the world as a whole is probably wage-led (Lavoie and Stockhammer 2013a).

The second mechanism we use to explain low productivity growth is the Marx-Webb effect. Here, higher real wages lead to higher investments in labour-saving technology, thereby increasing productivity. Furthermore, higher real wages increase motivation, which again increases productivity. While the first argument is more commonly used in heterodox economics, the second argument has been proposed by mainstream economics as well, especially in the available literature on efficiency wages. In chapter II, we estimate the Marx-Webb effect together with the Verdoorn effect. we use a panel data set of 23 EU member countries between 1997 and 2017 on different sectoral levels called 'EU-KLEMS' (Stehrer et al. 2019). Using EU-KLEMS, we estimate both Verdoorn's law and the Marx-Webb effect. In order to distinguish between Okun's law and Verdoorn's law, we use an ARDL model which differentiates between short-run effects and long-run effects. Furthermore, we use a special ARDL version which is robust to cross-sectional dependence (called CS-ARDL). The estimation's results indicate Verdoorn effects between 0.36 and 0.97 and Marx-Webb effects ranging from 0.19 to 0.31.

Apart from the results presented in the chapters of this thesis themselves, there are a few other thoughts that deserve mentioning. The first concerns the narrative of secular stagnation and the counter-narrative of stagnating aggregate demand proposed (amongst many others) by Storm and Naastepad (2013), Storm (2017), and Hein and Tarassow (2010) and myself. Over the past years we have been thinking about heterodox models of demand-, productivity- and employment regimes as models completely separated from the mainstream argument of secular stagnation. To our surprise, both the proposed counter-narrative as well as the secular stagnation-narrative have common roots in a series of debates in the 1950s between Paul Sweezy and Joseph Schumpeter about the future of capitalism (Roubtsova 2016; Lavoie 2017a). Although in both cases the origins might be traced back even further, both narratives did evolve side-by-side, even if there was not much interaction between the two so far.

Moreover, the results of our thesis indicate a complicated position for adherents of wage-led demand-, productivity- and employment-growth policies, mainly due to the meta-average in chapter III which finds a profit-led demand regime.

The Distribution-Productivity-Employment-Nexus Put Into Practice

The corresponding value of −0.6, together with the other results in this thesis, renders wage-led growth in all three dimensions improbable. Let us go through an example. The model proposed in the introduction can be reduced to the following model.

$$\dot{\psi} = \dot{w} - \dot{y} \tag{3.9}$$

$$\dot{y} = \dot{y_w}\dot{w} + \dot{y_q}\dot{q} \tag{3.10}$$

$$\dot{q} = \epsilon\psi \tag{3.11}$$

The change in the wage share $w\dot{\psi}$ is a product of real wage growth $\dot{w}$ and productivity growth $\dot{y}$. Demand growth $\dot{q}$ is a results of the change in the wage share and the demand regime ϵ. Productivity growth itself is the result of the demand-induced Verdoorn effect $\dot{y_q}$ and the real-wage-induced Marx-Webb effect $\dot{y_w}$.

Expressed in real wage growth, we get the following equations for productivity growth and demand growth.

$$\dot{y} = \frac{\dot{y}_w \dot{w} + \epsilon \dot{y}_q \dot{w}}{1 + \dot{y}_q \epsilon} \tag{3.12}$$

$$\dot{q} = \epsilon \dot{w}(1 - \frac{\dot{y}_w + \dot{y}_q \epsilon}{1 + \dot{y}_q \epsilon} \tag{3.13}$$

We can use the results conducted in the thesis on hand for the variables in this model. Let us start with values taken only from meta-regression analyses (Variant I in table 3.5a. Chapters I and III provide us values for $\dot{y}_q$ (0.44 – 0.69) and ϵ (−0.6). We did not conduct a meta-regression on the Marx-Webb effect in the present thesis, however the meta-regression analysis on efficiency wages by Krassoi Peach and Stanley (2009) could be used as a proxy. The resulting meta-averages in Krassoi Peach and Stanley (2009) range between 0.28 and 0.30, while our own estimates of the Marx-Webb coefficient conducted in chapter II lie within 0.19 and 0.31. For the sake of the argument, let us assume a Marx-Webb coefficient of $\dot{y}_w = 0.30$ and a Verdoorn coefficient of $\dot{y}_q = 0.69$. Given a profit-led demand regime ($\epsilon = -0.6$), the implications for a 1%-increase in real wages are as follows. The increase in the wage share has two effects on productivity growth, which in combination with real wage growth affects the change in the wage share itself (+1.19%). The increase in the wage share then affects demand growth via the demand regime, which in the meta-regression from chapter III was found to be −0.6. As a result of an increase in the wage share under a profit-led demand regime, demand growth changes by −0.72%, which via Verdoorn's law creates a Verdoorn effect of −0.49. Also, the direct effect of real wage growth on productivity growth via the Marx-Webb effect changes productivity by +0.30% (the result of the meta-regression on efficiency wages). Total productivity therefore changes by −0.19%, the sum of Verdoorn's law and the Marx-Webb effect. As was already explained, the growth in productivity has a feedback effect on the wage share, decreasing the overall effect of the original increase in real wages. Finally, we can calculate employment growth as the residual of demand growth and productivity growth. This leaves us a change of employment of -0.52. In the average, profit-led economy given by the results of three meta-regression analyses, the consequences of an increase in real wages are grim on all fronts. The combination of a strongly profit-led economy and a high Verdoorn coefficient results in a scenario in which the Verdoorn effects dominate the Marx-Webb effects on productivity growth. As a result, the fall in employment growth is somewhat cushioned by the simultaneous decrease in productivity growth. Hence, demand, productivity and employment all experience a decline, even though workers manage to increase their share of national income due to the slowdown in productivity growth.

Table 3.5a repeats the exercise with all extreme ranges available from the results of chapters I, II, III and Krassoi Peach and Stanley (2009). The logic of Variant I repeats itself in all the other variants, although with small differences. While most variants experience a decrease in demand growth, productivity growth and employment growth together with an increase in the wage share, there is one exception. In Variant II, the positive Marx-Webb effect dominates the negative Verdoorn effect so that productivity growth becomes positive.

The reason of this negative effect of real wages on all three regime once again lies in the combination of a strongly profit-led demand regime and a high Verdoorn coefficient. Let us remember that the meta-average for the demand regime in chapter III does only report the demand regime of the average country. An average country, however, does not exist. At the same time, due to the very uneven distribution of demand regime studies across all countries, the introduction of country dummies into our meta-regression was something that we decided not to do. If either the profit-led nature or the Verdoorn effect were weaker, there would be hope for the Marx-Webb effect to dominate Verdoorn's law and for the productivity regime to be wage-led. Even in this case, employment would still be profit-led. Only in the case of a wage-led demand regime, or (although in a much less favourable way) under a more profit-led productivity regime than the demand regime, would an increase in real wages lead to an increase in employment.

Contributions Of The Present Thesis

A first contribution of this thesis lies in using meta-regression analysis as a quantitative reading of economic literature. More precisely we use meta-regression analysis to provide a detailed summary of the empirical literature on Verdoorn's law (in chapter I) and the Bhadhuri-Marglin model, also known as the wage-led/profit-led model (in chapter III. Common journal articles are not able to provide a comprehensive overview of all empirical results in a specific field of research. in comparison, commonly used MRA tools such as funnel plots (Figures 1.4, 3.5 and 3.4) are able to depict the primary literature in one simple graph. Using such method, our thesis also raises awareness for the issue of trust in intransparent research processes. At the present point in time, many econometric studies are not reproducible. Either the underlying data sets or the code used in statistical software are often not published by authors, facts that tend to impair the reliability of these studies.

