GROWTH AND PRODUCER PRICES IN LATIN AMERICA

by

ANDREA LANGE

A dissertation submitted to the Graduate Faculty in Economics in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

2007

UMI Number: 3245099

UMI Microform 3245099

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This manuscript has been read and accepted for the Graduate Faculty in Economics in satisfaction of the dissertation requirements for the degree of Doctor of Philosophy.

Dec. 26, 2006
Date

David Laibman, Chair of Examining Committee

Thom Thurston, Executive Officer

Dr. David Laibman

Dr. Gayle DeLong

Dr. Michael Grossman
Supervisory Committee

THE CITY UNIVERSITY OF NEW YORK

Abstract

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Andrea Lange

Adviser: Professor David Laibman

My study is testing a new approach to analyzing the relationship between growth and inflation. Empirical studies have shown that the relationship may be nonlinear. With low and moderate inflation the correlation may be positive, albeit weakly. There is thus a breakpoint above which inflation turns destructive, in line with monetary theory. Previous studies commonly use the consumer price index as a measure of inflation. This study uses the producer price or, as available, the wholesale price index, as well as consumer prices. I examine the nonlinearity of wholesale or producer prices. The main finding is that the correlation between changes in producer prices and the change in GDP is positive, once changes in consumer prices are included in the model, with differing levels of significance, and even without cutting off the high inflation data.

The study thus supports empirically the existing findings of a positive growth-inflation correlation, and it backs them up theoretically. The work is inspired by a model that is based on input-output analysis, and on the distinction between a capital goods sector and a consumer goods sector, even if it is multi-sector multi-goods. One of its implications is that higher producer prices correlate positively with higher growth. The

model has a second explanatory variable, capital productivity. Overall this model is at odds with standard neo-classical theory where growth is explained with additions in labor and capital and a rest factor.

I do not attempt to "explain" growth, therefore my sensitivity analysis is somewhat limited, unlike in previous studies, in which many control variables are used. The variables used are annual change in gross domestic product, annual change in capital productivity, annual change in producer/wholesale prices, and in consumer prices. The econometric technique used is Ordinary Least Squares, with some quadratic formulation, to test for nonlinearity. I also use lags, and a Granger causality test. I mainly perform time series analysis, so as to not lose the individuality of results for specific countries. Panel data are used to find country and time fixed effects.

The geographic focus of the study is Latin America. The countries studied are all the South American countries and the Central American economies. Caribbean countries are not included. This makes 14 countries, as wholesale prices are not available for two of the six Central American countries, Nicaragua and Honduras. The time period is roughly 1960-2000, which in most cases yields 40 observations. For some countries, the time period is shorter, for lack of data.

Results indicate that the correlation between producer price changes and GDP changes is positive, once consumer price changes are controlled for, and that there are breakpoints in the wholesale price inflation-growth relationship.

Acknowledgements

This study has turned out to take longer and, in the end, be longer than I thought it would be. People that made it possible include my father, Klaus Lange, my friend Inas Rashad who helped me tirelessly and competently with the econometrics, Diane Williams who lent me moral support, André Hofman of the U.N. Commission for Latin America in Santiago, who readily gave me his capital stock and other data, various other Latin American economists who I will mention in the data source section, Michael Edelstein who procvided support in the early stages before my Latin America trip, Harvey Gram who advised me on theoretical literature, Dave Dhaval, for support and encouragement, and finally my three advisers, David Laibman, Gayle DeLong and Michael Grossman who each put out of the way obstacles that I would have not been able to handle by myself. David Laibman was involved at a very early point on theory, and suitably became my main adviser.

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Introduction

This thesis tests a model on GDP fluctuations that proposes an alternative to the standard neo-classical growth model, based on the neo-classical production function and its ensuing model on cycles, the real business cycle models. Real business cycle models have not performed well empirically. The Solow residual (Total Factor Productivity) is not a good predictor of changes in GDP. Gregory Mankiw masterfully criticizes RBC in an early paper: Real Business Cycles: A New Keynesian Perspective (1989). The neo-classical production function converts the factor inputs capital and labor into output, assuming constant returns to scale. It runs into a measurement problem (there are a multiplicity of practical problems measuring labor hours, quantity versus quality of labor, capital stock, etc. at a macroeconomic level) and it calls the discrepancy between the change in inputs and the change in resulting outputs *technological change*, the fluctuations of which form the basis of real business cycles.

In this study I do not attempt to "explain" growth. I look at correlations between changes in output and changes in different price variables, specifically producer prices, with the aim of identifying a reliable factor associated with GDP fluctuations. The main ingredients of the model, changes in producer prices and capital productivity, each have their motivators, but these are beyond the framework of this study. My work is based on a circular flow model, which claims to be a macroeconomic model, as opposed to the microeconomic neo-classical model of growth.

The data are from Latin America, 17 countries in total, 6 Central American and 11 South American countries. Studies on short-term GDP fluctuations in developing countries are rare. Latin America, though very rich in economic policy experimentation, continues to be an underdeveloped region. Countries with a high degree of GDP fluctuation provide a richer environment to analyze. My time frame is roughly from 1960 to 2000. This choice is mainly due to the fact that before 1960 consistent producer/wholesale price indexes are hard to come by.

The study also attempts to make a contribution to the debate on the optimal rate of inflation and inflation targeting. The main focus of the study, producer prices, is almost absent in previous work on inflation. My work is therefore original.

Chapter 1 looks at existing studies related to the topic of inflation, productivity and growth. The studies are from all quarters of the political economy spectrum. The strengths and weaknesses of the papers will be highlighted and the case for my study will be made.

Chapter 2 explains the variables and their occurrence on the Latin American continent. It will explain the particular motivation to study this part of the Western Hemisphere, and the particular relevance of my approach to the developing country context. Data sources are provided in detail at the end of the chapter.

Chapter 3 sets up the basic regression model and its refinements, explains the methods used and discusses positive and negative results. Tables with regression results are provided at the end of the chapter.

Chapter 4 presents a circular flow model that originally inspired my work. Briefly, the model is based on input-output analysis. However, unlike the neo-classical models in that area such as Leontief's input-output economics, it works with the distribution coefficients, those structural coefficients that measure the proportions in the *output* streams in economic processes. This enables macroeconomic analysis (accumulation) without requiring the assumption of constant returns to scale that all neo-classical models make. It also allows the inclusion of technical change. As opposed to all neo-classical models, this model refers to *nominal* prices. I test the effect of changes in nominal prices on real quantities. The model does not have maximization under constraint, there is no ceteris paribus per se (except in the econometric equation), no voluntary labor supply, and no distinction between exogenous and endogenous variables.

Chapter 5 places the model into the literature. The model will be compared and contrasted with Marxist-type and post-Keynesian models such as the general equilibrium model by Oskar Lange, from Michal Kalecki's model of the business cycle, from Piero Sraffa's multi-sector model and others, and also from neo-classical theory.

Chapter 6 concludes the study, sums up the findings and rates the model's validity for prediction. The study may provide a contribution to the current debate on inflation targeting by central banks.

Chapter 1

Existing Studies on Cycles, Growth and Inflation

This chapter examines previous empirical work that is related to my topic, with the aim of identifying a gap in the literature and justifying my own work. Studies include work on real business cycles, studies on growth in Latin America specifically, the neo-classical approach to the relationship between growth and inflation, and papers that examine the non-linearity of it. Not directly related is the discussion of an NBER paper co-authored by Professor Robert Lipsey that shows that investment is a determined variable rather than a determining one.

There is an extensive literature on real business cycles (RBC) when these became fashionable in the 1980s. In Gregory Mankiw's words, real business cycles are "the enemy at the other end of macroeconomics"[1]. The RBC approach to GDP fluctuations is very different from my own. I will discuss a representative sample. Kydland and Prescott (1982) estimate a competitive equilibrium model of a real business cycle type, focusing on auto-covariances of real output and co-variances of output with other time series related to the business cycle such as consumption, investment, capital stock and productivity. Ingredients of the model are also utility-maximizing households and the labor-leisure substitution model. The authors use dynamic programming to find equilibrium, and calibration to test the model. They present the results of their model's standard deviations and correlation versus those of the real post-war U.S. economy, but it is still obvious that the model parameter

[1] Mankiw, Gregory, Real Business Cycles: a New Keynesian Perspective

outcomes do not match those found in the U.S. economy very well. The authors also call their model simple, which it is not. It is not clear how output from a model that is so far off the real data would serve for predictive purposes. These real business cycle models are based on the Solow residual, a rest factor from an aggregative accounting-type model. As this residual is interpreted as technological progress, technology "shocks" are key to the real business cycles. Rising productivity therefore drives GDP expansion, falling productivity, which does not exist in the real world, makes GDP fall. Prices do not play a role in RBC.

A real business cycle model with emphasis on hours worked and labor productivity was estimated by calibration by Hansen and Wright (1992). It reports model outcomes that understate output, consumption and employment fluctuations, overstate investment fluctuations and finds that hours worked fluctuate considerably more than productivity in the real data. The authors put the lack of success of their model down to the fact that the Solow model provides for one single technology shock, while in the real economy there are plenty of other sources of uncertainty. I venture that the problem lies with using a pure supply model, focusing on labor supply and its elasticity. The concept of demand for labor comes up once in the paper, but it is held constant.

André Hofman (2000) is the first researcher to mention in the area of growth research in Latin America. He wrote *The Economic Development of Latin America in the Twentieth Century*. Hofman's comprehensive and thoughtful account is the basis for many studies issued by the Cepal, the U. N. Commission for Latin America and

others. While not suggesting real business cycles, Hofman works with the neo-classical production function, from which he estimates labor productivity, capital productivity and total factor productivity. In his words, his work deals with the "proximate" rather than with "ultimate causes of growth", proximate causes referring to capital, labor and productivity changes, ultimate causes including as internal factors climatic variations, the political process, military interventions and policy mistakes. "On the proximate level, the interaction between capital accumulation and technological progress is an example of this interdependence." This distinction is common in neo-classical theory. Hofman attempts to explain growth based on the Solow accounting framework. Importantly, a whole chapter is dedicated to the issue of human capital improvements and its positive impact on growth. There is only a brief reference to one of my variables of interest, capital productivity. Hofman finds that only the period 1989-94 shows generally increasing capital productivity on the subcontinent. With respect to prices, it is mentioned that, by comparison, Latin America had the highest inflation of all world regions in most periods, and that while inflation abated in the rest of the world after 1980, in Latin America it accelerated further. No theory on growth and inflation is offered.

The relationship between growth and inflation has been amply studied. Neoclassical theory proposes a trade-off between growth and inflation. The Phillips curve, the trade-off between wage inflation and unemployment, has come under attack around the end of the 1970s. The Phillips curve is an empirical reality that in its baseline supports my approach to growth and inflation in that it works with the

assumption of a positive correlation. I will not discuss it further since wage inflation is not directly my topic.

There is, however, a literature on the asymmetric effects of inflation, i.e. the convexity of the Phillips curve that has developed in the 1990s. A non-linear Phillips curve implies that positive output gaps have a stronger *inflationary* effect than negative output gaps have a disinflationary effect. Eric Schaling (2004) provides an account of the existing research into the non-linearity of the Phillips curve, and carries out testing for the G-7 countries. His evidence is clearly in the direction of non-linearity.

The relationship between producer and consumer prices has been studied. The purpose has been to establish the producer price index as a leading indicator for inflation. It has been found that producer prices lead consumer prices, the finding being based on causality tests and the estimation of lagged coefficients. Kaporale, Katsimi and Pittis (2002) validate unidirectional causality from producer prices/wholesale prices to consumer prices, while they include the transmission mechanism of monetary policy and attribute findings of opposite direction of causality to the lack of inclusion of monetary policy variables. They include the money supply, interest rates and real GDP in their bi-variate VAR analysis, but they do not comment on the role of GDP. The transmission is attributed to microeconomic supply mechanisms such as production timing. They call their model macro but here, retail prices are just price mark-ups on producer prices and depend on these and other microeconomic factors such as the level of taxes and the marginal cost of retail

production and a markup. I propose that there may be a real macroeconomic channel, by which a higher PPI leads to higher output and income, which leads to the higher CPI. We have observational equivalence, and further research on the sequence of events would be required.

Sam Peltzman (2000) studies the asymmetry in the transmission of changes from producer prices to consumer prices, taking for granted that rises in consumer prices are based on cost increases (rises in producer prices). This is a purely microeconomic approach. The problems are that conceptual differences in the construction of the CPI and the PPI preclude a direct matching. Also, the consumer price sample is smaller than the producer price sample. Peltzman regresses output prices on lagged input prices. He includes several aggregate price shocks, GDP is never included. The study is a valuable contribution on the make-up and mechanics of price indexes. Its focus on the asymmetries of cost transmission is not my focus.

The empirical evidence on inflation - consumer price inflation - and growth, however, is mixed. Adherents to the neo-classical school generally find a negative relationship while other studies point out the ambiguity of the results. Roubini and Sala-i-Martin (1992) present a simple model of inflation and growth, in which they use a simple neo-classical production function, utility-maximizing households, Euler equations, etc. It is argued that financial repression leads to inflation which depresses growth since the fact that financial institutions are underdeveloped increases the demand for money and gives governments more options to use seigniorage, the

inflation tax. It is thus argued that inflation does not have a direct effect on growth but is caused by money growth, while the underdevelopment of financial market leads to low growth, and the negative partial correlation between growth and inflation is a spurious one, coming from a third variable.

Another example for the neo-classical approach is a study by Javier Andrés and Ignacio Hernando (1997) on the relationship between growth and inflation, using so-called convergence equations. These are growth equations derived from the neo-classical production function. It is found that growth and inflation always correlate negatively, except in the long run, where results are more ambiguous. Implicitly, the authors wish to disprove findings that under certain conditions positive correlations obtain, i.e. when high-inflation economies are excluded. Without pursuing it further, I venture that the use of a very specific model with very specific pre-specified determinants, would bias the regression results. An "unexpected" positive coefficient is found when both the steady-state level of income and the permanent component of the growth rate are included. The authors also examine Granger causality between inflation and growth. It is mentioned that few regressors in convergence equations withstand the explanatory power of country dummies.

A small literature exists as to threshold effects in the relationship between growth and inflation. Mohsin S. Khan and Abdelhak S. Senhadji (2001*)* examine the threshold effect across developing and industrial countries, using dummy variables as an estimation method to model breakpoints in inflation rates. They use the change in

the CPI index, as is common in studies on inflation. They use panel data and five-year averages to smooth out business cycles. Therefore, the time dimension has only 8 observations. They find thresholds of 1-3 percent for industrial countries versus 11-12 percent for developing countries. Interestingly, in their sensitivity analysis, variables are included that would correlate both with each other (the log of initial income, and gross domestic investment over GDP) and with the dependent variable. This sort of excuses the fact that in my regressions, the capital productivity variable strongly correlates with the dependent variable (other people do it, too). It is found that there is a structural difference between industrial and developing countries when it comes to the inflation-growth relationship: for developing countries, the negative effect of inflation on growth increases with a higher threshold. For industrial countries, the negative effect first weakens as the inflation threshold increases, but then strengthens once past the threshold.

In an application to Latin America, Ochoa and Orellana (2002) test the theory of possible positive inflation effects for nine Latin American countries and finds a cut-off rate of 17%, with a margin of error of 9%, above which inflation turns to having adverse effects on growth. Issues discussed are both the level and the variability of inflation, the finding being that ”a high but predictable inflation rate is preferable to a lower-level but more volatile inflation rate”, a result that was also found by Judson and Orphanides (1996). In Ochoa’s thinking, high inflation is an obstacle to the efficiency and productivity of an investment. He uses panel data and eliminates Brazil from his study because of its atypical behavior: in Brazil, wide-spread indexing was practiced

and there was growth despite a hyper-inflationary environment. In his econometric model for growth, which is not the focus of his study, there is a vector of explanatory variables "which were suggested by the literature as variables that explain growth", among them investment and some measure of human capital.

Ruth Judson and Athanasios Orphanides (1996) pick up the idea of a cut-off rate of inflation above which the correlation with growth turns negative, but below which it is positive, in their study on Inflation, Volatility and Growth. The authors point out the difficulties of settling causality with a sufficiently accurate structural model. The study also examines the effect of the volatility of inflation, taking the logarithm of the standard deviation of inflation as their measure. Inflation volatility is found to be significantly negatively related to growth, unsurprisingly. Inflation volatility also provides at least as good a fit as the level of inflation alone. Investment is included in the growth equation, with significant coefficients. In the approach of this study, investment is a determined variable. A significant coefficient for investment does not prove that investment is a determining variable, it just correlates with growth. They also control for human capital, with little effect on the overall fit for growth, it does not invalidate their results. Descriptive statistics reveal that both average inflation rates and their volatility are quite high for the Latin American countries, 13 out of 119 countries in the sample. Argentina is not included in the sample.

Bruno and Easterly (1995), use a non-parametric definition of high inflation, placing the cut-off from moderate to high inflation at 40%. They coincide with my

view of inflation in that "high inflation is a different animal than low or moderate inflation". In terms of the significance of the inflation variable, they comment that "one is certainly not overwhelmed by the strength of the negative correlation of the regression slope." In their pre-1973 sample, the relation is insignificant and positive for consumer price inflation below 40%. They use mean comparison of inflation before, during and after inflation crises. Bruno and Easterly include TFP, as well as investment/GDP, population growth and income in their equations. The income variable is significant. Investment/GDP usually emerges with a strong coefficient in growth equations.

Blomström, Lipsey and Zejan (1993) test the proposition that in the relationship between growth and investment, the line of causation does not run from capital formation to growth but the other way round. They run regressions for 100 countries between 1965 and 1985, over 5-year periods, and find that the association becomes stronger when investment is advanced by one period. The coefficient on investment of the prior period is negative. The paper concludes that causality unambiguously runs from growth to investment, not vice verse. Multiple regressions include the initial income level, a proxy for human capital, income changes and inflows of FDI. The coefficients for the three fixed capital formation ratio variables are confirmed.

Dornbusch and Fischer (1993) study persistent intermediate inflation and find that inflation rates between 15 and 30% are sustainable for growth. The paper discusses causes of moderate inflation, defining it as 15-30% for at least three

consecutive years, the role of indexation and the modalities of disinflation. It is within the tradition of research on seigniorage and the vast research that has been done on inflation and monetary/fiscal policy. It discusses the game-theoretic approach to inflation à la Barro and Gordon, which I will not do. The study discusses inflationary developments in major Latin American economies, namely Brazil, Mexico, Colombia and Chile, four out of the eight moderate inflation cases. None of the four is among those that successfully disinflated (Brazil's currency reform and disinflation was in 1994, some years after publication of the paper). Dornbusch and Fischer study the CPI and the GDP deflator, not wholesale prices. The paper is comprehensive, relating the inflationary experiences to the other major macroeconomic variables, such as exchange rates and productivity. The study uses descriptive statistics, not regressions. Interestingly, it is found that commodity price shocks played a major role in most of the countries' inflationary experiences. This would contradict the government reputation games expectations, etc. literature as to the causes of inflation.

Levine and Zervos (1993) perform extreme bound analysis, regressing the growth rate in per capita GDP on a multiplicity of variables in cross-country simple OLS regressions, with the aim of identifying growth-enhancing policy actions. They do not find inflation to be significantly negatively related in any of the multifarious equations undertaken. They take an average inflation rate, leaving high inflation values in, which biases the variable upwards. The inflation variable does not seem to be correlated in any significant way with any of the other explanatory variables in their regressions. The authors also venture that the relationship between inflation and

growth may be discontinuous or nonlinear. The need to consider country-specific experiences is pointed out.

These results indicate that there may be a nonlinear relationship between inflation and growth. My study attempts to confirm this result, detailing the particular breakpoints in each country, and then puts forward the theory that the positive inflation effects may come from producer/wholesale prices. Or, alternatively, from those components in the consumer price index that are both input and output goods, as opposed to the pure output goods, i.e. from those goods in the consumer price index that coincide with and have little mark-up over prices achieved earlier in the manufacturing chain.

Existing studies have modeled business cycle fluctuations, studied the relationship between growth and inflation, and examined linearity issues. Nowhere in the literature did I find the distinction between consumer price inflation and producer price inflation in relation to GDP fluctuations. It is absent. In this study, I hope to fill this gap.

Chapter 2

The Scope of the Study

In this chapter I discuss the definition, make-up, practical availability and usage in previous empirical work of the independent variables that I use in my study. Detailed availability and data sources are provided at the end of the chapter.

Latin America is an underdeveloped region. A personal research trip has evaporated any doubts about the existence and persistence of a large development gap between South America and North America. While my study does not attempt to provide recipes for specific developmental policies, its conclusions will hint at causes and possible longer-term remedies to the Latin American situation. The continent and its problems have been studied by economists of all persuasions, by both Latin American and U.S. economists. There have also been practical policy experiments of all kinds on the continent, ranging from Marxist systems (Cuba, Chile under Salvador Allende), to ill-conceived Keynesian-type policies (populism) in various countries at various times and with mostly dire outcomes, to, in more recent times, neo-liberal policies (crudely and unsuccessfully imposed in Argentina in the 1990s, more competently in Brazil in the same time period).

The choice of the independent variables in my study is related to this development context. I think that, ultimately, prices and productivity are closely related to the issue of growth and development. Latin America as an underdeveloped

region is rich in natural resources, and its economies are still largely based on natural resource extraction. At the same time, their output consists of mostly low value-added goods (supply chain), and their income is clearly dependent on the level of producer prices.

Productivity and capital stock issues are, and this is uncontroversial, closely related to growth and development. The particular kind of productivity that I look at, capital productivity, is a macroeconomic variable, and it has rarely been used in previous studies as a determinant of growth, like producer prices. The variable is used for government statistics purposes in some countries, but it is almost absent in academic research.

I use data for the ten South American economies, that is South America in its entirety, and for four Central American economies: Guatemala, El Salvador, Costa Rica, and Panama. Producer or wholesale price indexes aren't available for Nicaragua and Honduras. The Caribbean countries are not studied because I did not travel there, and because the assumption is that their economies would behave similarly to the Central American economies, although on a still lower level. Cuba has a command economy and as such does not experience business cycles.

I now discuss the two variables in more detail.

The Producer Price Index

The producer price index measures the average change over time in the selling prices received by domestic producers for their output. The prices included in the PPI are from the first commercial transaction for many products and some services.[2] The PPI is not a standard measure of the price level any more. Three measures are commonly encountered in economic data, which are the GDP deflator, the PCE deflator and the CPI.[3] A major difference between the composition of the CPI and the PPI is the absence of services in the latter. It is conspicuous for its absence in the literature or even in statistical use. It does not feature in any of the available theories on inflation or growth. The standard measure of inflation in empirical research is the annual percentage change in the CPI; sometimes the GDP deflator is used. The PPI is a required indicator, however, for countries subscribing to the IMF Special Data Dissemination Standard.