Furthermore, there exists strong peer pressure among the economist community to obtain statistically significant results, indicating a very skewed understanding of

	Variant I: all effects taken from MRAs (max)		Variant II: all effects taken from MRAs (min)	
Marx-Webb coefficient (gamma)		0,30		0,28
Verdoorn coefficient (delta)		0,69		0,44
Demand regime (epsilon)		-0,60		-0,60
Real wage growth (in %)		1,00		1,00
Change in wage share (%)		1,19		0,98
Demand growth (%)		-0,72		-0,59
Verdoorn effect (%)	-0,49		-0,26	
Marx-Webb effect (%)	0,30		0,28	
Productivity growth (%)		-0,19		0,02
Employment growth (%)		-0,52		-0,61

	Variant III:Marx-Webb effect from chapter II (max)		Variant IV:Marx-Webb effect from chapter II (min)	
Marx-Webb coefficient (gamma)		0,31		0,19
Verdoorn coefficient (delta)		0,69		0,44
Demand regime (epsilon)		-0,60		-0,60
Real wage growth (in %)		1,00		1,00
Change in wage share (%)		1,18		1,10
Demand growth (%)		-0,71		-0,66
Verdoorn effect (%)	-0,49		-0,29	
Marx-Webb effect (%)	0,31		0,19	
Productivity growth (%)		-0,18		-0,10
Employment growth (%)		-0,53		-0,56

	Variant V: Both effects from chapter II (max)		Variant VI:Both effects from chapter II (min)	
Marx-Webb coefficient (gamma)		0,31		0,19
Verdoorn coefficient (delta)		0,97		0,36
Demand regime (epsilon)		-0,60		-0,60
Real wage growth (in %)		1,00		1,00
Change in wage share (%)		1,64		1,03
Demand growth (%)		-0,98		-0,62
Verdoorn effect (%)	-0,95		-0,22	
Marx-Webb effect (%)	0,31		0,19	
Productivity growth (%)		-0,64		-0,03
Employment growth (%)		-0,34		-0,59

Table 3.4 – Effects of a 1 %-pt.-increase in real wages on demand growth, productivity growth and employment growth.

(a) Additionally to the results from Chapters I to III, Variants I and II use results from a meta-regression analysis of efficiency wages as a proxy for the Marx-Webb effect (Krassoi Peach and Stanley 2009).

scientific progress. The road is paved with failure to prove existing theories just as much – if not more so – than success. As was already shown much earlier than in the works of Karl Popper, verification, even if repeated a thousand times cannot prove the correctness of a theory. As a result, this common misconception of scientific progress manifests itself in economic journals not accepting econometric studies without statistically significant results. The consequence is a hidden pile of unpublished studies which are not equipped with less statistical power than their published (and more prestigious) cousins. Furthermore, the pressure to submit studies with statistically significant results inflate the reported estimates. Both effects yield to significant overestimation of effects in entire fields of research. This problem is well-known to researchers in meta-analysis. As a consequence the 'Paldam Principle' states that in general, one is advised to divide all reported estimates by 2 no matter the economic journal – be it the *American Economic Review* or the *Journal of Ibn Haldun Studies.*

The issue only becomes more important in economics, as political and economic interests do influence studies and often even create entire think tanks for their own agenda. Meta-regression analysis is spreading quite rapidly in economics, but it still is unknown to most economists. The MRAs in this thesis estimate potential publication bias. If publication bias is found, as is the case in chapter III, we use meta-regression analysis to give unpublished studies the space in science it should have, while reducing the impact of studies that do not merit it. In the MRA in chapter I, we could not find signs for publication bias in the literature on Verdoorn's law. This is a rare occurrence, as the vast majority of conducted meta-regression analysis does find signs of publication bias. In the case of the MRA on the wage-led/profit-led model in chapter III, we do find signs of publication bias in favour of a wage-led demand regime. This implies that there are a number of unpublished studies that find aggregate demand (domestic as well as total) to be profit-led.

With roughly five years of use of meta-analytic tools, we came up with certain ideas on how to reduce the impact of these structural problems. First, the importance of academic studies should not be valued based on pseudo-neutral metrics such as impact factors or the statistical significance of the presented results. Rather, published empirical studies should be ranked based on how many replication studies did not manage to find different results. In the same vein, all empirical studies should have to go through a process similar to pre-registered controlled trials in medicine. All studies would have to me registered before the start, with a clear outline of the research to be undertaken and the methods used. All data sets would need to be published, including the code for the statistical software used together with the published study. These measures would help to reduce the amount of studies 'ending up in the drawer' and never seeing the light of day. Another suggestion lies in an intra-journal agreement on basic statistical data that need to be reported for any econometric results. No meta-regression analyst should have to obtain the number of observations or standard errors/t-statistics by e-mail in 2021 instead of a direct look at an output table (even less so if he is trying to finish his PhD).

A third contribution to the available literature lies in the estimation of Verdoorn's law in chapter I and of demand regimes in chapter III, after controlling for publication bias and study-specific moderator variables. The resulting meta-averages have higher statistical power than the individual estimates in the primary literature and yield more precise results (if an underlying effect actually exists). Both chapters find statistically significant meta-averages for Verdoorn's law and a profit-led demand regime, indicating that in both cases the effect of interest does indeed exist. Furthermore, the MRAs conducted in this thesis allow the reader to comprehend the differences in primary literature estimates in a more detailed way, taking into account differences in estimation methods, control variables used, the specification chosen or the year of publication. Here, the contribution consists in lifting the fog to a certain extend. It is not just about *Kaldor vs. Rowthorn* or *neo-Kaleckians vs. neo-Goodwinians* anymore. With our two MRAs, we do hope to provide a foundation which both (admittedly stylised) opposed sides can use discern difference in economic theory from difference in data or methods used.

The fourth contribution lies in a facilitated way to review the existing literature. Apart from providing concrete numbers on key economic indicators, the point of meta-regression analysis is to summarise the key points in a certain field, including historical origins, potential dividing lines, seminal contributions to the existing literature, extensions and open questions. We do hope that with our present thesis, we did manage to reduce the overall time needed for the interested reader to get an overview of the respective literature by a considerable margin.

Finally, the literature on the Marx-Webb effect is rather small (if one does not equate the literature on efficiency wages with the Marx-Webb effect, that is). The most-often cited papers are Lima (2004), Marquetti (2004), Naastepad (2006), Vergeer and Kleinknecht (2007), Hein and Tarassow (2010), and Storm and Naastepad (2013). Hence the panel data estimation of both Verdoorn's law and the Marx-Webb effect in chapter increases the amount of studies on the topic by another one II constitutes the fifth contribution of this thesis. Most studies on Verdoorn's law and/or the Marx/Webb effect do not take into account potential cross-sectional dependence. Furthermore, most studies do not differentiate between the short run and the long run. Chapter II in this thesis contributes to the available literature in that in takes into account both issues, thereby reducing the risk of potentially biased results. Still, more studies on the

Marx-Webb effect have to be conducted. Maybe at some point in time, this chapter will form part on yet another meta-regression analysis on the Marx-Webb effect one day (after all, following Stanley, Doucouliagos, et al. (2013), the minimal amount of studies needed for a MRA is 2). Until such a study is published, the MRA on efficiency wages by Krassoi Peach and Stanley (2009) can be used as a proxy for the Marx-Webb effect.

Policy Implications Of This Thesis

As a consequence of including the productivity regime and employment regime in post-Keynesian analysis, even under a wage-led demand regime, an increase in employment is not evident at all. Indeed, the political implications are worrying from a trade union perspective. Fighting for higher wages for their members, trade unions might win in the short run. In the long run, however, they will erode their own membership base as fewer trade union members will find themselves to be employed. With falling employment, trade unions lose bargaining power and Capitalism as of itself might not create the necessary jobs. In such a case, a project of state-led employment projects might be the only way forward, for example in the form of public jobs or via decreases in weekly working time.