For developing countries, the producer price index is often not available. If there is no theory about them and it is not interesting, data will not be measured. Price indexes are usually generated to keep track of inflation and holding it in check, and the consumer price index is usually the most obvious candidate for inflation targeting. In Brazil, the government uses the IPCA (Indice de Preços ao Consumidor Amplo) which includes gasoline among three major items, as a reference with respect to the inflation goals to be achieved.[4] A producer price index is available for Argentina; for Brazil

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[2] www.bls.gov, on the Producer Price Index
[3] Mishkin, 2004, P. 21
[4] O Globo, December 28, 2002, P. 25

there are plans to make one. The Brazilian IPA (indice de preços por atacado) which I use in this study, has 36% consumer goods and 63% producer goods, the latter including primary materials (crude and intermediate products). Primary materials are about half of the producer goods, the other half is made up of vehicles, equipment, parts for vehicles, and other, other being items such as glues, chemicals, fuels, etc.[5] The IPA currently contains 481 items. There is a distinction between IPA-DI (consumo - produçao - destino) and IPA-OG (agrícola/industrial – orígem).[6] The composition of the Mexican wholesale price index also shows that agricultural primary products form a large part of the index.[7]

For most other countries, a wholesale price index (indice de precios al por mayor, al mayorista) is available. I have to use the index that is available as a proxy. The wholesale price index is not ideal but it does provide a measure of inflation different from the consumer price index. In fact, for developing countries such as Latin America, a substantial proportion of output is agricultural and mineral products with low value-added, such that the wholesale price index reflects producer prices at least partly. Not even for some OECD countries, such as Italy and France, have producer prices been collected on a consistent basis and since earlier on.

Hyperinflationary environments are structurally different from environments with normal levels of price inflation. I will show in Chapter 3 that moderate inflation levels have a beneficial effect on GDP and trade while hyperinflation is destructive.

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[5] IBRE, Fundação Getulio Vargas, Indices de Preços por Atacado
[6] www2.fgv.br/dgd/asp/dsp_IPA.asp
[7] Indice de precios al mayoreo en la ciudad de México, INE, P. 936

Neo-classical models usually do not see any difference. Almost all countries on the Latin American continent have experienced hyperinflationary environments, usually due to incompetent fiscal policies and subsequent expansion of the money supply. Latin American hyperinflations can be easily explained by Cagan's model on hyperinflation, which explains expansion of the money supply in response to an increase in the demand for money. I have to take account of this when I look at producer or wholesale price rises. The major economies of Latin America, Brazil and Argentina, have experienced sustained periods of high and very high inflation. Felipe Pazos (1972) studies inflation in four Latin American economies (Argentina, Brazil, Chile and Uruguay) in the period 1950-1970, and finds that in all four countries 74% of the rates of variation of prices fall within a range of 10 to 50%. He finds these inflations to be of "long duration" and "intermediate intensities". He comments that these chronic inflations did not create conditions favorable to growth but on the other hand did not constitute an insuperable obstacle to it. They seem to be compatible with real expansions and contractions. Accelerating inflation of the Friedman type (1956) is only observed with rates above 50%, which will then lead to hyperinflations at 70, 80 and up to 100% per year. In regression analysis, Pazos finds a weak negative correlation between growth and consumer price inflation during his study period. His and other findings support the hypothesis that there may be a non-linear relationship between growth and inflation, which is examined in this study. Ideally, I would test my hypothesis on countries with moderate inflation and normal monetary policies. However, a model has to work in extreme environments, too. Also, in the last decade

of the time period studied, after 1990, most countries pursued anti-inflation policies, largely successfully.

An important issue is: at what point does moderate inflation turn into hyperinflation? Felipe Pazos suggests that wage contracts have a stabilizing effect on inflation, which is weakened when "intermediate" inflation rises above a certain point, which he puts at around 40%. At that point workers would request a shorter adjustment period, which will then accelerate inflation to 80, 90 or even 100%. I suggest at this point that moderate inflation becomes hyperinflation when it has a decreasing effect on GDP, when it starts to slow down economic activity because agents are sufficiently confused and wide-spread indexing takes hold. I venture that it does not much matter for the impact of price rises whether these come from "demand pull" or "cost push" since the two effects cannot be separated, and the result is what matters and impacts output. Wages are a case in point. How would one know why they rise? Do they rise because of more demand for labor in upturns (demand), or because of labor scarcity (supply)?

The Capital Stock

I discuss capital stock measurement because it is the main ingredient in my second "explanatory" variable, capital productivity. There is no unified definition of the capital stock but in practice economists work with some standard definition and methodologies. The following definition by Ariel Coremberg (2002) is useful: "The physical capital stock is the stock of capital goods of an economy, understanding as

such the goods used as inputs to the production process i.e. those that entail the production of other goods, whose service life exceeds one year and are generally used by firms." Coremberg also points to the significance of the capital stock as a component of a nation's wealth. Physical capital is one of the main production factors, and its significance has risen, and rises as a country develops. The productivity of the capital stock is an indicator of how well an economy uses its existing resources. The capital stock is generally seen to be formed by three different types of assets: residential structures, non-residential structures, and machinery and equipment. These are assumed to have certain durations of service life, between 40 and 50 years for construction, and 20 years for machines and equipment. Generally gross capital stock is the stock resulting from the accumulation over time of consecutive investment flows after subtracting retirements due to the end of their service life or economic obsolescence involving their replacement by a more efficient capital asset. Net capital stocks are obtained using one of several depreciation methods: rectangular (depreciation is single and sudden, at the end of the asset's service life), linear or delayed linear (in each period of time, a constant proportion of the productive capacity vanishes owing to wear and tear). Depreciation is also formulated as $1/T_i$, or geometric and hyperbolic depreciation. Different methods are used by different institutions, the linear depreciation method being the standard one. These depreciation methods are applied within the perpetual inventory method that views the capital stock as the sum of past net investments. A newer approach is *hedonic valuation* which requires more actual information about the market prices of the used assets, and therefore works with fewer assumptions regarding service life and retirement patterns.

Citing Pasinetti, capital goods are themselves commodities which have been produced in the economy. Capital goods are durable and, therefore, once produced, they go to increase the existing stock of capital goods, as in Sraffa's work, *Production of Commodities by Means of Commodities*, which provides for the circular flow of the model.

Different authors take different measures of the capital stock for their capital productivity measures. Harvey Gram suggests use of net domestic product/net capital stock. NDP data are hard to come by, or for that matter data on global depreciation to subtract from GDP. Net capital stock data, on the other hand, are a standard measure, computed from gross capital stock. If depreciation were used in both the numerator and the denominator of the capital productivity measure, it would be subtracted from the total of goods and services produced and from the durable goods that go into the capital stock. Banco Central de Chile (2001) holds net capital stock excluding residential structures to be the relevant measure for capital productivity. As data in the working paper show, the difference between net and gross capital stock is about one quarter. Various authors refer to the "quality" of the capital, quality usually referring to the share of machines and equipment in the total capital stock, the share of "productive" capital. A higher capital quality would, naturally, raise capital productivity.

DeLong and Summers (1993) studied the correlation between equipment investment and growth in an 88-country sample and find a strong partial association. In

particular they find that the "growth-equipment" nexus holds for a developing country subsample. They estimate a standard Solow growth accounting model and find a strong correlation between equipment investment and "TFP growth".

Authors working within the Solow model such as Villanueva Delgado (2000) call capital and labor productivity *partial factor productivities* as opposed to the total factor productivity, the rest factor from growth accounting. Capital productivity as I define it, Y/K, is not often worked with in empirical studies. The neo-classical framework sometimes looks at its reciprocal, the capital-output ratio. This is because capital does not play the role that it should in mainstream growth theory.

Capital productivity gains more importance in the developing country context. Rising capital productivity means that more real production from the existing technical resources becomes feasible. This is only possible if there is technical progress. Technical progress comes from more technical knowledge, more human capital. Since underdevelopment is the result of a lack of human capital, we would expect lower capital productivity in less developed countries. It is then the variable to watch, to see whether a country has potential for growth. Capital productivity is also the variable that I work with. It is little used in conventional studies. One reason may be that the neo-classical model generally has difficulty defining and modeling capital.[8] There is a tendency to skip capital altogether (for instance Ricardo), which makes such models automatically under-complex. I also have serious doubts about using the Solow measure for productivity, as an alternative to labor productivity, the "total factor

[8] Paul Simek

productivity" that models technological progress as a residual factor in an additive process and is used in countless papers, among others, by André Hofman. To call that part in growth which cannot be explained by additions in capital and additions in labor, productivity improvements, is an evasion. An interesting alternative measure for "aggregate factor productivity" has been found in a paper within the Inter-American Development Bank, Casacuberta (2004). Aggregate factor productivity is a weighted average of the firm level productivity, as opposed to taking the ratio of aggregate output per man hour, or per capital stock, respectively. I note, however, that this is a microeconomic approach. I prefer the simple ratio of the aggregate measures for my study, as this is a macro-variable. Different authors use different capital stock measures, I use both total gross capital stock as available and net non-residential stock as suggested by most.

Data Availability

Argentina

GDP data are from Oxford Latin America database (OxLad), in constant 1970 dollars. Indice de Precios al Productor available from Indec, the Instituto Nacional de Estadistica, website. The series coincides with IMF International Financial Statistics producer price series, except for the 1960s.
Capital productivity from André Hofman. He computed gross national product per capital stock, capital stock being the sum of vivienda, no-residencial, maquinaria y equipamiento. Hofman computed gross and net capital stock for seven countries.

Bolivia

Professor from Universidad San Andrés/La Paz said producer price index has not been raised. The IMF has a series that covers some 20 years. Curiously, more recently nothing is available any more.

Brazil

GDP data taken from Oxford Latin America database.
Indice de preços por atacado (IPA) available from Conjuntura Econômica, issue September 2002. Wholesale price index presumably created after 1944 but not available to public. Data availability in Brazil is quite limited, there are many bureaucratic hurdles (o custo Brasil) and simple lack of data collection or creation. The IPA includes at present 477 wholesale goods, its composition is changing. Among other things, crude oil was taken out in 1996.[9]

Until 2003, no official estimate of the capital stock was available. The one available was taken from a paper by Aumara Feu, from the web, Evaluation of Capital Productivity. Reliable sources include André Hofman's work who has worked out capital stock estimates for the major countries (Argentina, Brazil, Chile, Mexico, Colombia, Venezuela and Ecuador) with the perpetual inventory method in a paper published in the Cambridge Journal of Economics in 2000. Updates of these capital stock estimates for the countries mentioned except Ecuador, have kindly been provided by André Hofman from his as yet unpublished data stock.

Chile

GDP and CPI changes from OxLad. Wholesale price data from IMF. Capital productivity from Hofman. After 1994, from paper by Banco Central de Chile

[9] Divisão de Gestão de Dados, Fundação Getulio Vargas

Mexico

A wholesale price index is available for Mexico City, from Instituto Nacional de Estadística (INEGI) data. The index changes coincide with those from the IMF International Financial Statistics for the years after 1982. A producer price index is available from 1980 to 1997.

Paraguay

Master's thesis by Bernardo Dario Rojas Páez at Universidad de Tucumán on the water power project Itaipú, June 2001, estimates of capital stock based on permanent inventory method. It is not obvious whether net or gross stock, residential included or not.

Peru

IMF wholesale prices available only after 1980. An index has been collected from Instututo Nacional de Estadística (INEI), from Banco Central de la Reserva, from 1973-86.

Uruguay

Capital Stock data have been taken from an estimate from a paper by Victor Elías, Universidad de Tucumán, *El Capital Físico y Humano en Uruguay*, kindly provided, were available in 1978 N$, I converted them to dollars.

Central America

Overall in Latin America, no official time series of capital stock figures are prepared on a regular basis. The unofficial estimates were made by independent scholars and research institutes (Hofman 2000). Gross fixed investment available but would need a starting point to estimate according to Professor Cervantes method (perpetual inventory). A Master's thesis at Tucumán University, by Julio César Villanueva Delgado, has capital stock estimates for the six Central American economies. This growth study on Central America is unique. The thesis does not provide detailed information on how these were obtained. The text implies, though, that they come from some form of inventory method, based on investment and depreciation series.

Chapter 3

Regressions and Discussion of Results

This chapter presents the econometric model, the regression results and ventures explanations for them. In between I refer to previous studies using similar models.

Descriptive analysis shows that at these persistent "intermediate" levels of inflation, the correlation between producer/wholesale prices and GDP is generally weakly negative. Even export volumes correlate weakly negatively with wholesale prices. However, after taking out very high inflation rates, the correlation coefficient becomes positive for most countries, strongly positive for some. The breakpoint at which high inflation rates become destructive is different for every country. The major countries, Brazil and Argentina, have impossibly high cut-off rates. This ties in with results of a study by Marcelo Ochoa (2002) that focuses on a non-linear relationship between growth and inflation, suggesting a cut-off rate of inflation above which the relationship would turn negative. In previous studies, GDP and prices which are usually consumer prices, tend to correlate weakly.

My hypothesis is that my main independent variables, *producer prices* and *capital productivity*, correlate positively with output growth, that in fact they are complementary variables. A tautological proposition would be that the nominal value of output either rises if prices rise (the PPI) or if quantity rises, the amount of output

that can be gained from the same level of capital stock, that is if the capital productivity rises.

Regressions

Basic model:

Equation 1a: $\%chY = b_0 + b_1 \%chPPI + b_2 \%chProd + e$

I use OLS with changes in GDP (%chY) regressed on changes in wholesale prices (%chPPI) and changes in capital productivity (%chProd). The simple model has no lags because I assume that investment decisions happen almost simultaneously with price developments (price data are available and accessible to firms, even in developing countries).

I use percentage changes in *real* GDP. Nominal GDP changes will be used later, to confirm the tautological proposition outlined above. The regressions with real GDP are necessary for making my point about positive correlations between output and producer prices. I estimate correlations between nominal price changes and real quantity changes.

For the inflation series, I use percentages changes in levels, not logs. I do not want to scale down the extreme inflation values. Researchers disagree over the decision levels versus logs. Khan and Sendadji (2001) use the log of inflation in their

study on threshold effects, on the argument that the distribution of the levels of inflation values is highly skewed. Bruno and Easterly (1995) find both a linear and a log-linear functional form implausible. They use a non-parametric specification, with several cut-off inflation rates such as 20% and 40%, as breakpoints to high inflation. I am leaving the distribution of the values as it is, so as to bring out more clearly the breakpoint effects. I therefore use levels in inflation, not logs.

Results indicate generally significant coefficients, for 5 out of 14 countries, mostly negative for the price variable, while positive for 4 countries, three of these Central American countries. This is in line with results from various large-scale inflation-growth studies in the literature (notably the panel study by Bruno and Easterly, for 127 countries over 32 years). The coefficient on capital productivity is always positive, except for one country (Ecuador). Fits vary but are generally quite high. The strongly positive coefficients on the productivity variable probably come from a correlation with the dependent variable, a spurious correlation. There is serial correlation, generally.

(Table 1a)

Equation 1b: $\%chY = b_0 + b_1\ \%chPPI\ (-1) + b_2\ \%chProd + e$

I include a lag of one year for the price variable. Longer lags would be inappropriate because firms in developing countries tend to think short term. For one thing this is a

manifestation of under-development, for another, high inflation environments, which are observed in most of the countries studied, inhibit longer-term planning.

For 11 out of 14 countries, the coefficient on the lagged price variable is more positive than that on the simultaneous variable. This points toward Granger causality, higher producer price preceding higher output. Granger causality tests will be carried out later.

In five out of 13 countries, the fit goes slightly down with the lagged variable, in the other eight it goes up. This result calls for the use of country fixed effects for the Central American countries versus South American countries because the finding is that the coefficient on wholesale prices tends to be positive or turn more positive after lagging one period for the Central American countries.

Lagging the price variable by one period seems to alleviate the problem of serial correlation.

The Dickey-Fuller test on the price variable reveals weak non-stationarity at the 1% level for five countries (Brazil, Mexico, Colombia, Ecuador, and Guatemala). No obvious pattern appears to explain this (such as hyperinflation countries). Since non-stationarity does not appear a pervasive problem, I will not apply the conventional remedies (first-differencing the equations and including lagged values). (Table 1b)

Equation 2: $\%chY = b_0 + b_1\ \%chCPI + b_2\ \%chProd + e$

Including the CPI instead of the PPI yields only moderately inferior fits, disappointingly. This may be due to the fact that both price indexes are highly correlated. In the case of Brazil, for example, the wholesale price index (IPA) forms 60% of the consumer price index. Changes in CPI and PPI are highly correlated. (Table 2, correlation coefficients in Table 3c). Serial correlation does not seem to be present at all, except for Costa Rica.

Equation 3a: $\%chY = b_0 + b_1\ \%chCPI + b_2\ \%chPPI + b_3\ \%chProd + e$

Including both price indexes improves the overall fit but makes the coefficient on each one of the indexes insignificant. However, the coefficient on PPI turns positive for 8 out of 12 countries, while the CPI has a positive coefficient for only one country out of twelve. For 10 out of 12 countries the coefficient on the PPI is to the right on the negative-positive continuum, i.e. more positive than that on the CPI. This is the most interesting result yet: Inclusion of both price indexes seems to confirm the prediction of a positive correlation between the PPI and GDP. (Table 3a)

Equation 3b: $\%chY = b_0 + b_1\ \%chCPI + b_2\ \%chPPI + e$

I leave the capital productivity variable out, and find that the coefficients are slightly stronger in the direction of my prediction. Also, the R-squared are surprisingly strong,

for all the larger countries except Colombia. The high R-squared of the equation with capital productivity is not all due to spurious correlation; about a third of the variation in GDP is explained by the price variables. (Table 3b) There is no serial correlation to speak of. This underscores the fact that there may have been impure serial correlation due to an omitted variable, the CPI.

Equation 4: $\%chY/cap = b_0 + b_1 \%chPPI + b_2 \%chProd + e$

I use percentage change in GDP per capita as a dependent variable, on Harvey Gram's suggestion. This is taking account of population, or labor input in some way. Results are generally quite similar to those with simple GDP, no big discrepancies, except for Colombia. The price variable is now insignificant for 7 out of 14 countries. Per capita wealth is less related to prices than output per se, the additional variable has lowered the strength of the correlation. In 8 out of 14 countries the coefficient turns less negative. The addition of the population term has not altered results significantly. (Table 4)

Equation 5: $\%chY = b_0 + b_1 (\%chCPI-\%chPPI) + b_2 \%chProd + e$

Most of these coefficients are insignificant, some positive, some negative. (Table 7a)

Equation 6a: $\%changeYnom. = b_0 + b_1 \%chPPI + b_2 \%chProd + e$

I now use percentage changes in nominal GDP. As was to be expected, the coefficients on the PPI are very high. The significance of the productivity variable declines dramatically, for Brazil, Peru and Uruguay even turning negative. It is as if the spurious price correlation wiped out the spurious quantity correlation between independent and dependent variables. In a country with rampant inflation, almost any nominal variable will appear to be correlated with all other nominal variables.[10] In 10 countries, the coefficient on productivity turns insignificant. (Table 5a)

Equation 6b: $\%changeYnom. = b_0 + b_1\ \%chPPI + b_2\ \%chCPI + \%chProd + e$

In 9 out of 14 countries, the CPI is more significantly related to nominal GDP. This is because nominal GDP is computed with the finished goods prices, which have more weight in the composition of the CPI than the PPI. The 5 countries where wholesale prices are more significant are Ecuador, Chile, Venezuela, Uruguay and Panama. These countries have very little diversified economies, wholesale prices may concur with retail prices, and/or nominal GDP is computed with wholesale prices. This proposition would have to be verified. For Venezuela and Ecuador, untypical results have occurred before. For Brazil, Costa Rica and El Salvador, the coefficient on wholesale prices even turns negative with inclusion of the CPI. (Table 5b)

Equation 7: $\%changeY = b_0 + b_1\ \%chPPIsplined + b_2\ \%chProd + e$

[10] A. H. Studemund, Using Econometrics, Third Edition, P. 487

I now work out the proposition of non-linearity in the PPI inflation/GDP growth relationship. I first find breakpoints with simple correlation analysis. I sequentially delete hyper-inflation values until the correlation coefficient between changes in GDP and changes in the PPI turns positive. I later run regressions in which I spline the change in PPI series, based on the breakpoints found earlier. (Table 6) For Guatemala, Panama and Costa Rica, the coefficients on the PPI are positive and significant even without splining. I use simple exclusion of higher inflation values as a method. Every country is found to have a different breakpoint at which the correlation turns from negative to positive. For the larger countries, the breakpoint hovers between 40 and 50%, the standard cut-off rate cited in the literature, above which inflation is considered to be hyperinflation. The number of observations is usually about cut in half by this process. Only in one country (Ecuador), does the coefficient stay negative regardless. For Chile, the coefficient turns positive only when the PPI variable is lagged one period. Chile, like the Central American countries, has an undiversified economy, copper and its derivatives forming a major part of its output and exports.

Equation 8: $\%\text{changeY} = b_0 + b_1\ \%\text{ch PPI} + b_2\ \%\text{ch PPI}^2 + e$

Now a quadratic formulation is used to test for nonlinearity and confirm the above results. For 9 out of 14 countries, the coefficient on the squared term is less significant than that on the simple term. The sign of the coefficient changes from negative to positive, logically, as the variable is squared. Only for Guatemala, Paraguay, Uruguay and Panama, does the coefficient change from negative to positive. (Table 8a) Two of

these countries are from the group of Central American countries that exhibit positive correlation anyway. For Venezuela, coefficients are both weakly negative. Venezuela has shown outlier behavior before. A test statistic α is computed to check the behavior of the variable at the mean of the sample:

α = coefficient on %changePPI + 2 * coefficient on %changePPIsquared * mean of PPI squared

This test statistic should be positive for countries with lower inflation rates, and negative for those with high and very high rates. This condition is confirmed: 4 out of the 14 computed values are positive, 10 are negative. The four positive α's are those of El Salvador, Paraguay, Guatemala and Peru. In 3 of these, inflation rates have never surpassed 45% in the period studied (1960-2000). Peru is an outlier within this group. The wholesale price index is available only after 1975. Also, the country experienced a hyperinflation in 1989/90. The test has confirmed the existence of non-linearity in the wholesale price inflation-output relationship.

Equation 9: $\%changeY = b_0 + b_1\ \%ch\ PPI + b_2\ \%ch\ PPI^2 + b_3\ \%ch\ CPI + e$

As the CPI has been established to be an omitted variable, I include it in the equation to test for non-linearity. However, I lag the producer price variables for those countries where this provides better results (7 out of 14 countries). Results are presented in Table 8b. It is striking that the R-squared adjusted are invariably very low for the small and

very underdeveloped countries (Ecuador, El Salvador, Paraguay, Colombia and Uruguay). The latter two are not underdeveloped but Colombia is racked by civil war and Uruguay has had other severe macroeconomic problems. This lowers the sensitivity of economic agents to price changes. In 8 out of 14 countries, the coefficient on the simple PPI is positive and that on the squared PPI is negative, which would confirm the hypothesis of non-linearity in the producer price-output relationship. For Brazil, Venezuela and Mexico, both coefficients are positive, with weak significance. Paraguay has difficult results generally, as observed before, which raises the question of data reliability. The coefficient on the CPI is negative for all countries.

The joint significance of the regression is higher than is generally the case with price and growth correlations. Bruno and Easterly (1995) find that the number of cross-section growth regression that did NOT find inflation to be significant is notable, also Levine and Zervos (1993). Uctum and Thurston (2000) regress log per capita GDP on log inflation and one other explanatory variable and get low significance for the inflation variable. In my regressions, R^2 is as high as 25% for Venezuela and 35% for Chile and Mexico.