The case of working time reduction is of particular interest, as contrary to past trends of slow but steady global decreases in average working time, several countries have again extended the average weekly working time since the early 2000s. Examples for this are Germany or France under the current Macron government. In Austria, a new law increased the maximum allowed working time per week from 50 to 60 hours. However, these extensions are quite in opposition to the long-term trend of decreasing working time during the past 150 years. As Figure 3.8 shows, average weekly working

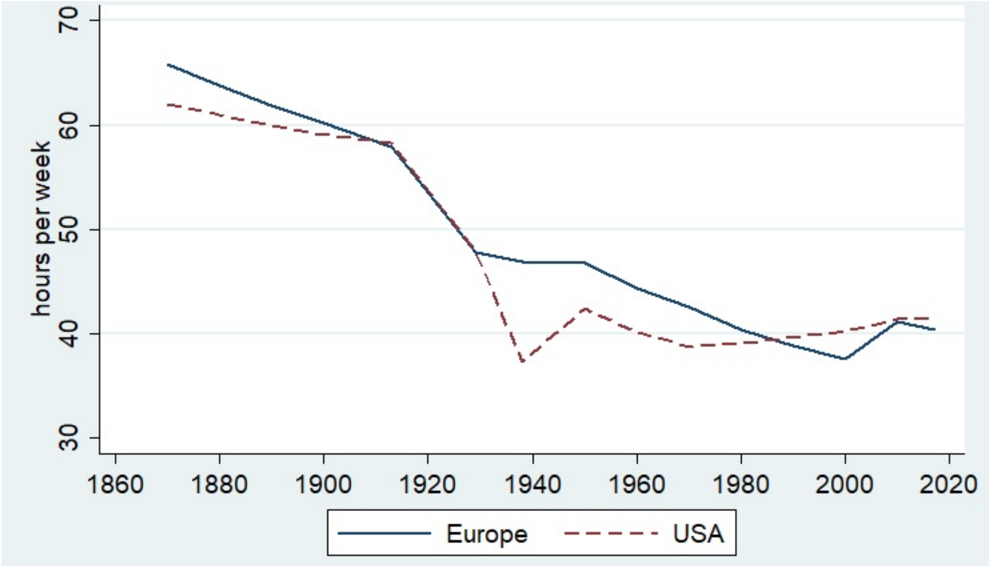

Figure 3.8 – Evolution of Weekly Working Time over 147 Years (full-time equivalents); sources: 1870-2000 – Huberman and Minns (2007) ; 2000-2017 – stats.oecd.org

decreased after the second world war both in Europe and in the United States. This process of decreasing working time was possible due to steady increases in productivity and usually accompanied by an increase in wages. This increase in wages happened in order to account for lost compensation due to less labour time. Working time reduction, accompanied by full wage compensation was the classic demand of trade unions during the 'golden age of capitalism'. This continuous reduction slowed down once the 40-hours-week was achieved. Nevertheless, there are economic circumstances that can facilitate the introduction of reforms concerning working time reduction. For instance, productivity increases determine long-term economic growth and create future possibilities for redistributional measures in a capitalist economy. As we can see in Figure 3.9, there is a clear negative relation between working hours and (labour) productivity in OECD countries in 2017. This relation holds for all the previous years covered by the OECD statistical database.

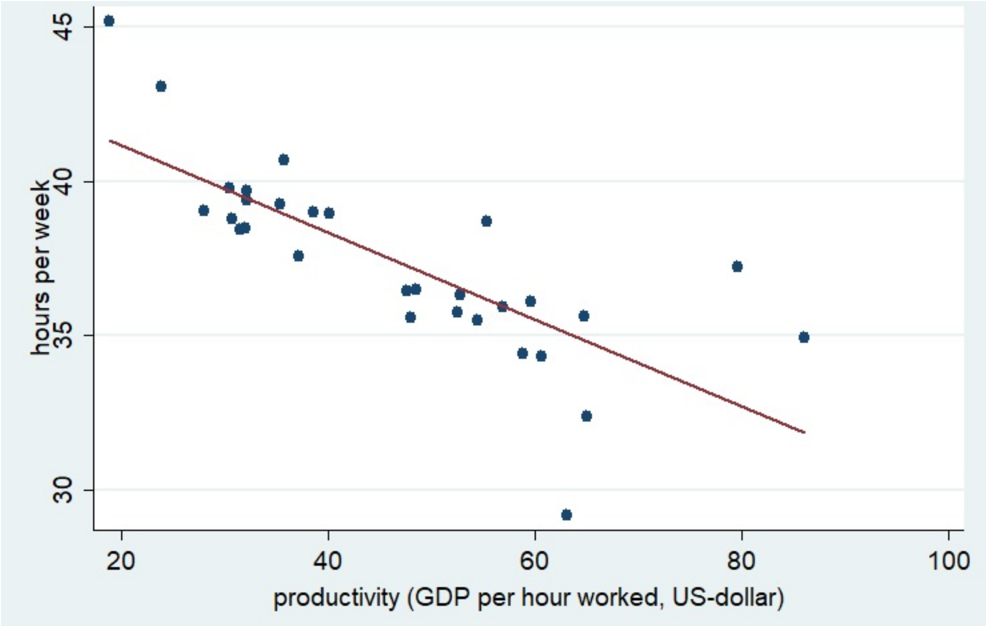

Figure 3.9 – Working Time and Productivity in OECD Countries (2017) in constant prices, 2010 PPPs; source: stats.oecd.org

One reason for this negative relation is that working hours have harmful effects on worker's well-being. Longer working hours are associated with a deterioration of both physiological and psychological health (Sparks et al. 1997). Another way of thinking about the relation between average weekly working hours and productivity is that increases in productivity enable decreases in working time. More productive countries can, therefore, afford reductions in working time with less difficulties. It is important to keep in mind that the effects regarding changes in working hours vary considerably depending on the time span of this change. A reduction in the retirement age has to be interpreted as a decrease in life-long working time, while the introduction of paid holiday weeks represents reductions in yearly working time. A decrease in weekly working hours might change employment structures, with workers switching from part-time to full-time positions. This would have especially strong implications for women, who in most countries represent a much larger share of part-time workers than men. The demands regarding the redistribution of working time and real wages of the international workers movement cannot be properly understood in isolation. Indeed, they have always been linked to the demands of the international women's rights movement for a reduction of working hours and the redistribution reproductive/care work, both inside and outside of the working place.

Following this logic, it is vitally important that the decrease in working time does not constitute one singular event. As was already discussed above, employment might have a tendency to decrease over time. This implies that working time needs to decrease steadily to guarantee the fragile balance between demand growth, productivity growth and employment growth. Following the argument of the 'political business cycle' presented in Kalecki (1943), capitalism in itself might not be able to politically sustain longer periods of full employment. If capitalism as a system of economic and political organisation manages to abolish unemployment and rising inequality in a sustainable way, then a virtuous cycle of rising wages, productivity and full employment is possible. If capitalism is not able to do so – and the short history of humankind is not supportive in that regard – then capitalism as a whole will have to be replaced by another system that is.

Future Areas Of Research

Apart from adjusting shortcomings of the present work, this thesis leaves me with many potential research projects. The following list is a small part of the many ideas occurring over the past six years. As such, the following paragraphs only enumerate some recurring themes that came up time and again.

One obvious area of research consists in the use of meta-regression analysis for other fields of debate among economists in general. The advantage of conducting meta-regression studies is that one necessarily becomes familiar with entire fields of literature and econometric methods. Indeed, the key interest of meta-regression analysis is to explain differences in estimation results in the primary literature in its entirety. Furthermore, the resulting meta-regression analysis has the enormous advantage of enabling the reader to comprehend most of the debate concerning the respective topic by reading one single study instead of dozens or hundreds of studies.

Another interesting potential area of research lies in the combination of meta-regression analysis with bibliometrics. Bibliometrics, the use of statistical instruments to analyse articles, texts and other documents can provide many valuable insights. For example, Fix (2020) uses a word-counting bot to analyse the language used in 43 economics textbooks (called *econospeak* by the author). He then compares each word relative to the number of its uses in the 43 textbooks as well as the general use of the word via Google corpus. As a result Fix (2020) separates econospeak into four groups: the quirks, the jargon, the underused words and the neglected words. One could use one's imagination to do a similar exercise for the top 10 journals by economic schools of thought - for example for the past 10 years. Similarly one could track certain words and their change between groups over time (for example from niche to quirk and back). Since inequality was not a big topic in the economic mainstream before the global financial crisis and the publication of Piketty (2014), one could imagine that the word 'inequality' might have changed from the neglected group to the jargon.

Combining the literature research part of a particular meta-regression analysis with corresponding citation analysis represents another promising area of research. The use of citation networks could help to identify many more suitable primary studies than one would possibly find by only using key words. Furthermore, citation analysis might be used as a suitable metric to represent certain isolated groups of citations, for example because of different schools of thought. In continuation, several moderator variables for the core studies of these different citation clusters could then be used as proxies for different economic schools of thought, something that was can be difficult to code in meta-regression analysis so far.

Typical meta-regression analyses are very work-intensive and time-consuming and need to be carried out with great care as they tend to imply a high propensity of data-error. Leif (2016) present a tool called 'p-curve' which examines the distribution of p-values in any given amount of studies. The idea behind this analysis is that there exist certain threshold values for p-values, which have to be reached in order to be eligible for publication. Researchers will therefore modify their estimation specification until they find statistically significant results (p-hacking). An unusual distribution of p-values around certain thresholds (for example 0.05) might indicate that some studies might be subject to p-hacking. The advantage of the p-curve is that it is easy to use and, as the only metric of interest are p-values, the studies in question need not to share a common topic. One could use the p-curve to analyse for example all studies published in 1988, in journal X or of author or institution Y, all studies with the word 'Z' in title etc.

As was briefly discussed before, it is our belief that the resulting pressures on employment growth described in section IV can only be overcome either by public job programs or through a reduction in weekly working time in the long run. While the effect of working hours reduction on health and productivity is well-documented (Sparks et al. 1997), the literature on the relation between working time reduction and employment however does not agree on the overall effect (Poyntner 2016). Here, meta-regression analysis could be used to explain the differences among respective econometric studies, their methods and their results. For example, do all of them actually estimate the effect of a change in weekly working time? Or do some take into account lifetime working time reduction, most often in form of earlier retirement age. Similarly, an MRA on the effects of a reduction of working time on productivity and/or unit labour costs could be a crucial stepping stone to provide value-added into the existing debate.

With regards to the effects of a change in real wages on productivity, the idea of 'conflict inflation', that is the post-Keynesian idea of distributional struggle driving inflation deserves a re-evaluation. Following Rowthorn (1980), an increase in wages will lead to a distributional struggle between capitalists raising prices to pass on the increase in cost of production and workers demanding higher wages to keep the desired level of real wages. If the increase in wages, both via Verdoorn's law and the Marx-Webb effect, really leads to higher productivity, then productive capacity increases. But if productive capacity increases, then inflationary pressures should weaken in the long run. Ignoring the possibility that this research has possibly already been conducted in Storm and Naastepad (2012), a study using a co-integration approach with an error-correction model could try to distinguish between a short-run effect and a long-run of wage growth on inflation. Following the logic of the argument, the short-run effect of a growth in wages should have a positive effect on inflation while the long-run effect should be weaker, or even negative. This estimation would use firm-level data variables together with variables which act as proxies for political power, such as the employment ratio or trade union coverage. The main result ultimately depends on whether profits get reinvested or distributed amongst share-holders. The value-added here lies in the fact that similar ideas have been portrayed by the French Regulationist school. However, we do know of no empirical study within this economic paradigm yet. The proposed project would therefore lead to a deeper integration between the two schools of thought regarding conflict inflation and the productivity regime.

Working on the meta-regression of the Bhadhuri-Marglin we got curious whether the demand regime would change depending on the kind of public social infrastructure in the respective country. While in Stockhammer, Durand, and List (2016), we distinguish in a limited way between different social welfare regimes and discuss differing growth models, no such thing has been done in the context of the Bhaduri-Marglin model so far. Using Esping-Andersen (1990) as a starting point for the literature research, the idea is to group countries according to the welfare state regimes they are commonly attributed to. According to Esping-Andersen (1990), welfare states vary in their dimensions of de-commodification and stratification, resulting in three stereotypical welfare regimes - the liberal regime, the conservative regime and the social-democratic regime. The question then arises whether certain welfare regimes correspond to specific demand, productivity or employment regimes. Implicitly, this research question touches the issue of policy agency regarding changes between regimes and could provide a new dimension of research to the existing literature.

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Appendix A

Primary Literature Used In MRA On Verdoorn's Law (Chapter I)

Primary Literature Used in MRA on Verdoorn's Law

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Appendix B

Alternative Specifications For Verdoorn's Law (Chapter II)

Table B.1 – Verdoorn's Law in Total Manufacturing (Kaldor specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
value added growth	0.343**	0.031	0.024	0.097
	(0.140)	(0.102)	(0.127)	(0.098)
real wage growth	−0.057	−0.160+		
	(0.067)	(0.045)		
productivity difference growth	0.105	0.103	0.151**	0.155
	(0.065)	(0.088)	(0.075)	(0.099)
L.employment growth	0.213*	0.307**	−0.018	−0.058
	(0.113)	(0.117)	(0.101)	(0.152)
D.Manufacturing share of value added	−0.012		0.006	
	(0.011)		(0.011)	
Manufacturing share of value added		0.023**		0.012
		(0.010)		(0.009)
lr_VA_share_manuf		0.031		−0.102
		(0.039)		(0.101)
lr__cons		−0.608		4.156
		(0.952)		(4.778)
lr_g_EMP		−0.693+		−1.058+
		(0.117)		(0.152)
lr_g_GAP		0.045		0.094
		(0.094)		(0.073)
lr_g_VA_Q		0.125		0.548
		(0.276)		(0.484)
lr_g_real_wages		−0.357**		
		(0.152)		
wage share by industry			−0.297**	0.062
			(0.142)	(0.161)
lr_wshare_by_industry				−2.491
				(2.143)
Constant	0.027	−0.124	0.102	−0.090
	(0.116)	(0.142)	(0.773)	(0.688)
Observations	437	437	437	437
R2	0.18	0.19	0.19	0.20

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.2 – Verdoorn's Law in Total Manufacturing (Kaldor specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
productivity difference (log)	0.099	0.327	0.114	0.267
	(0.211)	(0.197)	(0.209)	(0.239)
LD2.persons employed (1000, log)	−0.003		0.013	
	(0.122)		(0.101)	
L.persons employed (1000, log)		0.450+		0.368***
		(0.080)		(0.110)
D.value added (log)	0.281		0.109	
	(0.197)		(0.210)	
value added (log)		0.551+		0.542+
		(0.118)		(0.128)
D.real wages (log)	−0.256***			
	(0.094)			
real wages (log)		−0.092		
		(0.071)		
D.Manufacturing share of value added	−0.022		−0.022	
	(0.018)		(0.022)	
Manufacturing share of value added		−0.010		−0.006
		(0.009)		(0.007)
lr_VA_share_manuf		−0.120		0.153
		(0.101)		(0.183)
lr__cons		−89.111		−4.244
		(73.630)		(4.398)
lr_ln_EMP		−0.550+		−0.632+
		(0.080)		(0.110)
lr_ln_GAP		25.690		1.021
		(25.888)		(0.848)
lr_ln_VA_Q		11.055		1.033+
		(10.363)		(0.217)
lr_ln_real_wages		−2.435		
		(3.582)		
D.wage share by industry			−0.090	
			(0.182)	
wage share by industry				0.239*
				(0.127)
lr_wshare_by_industry				−0.307
				(0.961)
Constant	3.160	1.825	1.779	0.764
	(3.273)	(1.215)	(2.071)	(1.062)
Observations	324	360	324	360
R2	0.13	0.06	0.19	0.06

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.3 – Verdoorn's Law in Manufacturing Sub-sectors (Kaldor specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
value added growth	0.268+	0.278+	0.204+	0.237+
	(0.028)	(0.026)	(0.032)	(0.049)
real wage growth	−0.236+	−0.244+		
	(0.024)	(0.023)		
productivity difference growth	0.112+	0.116+	0.114+	0.130+
	(0.022)	(0.021)	(0.023)	(0.024)
L.employment growth	−0.001	0.007	−0.074**	−0.116+
	(0.027)	(0.027)	(0.031)	(0.034)
D.Manufacturing share of value added	0.009*		0.003	
	(0.005)		(0.005)	
Manufacturing share of value added		0.004		0.005
		(0.003)		(0.004)
lr_VA_share_manuf		0.032*		0.004
		(0.017)		(0.015)
lr__cons		−1.211*		−4.555
		(0.734)		(3.701)
lr_g_EMP		−0.993+		−1.116+
		(0.027)		(0.034)
lr_g_GAP		0.021		−0.049
		(0.075)		(0.127)
lr_g_VA_Q		0.284+		−0.253
		(0.077)		(0.288)
lr_g_real_wages		−0.269+		
		(0.075)		
wage share by industry			0.041	0.101
			(0.056)	(0.065)
lr_wshare_by_industry				−0.245
				(0.248)
Constant	−0.082	0.039	−0.409	−1.321
	(0.177)	(0.259)	(0.530)	(0.831)
Observations	5757	5757	5757	5757
R2	0.21	0.21	0.27	0.25