Granger causality tests regarding GDP changes and wholesale price changes, including only the two variables, yield no pattern regarding the direction of possible causation. Or rather, in 6 out of 14 countries (Argentina, El Salvador, Panama, Chile, Guatemala and Venezuela), is the probability that Granger causality exists from producer prices/wholesale prices to GDP. (Table 9) This is not the desired result. It is

in line with the literature, f.e. Bruno and Easterly (1995) in that the evidence is ambiguous when it comes to causality tests between growth and inflation. Bruno and Easterly use the CPI as the measure for inflation used.

I then test Granger causality *for all three variables*: %chGDP, %chPPI and %chCPI. The results are as follows: In 8 out of 14 countries, the probability of not being able to reject the null of no Granger causality is lower for the direction %change PPI to %change GDP than for %change GDP to %change PPI. This is a pattern weakly in favor of a leading producer price index. Albeit weak, the fact that it differs from the pattern that the two variables only yields, may again indicate that the %change CPI is an omitted variable, without which results are misleading. I do not, in principle, have a problem with a poritive feedback correlation between %change GDP and %change PPI, it does not contradict the hypothesis.

In 12 out of 14 countries, the Granger correlation between PPI and GDP is bigger than that of CPI and GDP. This may indicate that the succession of events goes from changes in the PPI through changes in GDP to changes in the CPI, and that, for growth the PPI matters more than the CPI. (Table 9)

Cautiously concluding, my hypothesis that producer prices precede growth, seems to be confirmed. While not in all cases significantly, in simple OLS regression the coefficient on the PMayor variable (producer prices) turns positive when changes in the CPI (consumer prices) are controlled for. This points to omitted variable bias. The

existence of an omitted variable could be confirmed through Granger causality tests. Once the Wald test is carried out using all three variables (GDP, PMayor, CPI), rather than only GDP and PMayor), results are stronger and seem to indicate that the succession of events is from producer prices to GDP growth to consumer prices, rather than any other way.

Table 1a

Equation 1a: Simple Regression with Wholesale Prices and Prod
95% confidence interval: significant at the 5% level, t-ratios below coefficients
Durbin-Watson alternative test statistic

Country	# observations	Intercept	Coefficient on wholesale prices	Coefficient on change net capital productivity	Adjusted R^2	p-value Dwa
Argentina	37	0.388	-0.002	0.766	0.79	.0006
			-3.92	9.83		
Brazil	40	0.067	-0.000027	0.8232	0.43	0.945
			-3.22	4.97		
Chile	40	0.0493	-0.000074	0.7346	0.66	0.468
			-2.83	7.91		
Mexico	40	0.063	-0.00052	0.678	0.68	0.4779
			-4.88	6.17		
Colombia	40	0.037	0.0003	0.8707	0.53	0.863
			1.04	6.82		
Venezuela	40	0.042	-0.00063	0.62	0.67	0.8081
			-3.93	7.73		
Peru	26	0.039	-0.0004	0.9001	0.92	0.3697
			-1.7	14.01		
Uruguay	33	0.0369	-0.0002645	0.65033	0.74	0.468
			-2.22	9.68		
Paraguay	26	0.0724	-0.0001541	0.4879	0.09	0
			-0.27	2.15		
Ecuador	20	0.076	-0.0008	-0.9151	0.63	0.64
			-3.11	*-5.89*		
Costa Rica	38	0.0593	-0.000216	0.4837	0.29	.8007
			-0.49	1.8		
El Salvador	38	0.038	0.00031	1.018	0.79	0.5721
			1.22	12.1		
Guatemala	26	0.034	0.0017	0.86	0.73	0.4878
			3.53	8.13		
Panama	32	0.053	0.0018	0.989	0.76	0.72
			3.34	0.102		

Table 1b

Equation 1b: Simple Regression with wholesale prices lagged by one year

Country	# observations	Intercept	Coefficient on lagged wholesale prices	Coefficient on Prod	Adjusted R^2	p-value Dwa
Argentina	37	0.0372	-0.001871	0.795	0.74	0
			-2.73	*10.37*		
Brazil	40	0.067	-2.63E-05	0.86	0.41	0
			-3.01	*4.99*		
Chile	40	0.05044	-0.000089	0.7039	0.68	0
			-3.43	*7.68*		
Mexico	40	0.063	-0.000514	0.888	0.6	0
			-4.86	*8.29*		
Colombia	40	0.04473	-8.63E-05	0.85077	0.54	0
			-0.28	*6.56*		
Venezuela	40	0.03	-0.00037	0.7	0.58	0
			-1.96	*0.43*		
Peru	26	0.0376	-0.000361	0.954	0.95	0.0057
			-1.83	*21.3*		
Uruguay	33	0.0219	-1.38E-05	0.62	0.69	0.686
			-0.1	*8.22*		
Paraguay	26	0.0754	-8.35E-05	0.552	0.13	0
			-0.14	*2.39*		
Costa Rica	38	0.0534	0.0003255	0.6962	0.32	0.555
			1.2	*4.22*		
Ecuador	20	0.075	-0.000897	-0.8742	0.68	0.0267
			-3.55	*-6.31*		
El Salvador	38	0.03682	0.0005443	1.03169	0.81	0
			2.12	*12.48*		
Guatemala	26	0.033878	0.002186	1.056159	0.77	0.28
			3.99			
Panama	32	0.054	0.0019	1.052	0.7595	0
			3.35	*9.78*		

Table 2

Equation 2: Simple Regression with CPI and Prod

Country	# observations	Intercept	Coefficient on CPI	Coefficient on Prod	Adjusted R^2	p-value Dwa
Argentina	37	0.0393	-0.0024	0.7139	0.79	.0003
			-4.12	*10.2*		
Brazil	40	0.066	-0.0026	0.789	0.42	0
			-3.24	*4.76*		
Chile	40	0.052136	-0.014607	0.717058	0.6647	0
			-3.08	*7.53*		
Mexico	40	0.063	-0.534	0.689	0.67	0
			-4.75	*6.21*		
Colombia	40	0.045408	-0.011821	0.8508825	0.541	0
			-0.39	*6.66*		
Venezuela	40	0.0428	-0.066	0.64	0.67	0
			-3.85	*7.84*		
Peru	26	0.039	-0.000434	0.913	0.92	.0015
			-1.87	*15.38*		
Uruguay	33	0.036872	-0.026094	0.6274878	0.7419	.677
			-2.23	*9.54*		
Paraguay	26	0.0639	0.05244	0.48	0.11	0
			0.71	*2.14*		
Costa Rica	38	0.055	0.02066	0.678	0.29	0.825
			0.41	*2.74*		
Ecuador	20	0.0838	-0.1076	-0.8764	0.73	.4907
			-4.45	*-7.05*		
El Salvador	38	0.0435	-0.0267	0.9955	0.79	0
			-0.85	*11.86*		
Guatemala	26	0.0353	0.1525	0.9161	0.67	0.0143
			2.35	*7.25*		
Panama	32	0.053	0.363	0.981	0.75	0
			2.62	*8.7*		

Table 3a

Equation 3a: Regression GDP on PPI CPI Prod

Country	Constant	Coefficient on PPI	Coefficient on CPI	Coefficient on Prod	R^{2-} adjusted	p-value Dwa
Argentina		-0.0017919	-0.0007851	0.7041879	0.78	0
		-0.57	-0.27	9.68		
Brazil		0.0044259	-0.0070391	0.753	0.41	0
		0.6	-0.96	4.24		
Chile		-0.0000293	-0.0103965	0.7266166	0.65	0
		-0.66	-1.31	7.47		
Colombia		0.1325491	-0.12244	0.895	0.5893	0
		2.29	-2.18	7.31		
Mexico		-0.0385042	-0.0145322	0.6799827	0.6688	0
		-0.38	-0.14	5.92		
	L1					
Costa Rica	Pmayor	0.0338278	-0.0051636	0.679709	0.3014	0.387
		1.08	-0.09	2.69		
	L1					
Panama	Pmayor	0.1243084	0.1368946	0.9878389	0.7575	0
		1.1	0.58	9.57		
	L2					
	Pmayor	0.1030153	0.2907714	0.980898	0.7897	
		1.68	2.32	9.33		
Ecuador		-0.0051739	-0.0847428	-0.764112	0.5736	0.463
		-0.08	-1.34	-4.75		
Peru		0.00317	-0.00322	0.89902	0.92	0.0024
		0.92	-1.06	14.63		
Venezuela		0.0221369	-0.0824455	0.606851	0.67	0
		0.89	-3.26	6.73		
El Salvador		0.0005201	-0.0529465	1.021637	0.8057	0
		1.8	-1.51	12.18		
	L1					
	Pmayor	0.0006648	-0.0521724	1.02664	0.8234	
		2.54	-1.63	12.72		
	L1					
Guatemala	Pmayor	0.0020907	-0.0489611	0.835689	0.7253	0.0282
		2.37	-0.47	6.95		
	L2					
	Pmayor	0.0019725	0.0460244	1.065796	0.765	
		3.13	0.71	8.94		
	L1					
Uruguay	Pmayor	0.0020907	-0.0489611	0.835689	0.7253	0.5003
		-0.47	2.37	6.95		
	L2					
	Pmayor	0.0019725	0.0460244	1.065796	0.765	
		3.13	0.71	8.94		
Paraguay		-0.1406	0.2008	0.4859	0.15	0
		-1.48	1.63	2.22		

The Central American countries perform better with PMayor lagged one period
Positive coefficient for PPI in 8 out of 12 countries

Positive coefficient on CPI for 1 out of 12 countries

Table 3b

Equation 3b: Regression GDP on PPI and CPI

Country	Constant		Coefficient on PPI	Coefficient on CPI	R^2 adjusted	p-value Dwa
Argentina			-0.0090467	0.0048275	0.2186	0.85
			-1.54	*0.87*		
		PPI L1	0.0019904	-0.0045634	0.2036	0.9104
			1.35	*-3.28*		
Brazil			0.0150074	-0.0171136	0.1451	0.0268
			1.78	*-2.04*		
Chile			-0.003258	-0.0164756	0.1413	0.6517
			-0.47	*-1.31*		
Colombia			0.0657665	-0.1025827	-0.0089	0.0001
			0.73	*-1.17*		
Mexico		PPI L1	0.0330556	-0.0976199	0.3651	0.2827
			1.41	*-4.05*		
Costa Rica			-0.2144618	0.1630884	0.2862	0.0218
			-2.61	*1.59*		
		PPI L1	0.0380395	-0.1239846	0.1736	0.0374
			1.12	*-2.92*		
Panama			0.065764	0.2030906	0.0005	0.0735
			0.29	*0.43*		
Ecuador			0.1129299	-0.1488121	0.0325	0.1907
			1.3	*-1.59*		
Peru			0.0156102	-0.0153994	0.2076	0.6423
			1.46	*-1.65*		
Venezuela			-0.1371215	0.0612792	0.2162	0.0006
			-1.58	*0.68*		
		PPI L1	0.0925789	-0.1409689	0.2673	0.0014
			2.73	*-3.98*		
El Salvador			-0.0002102	-0.0437384	-0.0368	0
			-0.32	*-0.54*		
			0.0001673	-0.0677539	-0.0365	0
			0.27	*-0.88*		
Guatemala			0.3826888	-0.3692174	0.1602	0.004
			2.58	*-2.27*		
Uruguay			0.0056153	-0.022244	-0.0387	0.0488
			0.23	*-0.9*		
Paraguay			-0.1372609	0.2024526	0.0133	0.0008
			-1.34	*1.52*		