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.4 – Verdoorn's Law in Manufacturing Sub-sectors (Kaldor specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
value added (log)	0.180***	0.346+	0.101	0.305+
	(0.055)	(0.031)	(0.066)	(0.033)
real wages (log)	−0.181+	−0.247+		
	(0.052)	(0.026)		
productivity difference (log)	0.201***	0.166+	0.161*	0.180+
	(0.067)	(0.030)	(0.086)	(0.037)
LD2.persons employed (1000, log)	−0.054*		−0.062*	
	(0.031)		(0.032)	
L.persons employed (1000, log)		0.246+		0.260+
		(0.031)		(0.036)
D.Manufacturing share of value added	0.011		0.014	
	(0.008)		(0.010)	
Manufacturing share of value added		0.004		0.008*
		(0.005)		(0.005)
lr_VA_share_manuf		−0.133		−0.022
		(0.085)		(0.045)
lr__cons		−9.480		1.785
		(7.575)		(2.064)
lr_ln_EMP		−0.754+		−0.740+
		(0.031)		(0.036)
lr_ln_GAP		−0.109		0.438**
		(0.368)		(0.223)
lr_ln_VA_Q		0.121		0.661**
		(0.531)		(0.298)
lr_ln_real_wages		0.079		
		(0.368)		
wage share by industry			0.059	0.246+
			(0.108)	(0.057)
lr_wshare_by_industry				0.562+
				(0.170)
Constant	0.731	−0.065	1.610**	−0.114
	(0.818)	(0.469)	(0.810)	(0.518)
Observations	3636	4040	3636	4040
R2	0.20	0.10	0.22	0.12

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.5 – Verdoorn's Law in All Main Sectors (Kaldor specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
value added growth	0.391+ (0.029)	0.397+ (0.028)	0.305+ (0.034)	0.293+ (0.032)
real wage growth	−0.239+ (0.024)	−0.239+ (0.025)		
productivity difference growth	0.139+ (0.031)	0.163+ (0.031)	0.168+ (0.030)	0.168+ (0.031)
L.employment growth	0.092+ (0.026)	0.057** (0.028)	−0.006 (0.026)	−0.075*** (0.027)
D.Manufacturing share of value added	0.004 (0.003)		0.009* (0.005)	
Manufacturing share of value added		0.004 (0.003)		0.002 (0.003)
lr_VA_share_manuf		0.008 (0.007)		−0.004 (0.006)
lr__cons		−0.087 (0.225)		0.836 (0.683)
lr_g_EMP		−0.943+ (0.028)		−1.075+ (0.027)
lr_g_GAP		0.023 (0.103)		0.034 (0.116)
lr_g_VA_Q		0.123 (0.219)		0.083 (0.117)
lr_g_real_wages		−0.118 (0.167)		
wage share by industry			0.044 (0.098)	0.336** (0.156)
lr_wshare_by_industry				0.302* (0.163)
Constant	−0.109** (0.052)	−0.154** (0.067)	0.144 (0.161)	−0.028 (0.163)
Observations	7106	7106	7106	7106
R2	0.14	0.13	0.17	0.19

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.6 – Verdoorn's Law in All Main Sectors (Kaldor specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wages (log)	−0.137+ (0.041)	−0.247+ (0.025)		
productivity difference (log)	0.118** (0.056)	0.203+ (0.048)	0.204+ (0.055)	0.299+ (0.045)
LD.persons employed (1000, log)	−0.262+ (0.037)		−0.311+ (0.037)	
L.persons employed (1000, log)		0.174+ (0.030)		0.146+ (0.029)
D.value added (log)	0.216+ (0.038)		0.190+ (0.042)	
value added (log)		0.431+ (0.032)		0.445+ (0.038)
D.Manufacturing share of value added	−0.001 (0.006)		0.002 (0.005)	
Manufacturing share of value added		−0.007 (0.004)		−0.006 (0.004)
lr_VA_share_manuf		−0.056 (0.056)		−0.005 (0.008)
lr__cons		−3.378 (2.382)		2.878 (3.891)
lr_ln_EMP		−0.826+ (0.030)		−0.854+ (0.029)
lr_ln_GAP		0.731 (0.513)		0.088 (0.298)
lr_ln_VA_Q		0.638+ (0.084)		0.080 (0.404)
lr_ln_real_wages		−0.599*** (0.230)		
wage share by industry			0.289 (0.221)	0.362+ (0.094)
lr_wshare_by_industry				0.020 (0.281)
Constant	−1.976** (0.911)	−0.317 (0.759)	−1.660** (0.744)	−1.318** (0.628)
Observations	4351	4580	4351	4580
R2	0.15	0.04	0.18	0.08

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.7 – Verdoorn's Law in Total Manufacturing (Rowthorn1 specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wage growth	0.110	0.178		
	(0.109)	(0.123)		
employment growth	0.449*	0.406	−0.025	−0.349
	(0.231)	(0.245)	(0.235)	(0.999)
productivity difference growth	−0.164*	−0.310***	−0.026	0.001
	(0.090)	(0.099)	(0.066)	(0.152)
L.value added growth	−0.067	−0.133**	−0.091	−0.305***
	(0.050)	(0.056)	(0.056)	(0.110)
D.Manufacturing share of value added	0.066+		0.072+	
	(0.011)		(0.010)	
Manufacturing share of value added		0.032***		0.018
		(0.010)		(0.011)
lr_VA_share_manuf		0.030***		0.015*
		(0.011)		(0.008)
lr__cons		−0.286		−4.531**
		(0.293)		(2.134)
lr_g_EMP		0.383*		−1.272
		(0.224)		(1.705)
lr_g_GAP		−0.273***		0.036
		(0.089)		(0.133)
lr_g_VA_Q		−1.133+		−1.305+
		(0.056)		(0.110)
lr_g_real_wages		0.246*		
		(0.127)		
wage share by industry			−0.388***	−0.712***
			(0.117)	(0.255)
lr_wshare_by_industry				−0.682**
				(0.292)
Constant	0.150	−0.270	−1.059*	−3.754**
	(0.126)	(0.320)	(0.613)	(1.450)
Observations	437	437	437	437
R2	0.03	0.17	0.03	0.08

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.8 – Verdoorn's Law in Total Manufacturing (Rowthorn1 specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
productivity difference (log)	0.027	−0.531**	−0.040	−0.702**
	(0.109)	(0.234)	(0.153)	(0.302)
LD2.value added (log)	0.040		0.016	
	(0.032)		(0.026)	
L.value added (log)		0.028		0.069
		(0.053)		(0.056)
D.persons employed (1000, log)	0.238		0.202	
	(0.147)		(0.153)	
persons employed (1000, log)		0.490+		0.629+
		(0.108)		(0.150)
D.real wages (log)	0.152***			
	(0.052)			
real wages (log)		0.067		
		(0.062)		
D.Manufacturing share of value added	0.060+		0.064+	
	(0.009)		(0.010)	
Manufacturing share of value added		0.038+		0.028***
		(0.007)		(0.010)
lr_VA_share_manuf		0.042+		0.035***
		(0.009)		(0.011)
lr__cons		0.440		−0.972
		(1.614)		(1.680)
lr_ln_EMP		0.489+		0.630+
		(0.121)		(0.142)
lr_ln_GAP		−0.610**		−0.719**
		(0.297)		(0.278)
lr_ln_VA_Q		−0.972+		−0.931+
		(0.053)		(0.056)
lr_ln_real_wages		0.046		
		(0.077)		
D.wage share by industry			−0.074	
			(0.136)	
wage share by industry				−0.415+
				(0.110)
lr_wshare_by_industry				−0.524+
				(0.139)
Constant	0.400	0.087	−0.757	−0.816
	(1.349)	(1.352)	(1.383)	(1.339)
Observations	324	360	324	360
R2	0.04	0.04	0.05	0.04

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.9 – Verdoorn's Law in Manufacturing Sub-sectors (Rowthorn1 specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wage growth	0.273***	0.342+		
	(0.090)	(0.074)		
employment growth	0.971+	0.988+	0.863**	0.791**
	(0.284)	(0.270)	(0.378)	(0.389)
productivity difference growth	−0.321***	−0.320+	−0.166+	−0.126**
	(0.106)	(0.077)	(0.039)	(0.052)
L.value added growth	−0.129+	−0.148+	−0.202+	−0.197+
	(0.027)	(0.026)	(0.032)	(0.028)
D.Manufacturing share of value added	0.024*		−0.026	
	(0.014)		(0.033)	
Manufacturing share of value added		0.018**		−0.011
		(0.009)		(0.030)
lr_VA_share_manuf		0.006		−0.004
		(0.012)		(0.026)
lr__cons		2.073***		0.604
		(0.691)		(3.692)
lr_g_EMP		0.757***		0.640*
		(0.275)		(0.331)
lr_g_GAP		−0.303+		−0.089**
		(0.077)		(0.045)
lr_g_VA_Q		−1.148+		−1.197+
		(0.026)		(0.028)
lr_g_real_wages		0.257		
		(0.186)		
wage share by industry			−0.495+	−0.518+
			(0.102)	(0.085)
lr_wshare_by_industry				−0.407+
				(0.086)
Constant	0.632	1.589**	−0.746	1.113
	(0.610)	(0.740)	(2.907)	(4.638)
Observations	5757	5757	5757	5757
R2	0.17	0.14	0.22	0.16

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.10 – Verdoorn's Law in Manufacturing Sub-sectors (Rowthorn1 specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wages (log)	0.313+	0.358+		
	(0.044)	(0.045)		
productivity difference (log)	−0.306+	−0.360+	−0.293+	−0.311+
	(0.040)	(0.054)	(0.045)	(0.044)
L.value added (log)	0.341+	0.039	0.355+	0.121+
	(0.038)	(0.029)	(0.036)	(0.029)
D.persons employed (1000, log)	0.392+		0.236+	
	(0.091)		(0.054)	
persons employed (1000, log)		0.665+		0.663+
		(0.091)		(0.084)
D.Manufacturing share of value added	0.026***		0.015	
	(0.009)		(0.010)	
Manufacturing share of value added		0.042+		0.030**
		(0.010)		(0.014)
lr_VA_share_manuf		0.045+		0.064
		(0.012)		(0.040)
lr__cons		−0.281		5.777
		(1.283)		(5.247)
lr_ln_EMP		0.722+		−0.519
		(0.109)		(1.025)
lr_ln_GAP		−0.405+		−0.036
		(0.078)		(0.253)
lr_ln_VA_Q		−0.961+		−0.879+
		(0.029)		(0.029)
lr_ln_real_wages		0.465+		
		(0.065)		
wage share by industry			−0.627+	−0.685+
			(0.075)	(0.067)
lr_wshare_by_industry				−0.207
				(0.425)
Constant	−0.235	0.331	−0.252	−0.223
	(0.890)	(1.238)	(1.093)	(1.235)
Observations	4040	4040	4040	4040
R2	0.14	0.13	0.14	0.11

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.11 – Verdoorn's Law in All Main Sectors (Rowthorn1 specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wage growth	0.356+	0.364+		
	(0.032)	(0.031)		
employment growth	0.643+	0.555+	0.454+	0.494+
	(0.056)	(0.068)	(0.064)	(0.067)
productivity difference growth	−0.200+	−0.226+	−0.240+	−0.260+
	(0.035)	(0.031)	(0.035)	(0.037)
L.value added growth	−0.076***	−0.096+	−0.179+	−0.173+
	(0.024)	(0.025)	(0.024)	(0.027)
D.Manufacturing share of value added	−0.005		0.002	
	(0.004)		(0.005)	
Manufacturing share of value added		−0.005		−0.005
		(0.004)		(0.004)
lr_VA_share_manuf		−0.006		0.016
		(0.008)		(0.014)
lr__cons		0.343		1.029*
		(0.266)		(0.592)
lr_g_EMP		0.851**		0.600+
		(0.358)		(0.145)
lr_g_GAP		−0.270+		−0.252+
		(0.068)		(0.047)
lr_g_VA_Q		−1.096+		−1.173+
		(0.025)		(0.027)
lr_g_real_wages		0.460+		
		(0.096)		
wage share by industry			−0.428+	−0.682+
			(0.105)	(0.144)
lr_wshare_by_industry				−0.532**
				(0.231)
Constant	0.168+	0.105	0.361	0.346
	(0.049)	(0.090)	(0.221)	(0.301)
Observations	7106	7106	7106	7106
R2	0.15	0.16	0.18	0.17

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.12 – Verdoorn's Law in All Main Sectors (Rowthorn1 specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wages (log)	0.172*** (0.053)	0.334+ (0.037)		
productivity difference (log)	−0.333+ (0.073)	−0.432+ (0.060)	−0.365+ (0.075)	−0.377+ (0.048)
LD.value added (log)	−0.436+ (0.032)		−0.356+ (0.029)	
L.value added (log)		0.018 (0.034)		0.077*** (0.028)
D.persons employed (1000, log)	0.414+ (0.103)		0.314+ (0.062)	
persons employed (1000, log)		0.572+ (0.064)		0.580+ (0.051)
D.Manufacturing share of value added	−0.013* (0.007)		−0.001 (0.006)	
Manufacturing share of value added		−0.004 (0.006)		−0.006 (0.004)
lr_VA_share_manuf		0.007 (0.013)		0.003 (0.015)
lr__cons		−0.944 (3.173)		3.798** (1.538)
lr_ln_EMP		0.769+ (0.141)		0.744+ (0.123)
lr_ln_GAP		−0.553+ (0.149)		−0.525+ (0.085)
lr_ln_VA_Q		−0.982+ (0.034)		−0.923+ (0.028)
lr_ln_real_wages		0.454+ (0.124)		
wage share by industry			−0.749+ (0.153)	−0.631+ (0.121)
lr_wshare_by_industry				−0.668** (0.319)
Constant	−1.398 (1.510)	2.101** (0.921)	2.424** (0.964)	2.109*** (0.659)
Observations	4351	4580	4351	4580
R2	0.16	0.05	0.13	0.07

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.13 – Verdoorn's Law in Total Manufacturing (Rowthorn2 specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wage growth	0.069	0.188		
	(0.101)	(0.114)		
employment growth	−0.546***	−0.697***	−1.053+	−1.337
	(0.199)	(0.233)	(0.288)	(0.983)
productivity difference growth	−0.171*	−0.325***	−0.047	−0.075
	(0.094)	(0.103)	(0.076)	(0.131)
L.g_gdpperworker	−0.060	−0.144**	−0.141***	−0.291+
	(0.045)	(0.072)	(0.051)	(0.083)
D.Manufacturing share of value added	0.065+		0.069+	
	(0.010)		(0.008)	
Manufacturing share of value added		0.035***		0.020
		(0.010)		(0.014)
lr_VA_share_manuf		0.032+		0.019**
		(0.009)		(0.009)
lr__cons		−0.331		−4.119**
		(0.297)		(1.671)
lr_g_EMP		−0.483*		−1.989
		(0.256)		(1.546)
lr_g_GAP		−0.299***		−0.027
		(0.111)		(0.102)
lr_g_gdpperworker		−1.144+		−1.291+
		(0.072)		(0.083)
lr_g_real_wages		0.359*		
		(0.194)		
wage share by industry			−0.420***	−0.762***
			(0.133)	(0.256)
lr_wshare_by_industry				−0.636**
				(0.265)
Constant	0.136	−0.259	−1.592**	−3.961***
	(0.120)	(0.339)	(0.627)	(1.280)
Observations	437	437	437	437
R2	0.03	0.17	0.03	0.08