Table 3c

Correlation Change CPI/Change PPI

	r
Argentina	0.97
Brazil	0.99
Chile	0.95
Mexico	0.99
Colombia	0.86
Venezuela	0.95
Uruguay	0.44
Paraguay	0.8
Panama	0.87
Costa Rica	0.95
Nicaragua	PPI n.a.
Honduras	PPI n.a.
El Salvador	0.47
Guatemala	0.9
Bolivia	0.19
Ecuador	0.89

Table 4

Equation 4: Regression Dependent Variable PerCapita GDP

Country	# observations	Intercept	Coefficient on wholesale prices	Coefficient on change net capital productivity	Adjusted R^2
Argentina	38	0.0233642	-0.0025091	0.6886471	0.79
			-4.13	*10.12*	
Brazil	39	0.042	-0.0000218	0.8379	0.46
			-2.84	*5.52*	
Chile	39	0.0304753	-0.0000559	0.6766904	0.58
			-2.02	*6.92*	
Mexico	39	0.034	-0.0004	0.70039	0.76
			-4.87	*8.26*	
Colombia	39	5.51	0.000909	1.11	0.38
			1.69	*5.01*	
Venezuela	39	0.009	-0.00049	0.6364	0.69
			-3.21	*8.4*	
Peru	26	0.0187	-0.0004636	0.8934	0.91
			-1.54	*13*	
Uruguay	33	0.028	-0.0002278	0.625	0.72
			-1.93	*9*	
Paraguay	26	0.043	-0.0001735	0.5111	0.12
			-0.32	*2.37*	
Costa Rica	38	0.0385349	-0.0005441	0.6193571	0.61
			-1.48	*2.78*	
Ecuador	20	0.045	-0.00074	-0.840089	0.67
			-3.15	*-6.46*	
El Salvador	37	0.01317	0.00037	0.933	0.78
			1.52	*11.39*	
Guatemala	25	0.0059	0.0016	0.8146	0.58
			2.38	*5.75*	
Panama	32	0.0296	0.00127	0.922	0.75
			2	9	

Table 5a

Equation 6a: Nominal GDP

	# observations	Intercept	Coefficient on PPI	Coefficient on change net capital productivity	Adjusted R^2	CPI alone
Argentina	40		0.8785407	4.080301	0.8988	0.835301
			17.86	*0.74*		22.09
Brazil	39		0.6060032	-24.93916	0.5523	
			6.97	*-1.45*		
Chile	39		0.6403677	0.5955702	0.8756	
			16.32	*0.43*		
Mexico	39		0.9323673	1.356182	0.6865	
			9.15	*1.32*		
Colombia	39		0.8164328	1.4012	0.5233	
			6.5	*2.69*		
Venezuela	39		0.8717426	0.7414055	0.8096	
			12.78	*2.2*		
Peru	26		0.7635599	-4.252524	0.9889	
			43.75	*-1.08*		
Uruguay	35		0.0078762	-1.186459	0.3452	
			4.42	*-0.85*		
Paraguay	26		0.664582	0.7934915	0.571	
			5.63	*1.7*		
Costa Rica	38		0.576891	0.0618891	0.6162	
			4.2	*0.07*		
Ecuador	20		0.7576169	1.398714	0.6451	
			5.98	*2*		
El Salvador	37		0.0014927	0.6113601	0.0485	
			1.35	*1.68*		
Guatemala	25		0.8558594	0.2759379	0.6271	
			6.51	*1.06*		
Panama	32		0.4765472	0.4050464	0.227	
			3.1	*1.4*		

Table 5b

Equation 6a: Nominal GDP with CPI

Country	# Observations	Coefficient on PPI	Coefficient on CPI	Coefficient on change net capital productivity	Adjusted R^2
Argentina	40	0.0720417	0.7693715	0.3532549	0.9297
		0.35	*4.05*	*0.08*	
Brazil	39	-1.285119	1.880583	-10.01534	0.6207
		-1.85	*2.74*	*-0.6*	
Chile	39	0.5740314	0.1484579	0.7153246	0.8768
		8.74	*1.25*	*0.5*	
Mexico	39	0.3061249	0.6407527	1.227706	0.6818
		0.33	*0.68*	*1.17*	
Colombia	39	0.3773298	0.4945061	1.34903	0.5677
		1.6	*2.17*	*2.71*	
Venezuela	39	0.4552474	0.4491522	0.602705	0.8236
		2.05	*1.97*	*1.82*	
Peru	26	0.1517797	0.5419484	-1.250835	0.992
		0.79	*3.18*	*-0.36*	
Uruguay	35	0.7248171	0.1452649	0.3025169	0.3367
		3.84	*0.74*	*-0.87*	
Paraguay	26	0.0124218	1.045595	0.7827078	0.8605
		0.11	*6.98*	*2.94*	
Costa Rica	38	-0.0662624	.8500408 .	0.1350085	0.6868
		-0.27	*2.98*	*0.18*	
Ecuador	20	0.5833955	0.1969238	1.292586	0.6338
		2.05	*0.69*	*1.78*	
El Salvador	37	-0.0004443	0.4999162	0.5855866	0.3325
		-0.42	*3.93*	*1.93*	
Guatemala	25	0.1744157	0.9915104	0.8017003	0.8525
		1.23	*5.88*	*4.13*	
Panama	32	0.3025169	0.4151077	0.3996871	0.2104
		0.95	*0.62*	*1.37*	

Table 6

Equation 7: Basic model with breakpoints for PPI

Country	# observations	Intercept	Coefficient on wholesale prices	Coefficient on change net capital productivity	Adjusted R^2	Breakpoint	
Argentina	18		0.0285737	0.6262408	0.8362	0.4	
			0.96	*9.42*			
Brazil	19		0.0860817	0.7743053	0.2441	0.5	
			1.41	*2.53*			
Chile	13		0.05178	0.8460167	0.405	0.15	lag one period
			0.12	*3.18*			
Mexico	30		-0.0221018	0.3292521	0.0326	0.3	still negative
			-0.47	*1.69*			
Colombia	29		0.051322	0.9419091	0.5435	0.25	
			1.12	*5.93*			
Venezuela	19		0.3170445	0.6761989	0.6396	0.1	
			1.47	*5.64*			
Peru	9		0.1379862	0.7729147	0.9166	0.45	
			3.44	*9.41*			
Uruguay	9		0.0028307	0.9655608	0.9853	0.4	
			0.17	*21.5*			
Paraguay	18		0.1222978	0.2865239	0.1019	0.2	
			0.94	*0.92*			
Costa Rica	37		0.032548	0.6962928	0.3218		lag one period
			1.2	*4.22*			
Ecuador						will not turn positive	
El Salvador	37		0.0544333	1.031692	0.8251		lag one period
			2.12	*12.48*			
Guatemala	26		0.1748422	0.8609066	0.7345		
			3.53	8.13			
Panama	32		0.1817003	0.9896063	0.763		
			3.34	9.7			

Table 7

Equation 5: Difference CPI_PPI

Country	# Observations	Intercept	Coefficient on difference CPI_PPI	Coefficient on change net capital productivity	Adjusted R^2
Argentina	38	0.033446	-0.0033266	0.7788365	0.6966
			-0.97	*9.32*	
Brazil	39	0.056449	-0.0081162	0.6767388	0.2828
			-1	*3.46*	
Chile	38	0.045602	0.0094617	0.7577427	0.6152
			1.68	*7.6*	
Mexico	39	0.04964	0.08181	0.8022	0.48
			0.65	*5.73*	
Colombia	38	0.04368	-0.1263716	0.8863344	0.5994
			-2.33	*7.5*	
Venezuela	38	0.029568	0.0246589	0.650746	0.54
			0.37	*6.54*	
Peru	25	0.03971	-0.00352	0.8987348	0.92
			-2.13	*14.96*	
Uruguay	32	0.021371	-0.0004448	0.6195687	0.6991
			-0.04	*8.66*	
Paraguay	26	0.073242	0.1350064	0.4916203	0.1683
			1.44	*2.26*	
Costa Rica	38	0.056896	0.1498205	0.419883	0.3515
			-0.09	*2.48*	
Ecuador	20	0.04847	0.08517	-0.6199	0.46
			-1.16	*-3.51*	
El Salvador	37	0.0416	-0.0523	1.022	0.81
			-1.98	*12.53*	
Guatemala	26	0.044275	0.1962489	0.7202276	0.6502
			1.97	*5.68*	
Panama	32	0.05939	-0.2502352	0.9888337	0.7395
			-2.75	*9.24*	

Table 8a

Equation 8: PPI PPIsquared
Testing for nonlinearity

	PPI	PPIsquared	Adjusted Rsquared	Test statistic
Argentina	-0.01027	0.0002051	0.2662	**-0.009290822**
t	*-2.75*	*1.76*		
Brazil	-0.00551	0.0001445	0.0688	**-0.00460972**
	-1.32	*0.83*		
Chile	-0.03908	0.0032865	0.2045	**-0.033935185**
	-3	*2.32*		
Colombia	-0.07876	0.159479	-0.0435	**-0.019103306**
	-0.43	*0.32*		
Venezuela	-0.02906	-0.0534668	0.1598	**-0.049900159**
	-0.34	*-0.61*		
Peru	-0.01049	0.0001359	0.3413	**0.034478**
	-3.35	*2.82*		
Costa Rica	-0.24927	0.1711137	0.3696	**-0.198033558**
	-3.99	*2.74*		
Ecuador	-0.1492	0.173053	0.0494	**-0.04941994**
	-0.94	*0.89*		
El Salvador	-0.00175	0.470869	0.0433	**0.067782776**
	-1.84	*1.78*		
Guatemala	0.002332	-0.7946946	-0.0097	**-0.099546333**
	1.1	*-0.65*		
Mexico	-0.14923	0.0685041	0.4038	**-0.112872674**
	-3.21	*1.75*		
Paraguay	0.171488	-0.5166321	0.03925	**0.033332576**
	1.02	*-1.16*		
Panama	0.269721	-0.8588677	0.04784	**0.074214258**
	1.89	*-1.28*		
Uruguay	0.000496	-0.0418394	0.04167	**-0.044439316**
	0.62	*-0.68*		

Table 8b

Equation 9: PPI PPIsquared CPI

	PPI	l.PPI	PPIsquared	l.PPIsqu	CPI	Adjusted Rsquared
Argentina		0.0035035		0.0000492	-0.00458	0.18
t		*0.85*		*-0.39*	*-3.25*	
Brazil	0.011969		0.0001219		-0.01688	0.1336
	1.26		*0.72*		*-2*	
Chile		0.0209781		-0.003428	-0.0173	0.3505
		1.63		*-2.56*	*-2.28*	
Colombia	0.120576		-0.1271455		-0.11298	-0.0364
	0.44		*-0.21*		*-1.11*	
Venezuela		0.0525847		0.0366033	-0.13129	0.2488
		0.43		*0.34*	*-2.86*	
Peru		0.0216194		-0.000311	-0.00604	0.1624
		1.33		*-1.31*	*-1.83*	
Costa Rica		-0.0652581		0.0952754	-0.09688	0.1818
		-0.68		*1.16*	*-2*	
Ecuador		0.0264984		-0.03728	-0.02956	-0.1604
		0.14		*-0.18*	*-0.41*	
El Salvador	-0.0016		0.4611283			0.019
	-1.55		*1.71*			
Guatemala	0.564076		-0.7946946		-0.38692	0.1583
	2.37		*-0.65*		*-2.36*	
Mexico		0.0102957		0.0180009	-0.09439	0.3502
		0.17		*0.42*	*-3.69*	
Paraguay	0.031566		-0.4524183		0.187947	0.0163
	0.16		*-1.03*		*1.4*	
Panama	.0116765		-1.585891		.8563865	.0891
	.05		*-1.95*		*1.52*	
Uruguay	0.066731		-0.0487201		-0.02277	-0.0496
	0.86		*-0.83*		*-0.91*	

Table 9

Granger Causality Wald tests

Argentina

Dep. Var.	Indep. Var.	chi2	df	Prob > chi2	Dep. Var.	Indep. Var.	chi2	df	Prob > chi2
GDP	PMayor	3.0012	2	0.223	GDP	PPI	2.9049	2	0.234
GDP	CPI	2.7634	2	0.251	GDP	ALL	2.9049	2	0.234
GDP	ALL	5.8912	4	0.207					
PMayor	GDP	1.4743	2	0.478	PPI	GDP	1.3752	2	0.503
PMayor	CPI	17.272	2	0.000	PPI	ALL	1.3752	2	0.503
PMayor	ALL	19.307	4	0.001					
CPI	GDP	.86114	2	0.650					
CPI	PMayor	24.154	2	0.000					
CPI	ALL	26.636	4	0.000					

Brazil

Dep. Var.	Indep. Var.	chi2	df	Prob > chi2	Dep. Var.	Indep. Var.	chi2	df	Prob > chi2
GDP	PMayor	.39352	2	0.821	GDP	IPA	1.22	2	0.543
GDP	CPI	.24492	2	0.885	GDP	ALL	1.22	2	0.543
GDP	ALL	1.4509	4	0.835					
PMayor	GDP	1.9479	2	0.378	IPA	GDP	5.2157	2	0.074
PMayor	CPI	8.8457	2	0.012	IPA	ALL	5.2157	2	0.074
PMayor	ALL	15.103	4	0.004					
CPI	GDP	1.9408	2	0.379					
CPI	PMayor	7.7343	2	0.021					
CPI	ALL	13.028	4	0.011					

Chile

Dep. Var.	Indep. Var.	chi2	df	Prob > chi2	Dep. Var.	Indep. Var.	chi2	df	Prob > chi2
GDP	PMayor	9.7297	2	0.008	GDP	PMayor	14.187	2	0.001
GDP	CPI	4.4827	2	0.106	GDP	ALL	14.187	2	0.001
GDP	ALL	20.902	4	0.000					
PMayor	GDP	5.2731	2	0.072	PMayor	GDP	4.8286	2	0.089
PMayor	CPI	1795.7	2	0.000	PMayor	ALL	4.8286	2	0.089
PMayor	ALL	2033.1	4	0.000					
CPI	GDP	3.7105	2	0.156					
CPI	PMayor	5.1439	2	0.076					
CPI	ALL	7.2668	4	0.122					

Table 9 continued

Colombia

Dep. Var.	Indep. Var.	chi2	df	Prob > chi2	Dep. Var.	Indep. Var.	chi2	df	Prob > chi2
GDP	PMayor	3.1545	2	0.207	GDP	PMayor	.56176	2	0.755
GDP	CPI	4.9504	2	0.084	GDP	ALL	.56176	2	0.755
GDP	ALL	5.4152	4	0.247					
PMayor	GDP	2.5391	2	0.281	PMayor	GDP	5.8854	2	0.053
PMayor	CPI	8.0837	2	0.018	PMayor	ALL	5.8854	2	0.053
PMayor	ALL	14.794	4	0.005					
CPI	GDP	.22947	2	0.892					
CPI	PMayor	5.3224	2	0.070					
CPI	ALL	6.4229	4	0.170					

Costa Rica

Dep. Var.	Indep. Var.	chi2	df	Prob > chi2	Dep. Var.	Indep. Var.	chi2	df	Prob > chi2
GDP	PMayor	2.6326	2	0.268	GDP	PMayor	3.092	2	0.213
GDP	CPI	1.5142	2	0.469	GDP	ALL	3.092	2	0.213
GDP	ALL	4.7362	4	0.315					
PMayor	GDP	33.769	2	0.000	PMayor	GDP	44.681	2	0.000
PMayor	CPI	11.115	2	0.004	PMayor	ALL	44.681	2	0.000
PMayor	ALL	69.59	4	0.000					
CPI	GDP	24.757	2	0.000					
CPI	PMayor	11.828	2	0.003					
CPI	ALL	86.592	4	0.000					

Ecuador

Dep. Var.	Indep. Var.	chi2	df	Prob > chi2	Dep. Var.	Indep. Var.	chi2	df	Prob > chi2
GDP	PMayor	1.0044	2	0.605	GDP	PMayor	.85009	2	0.654
GDP	CPI	.97651	2	0.614	GDP	ALL	.85009	2	0.654
GDP	ALL	1.8727	4	0.759					
PMayor	GDP	38.79	2	0.000	PMayor	GDP	16.841	2	0.000
PMayor	CPI	11.774	2	0.003	PMayor	ALL	16.841	2	0.000
PMayor	ALL	39.63	4	0.000					
CPI	GDP	28.185	2	0.000					
CPI	PMayor	22.777	2	0.000					
CPI	ALL	38.975	4	0.000					

El Salvador

Dep. Var.	Indep. Var.	chi2	df	Prob > chi2	Dep. Var.	Indep. Var.	chi2	df	Prob > chi2
GDP	PMayor	1.8817	2	0.390	GDP	PMayor	1.7814	2	0.410

Table 9 continued

GDP	CPI	.9046	2	0.636	GDP	ALL	1.7814	2	0.410
GDP	ALL	2.7348	4	0.603					
PMayor	GDP	.18542	2	0.911	PMayor	GDP	.24321	2	0.885
PMayor	CPI	.22185	2	0.895	PMayor	ALL	.24321	2	0.885
PMayor	ALL	.46669	4	0.977					
CPI	GDP	.00521	2	0.997					
CPI	PMayor	.04059	2	0.980	not significant				
CPI	ALL	.0481	4	1.000					

Guatemala

Dep. Var.	**Indep. Var.**	**chi2**	**df**	**Prob > chi2**	**Dep. Var.**	**Indep. Var.**	**chi2**	**df**	**Prob > chi2**
GDP	PMayor	1.9562	2	0.376	GDP	PMayor	3.7953	2	0.150
GDP	CPI	.95963	2	0.619	GDP	ALL	3.7953	2	0.150
GDP	ALL	4.9066	4	0.297					
PMayor	GDP	4.8372	2	0.089	PMayor	GDP	.84151	2	0.657
PMayor	CPI	14.429	2	0.001	PMayor	ALL	.84151	2	0.657
PMayor	ALL	15.777	4	0.003					
CPI	GDP	.85534	2	0.652					
CPI	PMayor	.68968	2	0.708					
CPI	ALL	2.8055	4	0.591					

Mexico

Dep. Var.	**Indep. Var.**	**chi2**	**df**	**Prob > chi2**	**Dep. Var.**	**Indep. Var.**	**chi2**	**df**	**Prob > chi2**
GDP	PMayor	4.1262	2	0.127	GDP	PMayor	1.3845	2	0.500
GDP	CPI	4.7407	2	0.093	GDP	ALL	1.3845	2	0.500
GDP	ALL	6.2889	4	0.179					
PMayor	GDP	.61288	2	0.736	PMayor	GDP	1.6247	2	0.444
PMayor	CPI	2.2229	2	0.329	PMayor	ALL	1.6247	2	0.444
PMayor	ALL	4.0284	4	0.402					
CPI	GDP	.3118	2	0.856					
CPI	PMayor	1.4656	2	0.481	less				
CPI	ALL	2.6469	4	0.619					

Panama

Dep. Var.	**Indep. Var.**	**chi2**	**df**	**Prob > chi2**	**Dep. Var.**	**Indep. Var.**	**chi2**	**df**	**Prob > chi2**
GDP	PMayor	8.9582	2	0.011	GDP	PMayor	1.4802	2	0.477
GDP	CPI	7.2526	2	0.027	GDP	ALL	1.4802	2	0.477
GDP	ALL	9.0795	4	0.059					
PMayor	GDP	.45694	2	0.796	PMayor	GDP	1.1025	2	0.576
PMayor	CPI	2.3367	2	0.311	PMayor	ALL	1.1025	2	0.576

Table 9 continued

PMayor	ALL	3.0422	4	0.551
CPI	GDP	.5098	2	0.775
CPI	PMayor	.69369	2	0.707
CPI	ALL	1.283	4	0.864

Paraguay

Dep. Var.	**Indep. Var.**	**chi2**	**df**	**Prob > chi2**
GDP	PMayor	2.2293	2	0.328
GDP	CPI	2.7269	2	0.256
GDP	ALL	2.8761	4	0.579
PMayor	GDP	.75568	2	0.685
PMayor	CPI	.38254	2	0.826
PMayor	ALL	1.411	4	0.842
CPI	GDP	.76749	2	0.681
CPI	PMayor	1.1057	2	0.575
CPI	ALL	1.7597	4	0.780

Dep. Var.	**Indep. Var.**	**chi2**	**df**	**Prob > chi2**
GDP	PMayor	.13392	2	0.935
GDP	ALL	.13392	2	0.935
PMayor	GDP	1.0123	2	0.603
PMayor	ALL	1.0123	2	0.603

Peru

Dep. Var.	**Indep. Var.**	**chi2**	**df**	**Prob > chi2**
GDP	PMayor	1.5528	2	0.460
GDP	CPI	1.4666	2	0.480
GDP	ALL	2.8612	4	0.581
PMayor	GDP	11.197	2	0.004
PMayor	CPI	159.4	2	0.000
PMayor	ALL	216.69	4	0.000
CPI	GDP	11.188	2	0.004
CPI	PMayor	103.87	2	0.000
CPI	ALL	140.25	4	0.000

Dep. Var.	**Indep. Var.**	**chi2**	**df**	**Prob > chi2**
GDP	PMayor	1.3143	2	0.518
GDP	ALL	1.3143	2	0.518
PMayor	GDP	7.4966	2	0.024
PMayor	ALL	7.4966	2	0.024

Uruguay

Dep. Var.	Indep. Var.	chi2	df	Prob > chi2
GDP	PMayor	4.7556	2	0.093
GDP	CPI	6.8543	2	0.032
GDP	ALL	6.9025	4	0.141
PMayor	GDP	9.1787	2	0.010
PMayor	CPI	12.267	2	0.002
PMayor	ALL	23.307	4	0.000
CPI	GDP	.42282	2	0.809
CPI	PMayor	49.688	2	0.000
CPI	ALL	50.971	4	0.000

Dep. Var.	Indep. Var.	chi2	df	Prob > chi2
GDP	PMayor	.0278	2	0.986
GDP	ALL	.0278	2	0.986
PMayor	GDP	8.4072	2	0.015
PMayor	ALL	8.4072	2	0.015

Table 9 continued

Venezuela

Dep. Var.	Indep. Var.	chi2	df	Prob > chi2	Dep. Var.	Indep. Var.	chi2	df	Prob > chi2
GDP	PMayor	10.025	2	0.007	GDP	PMayor	10.406	2	0.006
GDP	CPI	6.6452	2	0.036	GDP	ALL	10.406	2	0.006
GDP	ALL	17.922	4	0.001					
PMayor	GDP	.21994	2	0.896	PMayor	GDP	.04177	2	0.979
PMayor	CPI	7.4936	2	0.024	PMayor	ALL	.04177	2	0.979
PMayor	ALL	7.5607	4	0.109					
CPI	GDP	.00973	2	0.995					
CPI	PMayor	10.092	2	0.006					
CPI	ALL	12.673	4	0.013					

Chapter 4

An Alternative Model of GDP Fluctuations

Given the body of empirical work surveyed in Chapter 1, I now note that the distinction between the CPI and the PPI is relevant in explaining GDP growth in Latin America, and that the existing literature does not address this distinction. There is, however, an approach to growth and cycles associated with the work of Paul Simek in the Mathematical Appendix to a volume that is to be published shortly. The Simek model does provide an explanation for my results. In this chapter, I will present the Simek model and develop its implications for the empirical study of the last chapter.