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.14 – Verdoorn's Law in Total Manufacturing (Rowthorn2 specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
productivity difference (log)	−0.104	−0.489**	−0.261	−0.804**
	(0.164)	(0.244)	(0.166)	(0.400)
LD.productivity (log)	−0.013		−0.050	
	(0.045)		(0.049)	
L.productivity (log)		0.008		−0.027
		(0.059)		(0.067)
D.persons employed (1000, log)	−0.681+		−0.638+	
	(0.116)		(0.110)	
persons employed (1000, log)		−0.457+		−0.303*
		(0.089)		(0.167)
D.real wages (log)	0.075*			
	(0.044)			
real wages (log)		0.071		
		(0.063)		
D.Manufacturing share of value added	0.060+		0.057+	
	(0.008)		(0.011)	
Manufacturing share of value added		0.040+		0.025*
		(0.006)		(0.014)
lr_VA_share_manuf		0.043+		0.034***
		(0.007)		(0.012)
lr__cons		0.287		0.025
		(1.566)		(1.995)
lr_ln_EMP		−0.522+		−0.432**
		(0.119)		(0.176)
lr_ln_GAP		−0.528*		−0.631**
		(0.268)		(0.291)
lr_ln_gdpperworker		−0.992+		−1.027+
		(0.059)		(0.067)
lr_ln_real_wages		0.074		
		(0.067)		
D.wage share by industry			−0.329***	
			(0.112)	
wage share by industry				−0.376***
				(0.121)
lr_wshare_by_industry				−0.355***
				(0.129)
Constant	0.871	0.077	−1.944*	−0.402
	(1.226)	(1.344)	(1.096)	(1.708)
Observations	342	360	342	360
R2	0.05	0.07	0.04	0.06

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.15 – Verdoorn's Law in Manufacturing Sub-sectors (Rowthorn2 specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wage growth	0.266*** (0.088)	0.345+ (0.071)		
employment growth	0.007 (0.323)	−0.079 (0.290)	−0.312 (0.320)	−0.169 (0.400)
productivity difference growth	−0.311*** (0.105)	−0.272+ (0.074)	−0.167+ (0.041)	−0.146+ (0.044)
L.g_gdpperworker	−0.112+ (0.029)	−0.126+ (0.026)	−0.202+ (0.026)	−0.191+ (0.025)
D.Manufacturing share of value added	0.020 (0.014)		−0.030 (0.038)	
Manufacturing share of value added		0.012 (0.009)		−0.022 (0.033)
lr_VA_share_manuf		0.122 (0.089)		0.086 (0.105)
lr__cons		−4.697 (6.551)		−38.442 (38.998)
lr_g_EMP		−1.383 (1.140)		−2.011 (1.746)
lr_g_GAP		−0.337+ (0.102)		0.092 (0.260)
lr_g_gdpperworker		−1.126+ (0.026)		−1.191+ (0.025)
lr_g_real_wages		0.436 (0.283)		
wage share by industry			−0.492+ (0.089)	−0.568+ (0.087)
lr_wshare_by_industry				0.447 (1.015)
Constant	1.134 (0.917)	2.168** (1.001)	−1.930 (2.933)	−0.661 (3.836)
Observations	5757	5757	5757	5757
R2	0.18	0.15	0.27	0.21

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.16 – Verdoorn's Law in Manufacturing Sub-sectors (Rowthorn2 specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wages (log)	0.433+	0.352+		
	(0.043)	(0.048)		
productivity difference (log)	−0.336+	−0.360+	−0.393+	−0.334+
	(0.042)	(0.054)	(0.049)	(0.046)
L.productivity (log)	0.196+	−0.005	0.242+	0.054*
	(0.031)	(0.034)	(0.031)	(0.029)
D.persons employed (1000, log)	−0.136		−0.377+	
	(0.089)		(0.052)	
persons employed (1000, log)		−0.360+		−0.276***
		(0.092)		(0.091)
D.Manufacturing share of value added	0.033+		0.016*	
	(0.008)		(0.009)	
Manufacturing share of value added		0.034+		0.025*
		(0.010)		(0.015)
lr_VA_share_manuf		−0.132		0.075+
		(0.178)		(0.022)
lr__cons		4.710		−0.095
		(4.594)		(1.892)
lr_ln_EMP		1.676		−0.562***
		(2.185)		(0.182)
lr_ln_GAP		−0.928		−0.224*
		(0.585)		(0.119)
lr_ln_gdpperworker		−1.005+		−0.946+
		(0.034)		(0.029)
lr_ln_real_wages		0.687***		
		(0.259)		
wage share by industry			−0.774+	−0.641+
			(0.079)	(0.074)
lr_wshare_by_industry				−0.779+
				(0.137)
Constant	−0.093	0.942	0.149	−0.037
	(0.806)	(1.278)	(1.060)	(1.222)
Observations	4040	4040	4040	4040
R2	0.13	0.13	0.12	0.10

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.17 – Verdoorn's Law in All Main Sectors (Rowthorn2 specification, growth rates, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wage growth	0.332+	0.357+		
	(0.032)	(0.030)		
employment growth	−0.401+	−0.396+	−0.605+	−0.548+
	(0.057)	(0.063)	(0.067)	(0.063)
productivity difference growth	−0.177+	−0.234+	−0.217+	−0.233+
	(0.043)	(0.042)	(0.035)	(0.036)
L.g_gdpperworker	−0.082+	−0.111+	−0.147+	−0.153+
	(0.024)	(0.025)	(0.022)	(0.024)
D.Manufacturing share of value added	−0.008*		0.005	
	(0.005)		(0.005)	
Manufacturing share of value added		−0.005		−0.003
		(0.003)		(0.004)
lr_VA_share_manuf		−0.018		−0.012
		(0.025)		(0.010)
lr__cons		0.184		1.013
		(0.540)		(1.032)
lr_g_EMP		0.812		−0.194
		(0.960)		(0.638)
lr_g_GAP		−0.090		−0.266+
		(0.134)		(0.065)
lr_g_gdpperworker		−1.111+		−1.153+
		(0.025)		(0.024)
lr_g_real_wages		−0.120		
		(0.403)		
wage share by industry			−0.389+	−0.650+
			(0.085)	(0.113)
lr_wshare_by_industry				−0.698**
				(0.280)
Constant	0.151**	0.186*	0.386*	0.661***
	(0.071)	(0.099)	(0.217)	(0.250)
Observations	7106	7106	7106	7106
R2	0.11	0.12	0.14	0.13

* p< 0.1 ** p < 0.05, *** p < 0.01, + p < 0.001; standard errors in parentheses.

Table B.18 – Verdoorn's Law in All Main Sectors (Rowthorn2 specification, logarithms, 23 countries)

	real wages		wage share	
	(1) Dynamic CCE	(2) CS-ARDL	(3) Dynamic CCE	(4) CS-ARDL
real wages (log)	0.311+	0.266+		
	(0.032)	(0.047)		
productivity difference (log)	−0.434+	−0.449+	−0.437+	−0.365+
	(0.060)	(0.062)	(0.051)	(0.049)
L.productivity (log)	0.146+		0.250+	0.017
	(0.032)		(0.032)	(0.024)
D.persons employed (1000, log)	−0.139*		−0.216+	
	(0.075)		(0.056)	
persons employed (1000, log)		−0.587***		−0.399+
		(0.178)		(0.052)
D.Manufacturing share of value added	−0.003		−0.002	
	(0.005)		(0.004)	
Manufacturing share of value added		−0.005		−0.004
		(0.009)		(0.004)
L.g_gdpperworker		−0.034		
		(0.025)		
lr_VA_share_manuf		−0.067		−0.006
		(0.065)		(0.008)
lr__cons		1.637		2.480***
		(2.987)		(0.940)
lr_g_gdpperworker		−1.034+		
		(0.025)		
lr_ln_EMP		−0.473*		−0.393***
		(0.274)		(0.135)
lr_ln_GAP		−0.400+		−0.314+
		(0.110)		(0.079)
lr_ln_real_wages		0.165*		
		(0.099)		
wage share by industry			−0.711+	−0.678+
			(0.167)	(0.151)
lr_ln_gdpperworker				−0.983+
				(0.024)
lr_wshare_by_industry				−0.346
				(0.526)
Constant	0.649	3.340*	1.789***	1.919***
	(0.906)	(1.841)	(0.635)	(0.705)
Observations	4580	4580	4580	4580
R2	0.06	0.04	0.08	0.07

* $p < 0.1$ ** $p < 0.05$, *** $p < 0.01$, + $p < 0.001$; standard errors in parentheses.

Appendix C

Primary Literature Used In MRA On The Bhadhuri-Marglin Model (Chapter III)

Primary Literature Used In MRA On The Bhadhuri-Marglin Model (Chapter III)

Allain, Olivier and Nicolas Canry (2007). *Distribution and Growth in France (1982-2006): A Cointegrated VAR Approach*. Post-Print and Working Papers. Université Paris1 Panthéon-Sorbonne.

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Contents

Income Distribution, Productivity and Stagnation
An Alternative to the 'Secular Stagnation'-Narrative

Abstract

Since the Global Financial Crisis in 2007, mainstream economics debate has revolved around the possibility of 'secular stagnation', that is, a prolonged period of no or very low GDP growth. Adherents of the secular stagnation-narrative usually find possible explanations in imperfect capital markets, demographic change and capital-saving rather than capital-using innovations. The aim of the present PhD thesis is to present an alternative to the secular stagnation-narrative, by connecting income distribution, demand and productivity. We argue that increasing income inequality led to lower aggregate demand and productivity. Stagnation is not secular but human-made and measures can be taken to combat it. Chapter I is dedicated to Verdoorn's law – the link between output growth and productivity growth. While the overwhelming majority of empirical studies finds statistically significant and positive results for Verdoorn's law, there is no consensus about its magnitude. Using meta regression analysis (MRA) on 52 studies with 665 estimations of Verdoorn's law, we find no publication bias and statistically significant meta-averages for Verdoorn's law in all specifications used by Verdoorn (1949), Kaldor (1975), and Rowthorn (1975). Apart from Rowthorn's first specification, all used specifications yield Verdoorn coefficients between 0.44 and 0.69 which indicate increasing returns to scale.

Chapter II estimates Verdoorn's law and the Marx-Webb effect based on data for 23 EU28 members for the period 1995-2017 using the EU-KLEMS data set (Stehrer et al. 2019). As EU-KLEMS separates by sector, the panel data analysis can differentiate between manufacturing and non-manufacturing sectors. Our contribution to the existing literature consists in 1) the
3936 use of auto-regressive distributed lag (ARDL) models, in order to separate between short-run Okun effects and long-run Verdoorn effects. Another contribution lies in the fact that, contrary to most of the available literature on Verdoorn's law and the Marx-Webb effect, the analysis undertaken controls for potential cross-sectional dependence. Again, our analysis finds statistically significant Verdoorn coefficients – between 0.378 and 0.966 – and statistically significant Marx-Webb effects – between 0.193 and 0.315.

Chapter III again uses meta-regression analysis to provide an overview of the literature on the Bhadhuri-Marglin model. Most industrial countries have experienced a long-term fall in the wage share since the 1970s. Thus, there has been a shift in the functional distribution from wages to profits with consequences for economic growth. The overall strength of the approach consists in presenting a compromise between the neo-Kaleckian and neo-Goodwinian views of how changes in income distribution affect economic growth. The estimation results can thus be directly used for policy recommendations and are thus (at least amongst heterodoxy) subject to great debates. Two problems arise out of this. First, there is a strong split between wage-led and profit-led country results which are assumed to be partly explained by differences in estimation methodology. Therefore, there exists a need for a definitive answer how strongly these differences affect the overall outcome. This meta-regression analysis assesses 34 studies with 494 empirical estimates for domestic and total demand. Here, the MRA finds indications of small-magnitude publication bias in favour of wage-led demand regimes. More precisely, the average country is found to be wage-led when analysing domestic demand and profit-led in the case of total demand.

Keywords: wages, productivity, wage-led, profit-led, verdoorn's law, meta-regression analysis, marx-webb effect

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Résumé

Depuis la crise financière mondiale de 2007, le débat économique dominant s'articule autour de la possibilité d'une "stagnation séculaire", c'est-à-dire une période prolongée de croissance nulle ou très faible du PIB. Les partisans de la stagnation séculaire trouvent généralement des explications possibles dans l'imperfection des marchés des capitaux, les changements démographiques et les innovations qui économisent le capital plutôt que de l'utiliser.

L'objectif de cette thèse thèse de doctorat est de présenter une alternative au récit de la stagnation séculaire, en reliant la distribution des revenus, la demande et la productivité. Nous soutenons qu'inégalité croissante des revenus entraîne une baisse de demande globale et la productivité. La stagnation n'est pas séculaire mais d'origine humaine et des mesures peuvent être prises pour la combattre. Le chapitre I est consacré à la loi de Verdoorn – le lien entre la croissance de la production et la croissance de la productivité. Si l'écrasante majorité des études empiriques semble trouver des résultats statistiquement significatifs et positifs pour la loi de Verdoorn, il n'y a pas de consensus à propos de son ampleur. En utilisant une méta-analyse (MRA) sur 52 études avec 665 estimations de la loi de Verdoorn, nous ne trouvons aucun biais de publication et des méta-moyennes statistiquement significatives pour la loi de Verdoorn dans toutes les spécifications utilisées par Verdoorn (1949), Kaldor (1975) et Rowthorn (1975). Hormis la première spécification de Rowthorn, toutes les spécifications utilisées donnent des coefficients de Verdoorn compris entre $0,44$ et $0,69$ qui indiquent des rendements d'échelle croissants.

Le chapitre II estime la loi de Verdoorn et l'effet Marx-Webb sur la base des données de 23 membres de l'UE28 pour la période 1995-2017 en utilisant l'ensemble de données EU-KLEMS (Stehrer et al. 2019). Comme EU-KLEMS permet l'analyse par secteur, l'analyse des données de panel peut différencier les secteurs manufacturiers et non manufacturiers. Notre contribution à
3938 la littérature existante consiste en 1) l'utilisation de modèles ARDL (auto-regressive distributed lag), afin de séparer les effets Okun à court terme des effets Verdoorn à long terme. Une autre contribution réside dans le fait que, contrairement à la plupart de la littérature disponible sur la loi de Verdoorn et l'effet Marx-Webb, l'analyse entreprise contrôle la dépendance transversale potentielle. Encore une fois, notre analyse trouve des coefficients de Verdoorn statistiquement significatifs – entre $0,38$ et $0,97$ – et des effets Marx-Webb statistiquement significatifs – entre $0,19$ et $0,32$.

Le chapitre III utilise à nouveau la méta-régression pour donner un aperçu de la littérature sur le modèle de Bhadhuri-Marglin. La plupart des pays industriels ont connu une baisse de la part des salaires depuis les années 1970. Il y a donc eu une déformation du partage de la valeur ajoutée en faveur des profits, avec des conséquences sur la croissance économique. L'originalité de notre approche consiste à présenter un compromis entre les points de vue néo-Kaleckien et néo-Goodwinien sur la façon dont les changements dans la distribution des revenus affectent la croissance économique. Les résultats de l'estimation peuvent donc être directement utilisés pour des recommandations politiques et sont donc sujets de grands débats. Deux problèmes en découlent (au moins parmi les hétérodoxes). Tout d'abord, il existe un fort clivage entre les résultats des pays tirés par les salaires et ceux des pays tirés par les bénéfices, qui s'expliquerait en partie par des différences dans la méthodologie d'estimation. Il est donc nécessaire d'apporter une réponse tranchée à la question de la mesure dans laquelle ces différences affectent le résultat global. Cette analyse de méta-régression évalue 34 études avec 494 estimations empiriques pour la demande intérieure et totale. Ici, la méta-régression trouve des indications d'un biais de publication de faible ampleur en faveur des régimes de demande tirés par les salaires. Plus précisément, on constate que le pays moyen est wage-led lorsqu'on analyse la demande intérieure et profit-led dans le cas de la demande totale.

Mots clés : salaires, productivité, wage-led, profit-led, loi de verdoorn, analyse méta-régression, effet marx-webb