This model views the economic process as a circular flow, where economic values flow into and out of production units. The proportions in which inputs flow into a pole, are described by *technical coefficients*, those that describe the composition of the outflowing streams, are called *distribution coefficients*.

Mathematically, these coefficients are defined as follows:

$$\Gamma_{kj} = X_{kj}/X_j \qquad\qquad \delta_{jk} = X_{jk}/X_j$$

technical coefficients distribution coefficients

There are many business sectors, and Γ_{kj} are the inputs that flow from sector k into sector j, and δ_{jk} are the proportions in which factors flow out of sector j into the k other

sectors. The Simek model works with the distribution coefficients because it considers the technical coefficients that are used in the neo-classical production function as not suited for dynamic macroeconomic analysis as their use requires the assumption of *constant returns to scale*. The distribution coefficients, on the other hand, can capture cumulative processes, and the assumption of constant returns to scale, which is not realistic, is obsolete.

Every undergraduate macroeconomics textbook contains the circular flow model of national income accounting. The sum of all output must equal the sum of all income.

The starting point in the Simek model is the following algebraic equation:

(1) $$x_{1j}p_1 + x_{2j}p_2 + x_{3j}p_3 + ... + x_{nj}p_n + \hat{Y}_j = x_j p_j$$

It represents production costs, where x_{1j} is that quantity of an input good which is carried from sector 1 to sector j, to be processed there. p_1 is the price of this good, the nominal price as it appears in the market. The model does not focus on the determination of these prices. The products of all quantities and prices are added up and also added is a term representing various kinds of value-added (wages, etc ($\hat{Y}_j$).[11] Now a mathematical trick is used to derive the distribution coefficients. We multiply and divide each term on the left-hand side by $x_{k,k=1-n}$. The first term then turns out to be the distribution coefficient x_{jk}/x_j, which I will call $\delta_{1j,}$ the second term is the income of this sector - $x_1 p_{1,} y_1$. The equation can now be expressed as follows.

(2) $$\delta_{1j}y_1 + \delta_{2j}y_2 + \delta_{3j}y_3 + ... + \delta_{nj}y_n + \hat{Y}_j = y_j$$

[11] Incidentally, the prices of services are not in the producer prices index, but in the consumer price index, which in the model is irrelevant for growth.

This equation represents one business sector. N business sectors are represented by n such equations, where all distribution coefficients δ_{kj} form a (transposed) matrix Δ. The matrix has two parts, reflecting the two sectors of the economy, as this model sees them: the consumer goods sector and the producer goods/technological goods sector.

$$\begin{array}{l|l} \delta_{11} \quad \delta_{21} \quad \delta_{31} \quad \ldots \delta_{h1} & 0 \quad 0 \ldots 0 \\ \ldots \quad \ldots \ldots \quad \ldots \ldots \quad \ldots \ldots \ldots \ldots & \\ \delta_{1h} \quad \delta_{2h} \quad \delta_{3h} \quad \ldots \delta_{hh} & 0 \quad 0 \quad \ldots 0 \\ \hline \delta_{1h+1} \quad \delta_{2h+1} \; \delta_{3h+1} \ldots \delta_{h\,h+1} & 0 \quad 0 \quad \ldots 0 \\ \ldots \quad \ldots \quad \ldots \ldots \quad \ldots \quad \ldots \ldots & \\ \delta_{1n} \quad \delta_{2n} \quad \delta_{3n} \quad \ldots \delta_{hn} & 0 \quad 0 \ldots 0 \end{array} \longrightarrow \begin{array}{|c|c|} \hline \Delta_t & 0 \\ \hline \Delta_c & 0 \\ \hline \end{array}$$

In compact form, they are written as:

(3) $\Delta y + \hat{Y} = y$

Technological goods are raw materials, intermediate goods and machines. The model allows for a surplus, composed of wages, interest, profits, taxes, etc., to be distributed ($\hat{Y}$). It is there but its composition does not matter for the model dynamics. From the matrix back to a decomposed matrix formulation, we have

(4a) $\Delta_t y_t + \hat{Y}_t = y_t$

(4b) $\Delta_c y_t + \hat{Y}_c = y_c$

and after some manipulation, we wind up with an equation of four terms[12]: on the left-hand side we have the income of the technological goods sector and that of the consumer goods sector, both of which form *effective demand* because income is used by the agents to demand goods and services. In the circular flow model the sum of all the income equals the sum of all the expenditures. On the right-hand side we have output, *effective supply*: those technological goods that are transformed into consumer goods, the first term – output of the producer goods sector with the relevant output coefficients (Δ_c), the consumer good distribution coefficients, and another term which is the same as the second term on the left-hand side. On this side, the income of the consumer goods sector ($\hat{Y}_c$) is to be understood as cost (wages, interest, profits, taxes), as part of supply.

(5a) $$(I - \Delta_t)\, y_t + \hat{Y}_c = \Delta_c\, y_t + \hat{Y}_c$$

effective demand *effective supply*

The author of the model makes a point about time subscripts, which represent the inter-temporality of the model. Prices are different in two subsequent and overlapping production periods, exchange happens at the end of the production periods, at different prices. On the right-hand side, technological goods have been bought at the previous

[12] We add first the left and then the right side of the above system of equations (b), using a summation vector (1), which yields

$\Delta_t\, y_t + \hat{Y}_t + \Delta_c\, y_t + \hat{Y}_c = y_t + y_c$.

If we put the terms into a different order now and use the diagonal *unit matrix* (I) we obtain

$(I - \Delta_t) y_t + (y_c - \hat{Y}_t) = \Delta_c\, y_t + \hat{Y}_c$.

Since the value of all consumer goods ($1 y_c$) in stationary equilibrium equals the sum of all net income ($1\, \hat{Y}_c + 1\, \hat{Y}_t$), the expression in the second parenthesis has the value $1\, \hat{Y}_c$, from which follows equation **5a**.

period's prices and therefore have the subscript t-1 and have the distribution coefficients subscripted also with t-1. On the left-hand side they are bought at this period's prices. This does not mean that the supply "precedes" the demand, the time periods simply overlap.

(5b) $$(I - \Delta_t^t)\, y_t^t + \hat{Y}_c^t = \Delta_c^{t-1}\, y_t^{t-1} + \hat{Y}_c^t$$

Growth starts to happen by reallocation of investment to technological goods, investment which has been made possible from additional growth in the previous production period. Firms expand their productive capacity. This makes some of the distribution coefficients (Δ_t^t) bigger. The output vector (y_t^t) staying the same (no price changes), the first term on the left-hand side becomes smaller – we have a *demand gap*: effective demand is smaller than effective supply. This can be corrected either if *producer goods prices* rise (the PPI) or if *capital productivity*, the quantity produced from existing capital, rises. The implication from this is that prices and output quantity rise concurrently, in the same production period, and causality is hard to establish, much as one would like.

The model represents shortcomings in aggregate demand, which it claims is an unfavorable constellation that is inbuilt in the market economy. It can be corrected, that is, the economy can grow through a rise in producer prices, or, also when a higher quantity is produced from existing resources. These mechanics could be represented by difference equations, however, to explain the basic structure of the model, an algebraic

representation such as above, is sufficient. The model does not answer the deeper question on the origins of growth. It is descriptive and illustrates a succession of events, working from a rise in demand for investment goods that first cause a lack of aggregate demand, but then through higher prices for producer goods coming from this demand for capital goods, the demand gap is remedied, and growth occurs. Alternatively, a rise in capital productivity can close the gap.

The choice of the independent variables of my empirical work is based on this implication. The change in GDP would depend positively on the change in producer prices or the change in capital productivity.

Chapter 5

The Simek Model in Comparison and Contrast to other Circular Flow Models

This chapter attempts to place Paul Simek's circular flow model into the context of major existing economic thought. I do not pretend to be complete in the choice of the authors reviewed or even fair to their importance and impact in terms of the space allocated to them. The intention is to highlight and contrast key aspects of Simek's approach to economic theory with that of previous scholars.

One person's or firm's expenditure is another person's/firm's income. Milton Friedman puts it this way: One man's spending is another man's income. Consequently, when the one man doesn't spend (because he can't or he doesn't want to), the other doesn't have an income. This is the basic idea of macroeconomics. Microeconomic textbooks have the same circular flow model as macro textbooks. This is indicative of current economic thinking which works on the idea that for macroeconomics we just need to add up the microeconomic result. Angus Deaton and John Muellbauer (1980) set out the reigning microeconomic theory in detail. The microeconomic model linking factor markets and goods markets builds on Marshallian demand functions. A budget constraint and ensuing trade-off is involved (adding-up restriction). Also, we have the homogeneity restriction which postulates "absence of money illusion". Somehow, income and prices change proportionately and purchases are not altered as a result of price increases. The adding-up constraint implies that purchases are merely rearranged when changes in prices or income occur. Prices are normalized to unity, which means that we are back to the barter economy. The only

prices that are considered are then relative prices, the price of one good in terms of the other. Deaton and Muellbauer seem to be critical of the microeconomic approach, however they suggest only minor extensions such as kinks and shifts in the budget constraint, and mention that the Keynesian "fallacy of composition" may be no more than an intellectual curiosity. "Group behavior can then be derived as the sum of its parts." As soon as there are many actors (firms, households and the government), we must have a macroeconomic model. And it cannot be the same as the microeconomic one, or an additive version of it.

Prominent circular flow models include those by Sraffa, Pasinetti, Leontief, Kalecki and others. However, contrary to the idea of the circular flow, which is macro, most of these models argue from a microeconomic/supply-side point of view. In the following I will review some of the better-known approaches to the modeling of the economy as a circular flow, and by extension, output fluctuations. These will be compared and contrasted with the Simek model that is supporting this study. It is found that the Simek model has a genuinely macroeconomic approach, which goes beyond the earlier macroeconomic models, of which the General Theory is the most famous.

Sraffa/Production of Commodities by Means of Commodities

Piero Sraffa (1960) has the distinction between *basic* and *non-basic* products, which seems to come close to the producer good/consumer good distinction in the Simek model, basic goods entering into the production of all commodities, and non-basic

products - consumer goods - being no longer means of production. There is the idea of a circular flow (the means of production of an industry are themselves the product of one or more industries). In Simek, the producer goods (technological goods) are output goods of one sector and input goods for the other at the same time, whereas consumer goods are output goods only. This macroeconomic idea is strangely abandoned as Sraffa uses microeconomic arguments in his reasoning on the wage-profit relationship. If wages are reduced the rate of profit will rise. Here, he looks at the cost part of the profit equation, not the revenue part. The straight-line downward-sloping relationship between profits and wages looks like standard neo-classical microeconomics. It is not clear how this would serve for dynamic macroeconomic analysis. "While the rate of profits is uniform in all industries, and depends only on the wage" points to pure supply-side economics. Sraffa's fundamental system of equations is $pA(1+r) + wq = pB$, which looks indeed similar to Simek's original system of equations, except that Simek uses the distribution coefficients, where Sraffa has the technical coefficients. Technical coefficients describe those relations between stream width and pole width as the stream flows into a pole, whereas the distribution coefficients are those that describe the relation as the stream flows out of the pole. They are the structural coefficients that measure the factor proportions in the *output* streams in economic processes. This enables macroeconomic analysis (accumulation) without requiring the assumption of constant returns to scale that all neo-classical models make. It goes back to the definition in the circular flow model by Hans Peter which sees firms or economic sectors as poles among which products flow.[13]

[13] Simek, Mathematical Appendix, P. 1

Importantly, the rate of profit is proportional to the cost of the input. A parallel to Simek's model consists in the irrelevance of the consumer goods sector – the fact that the non-basic industries have no role in the determination of prices – in the Simek model consumer price inflation has no importance for output, as they appear in a term on both sides of the general equilibrium equation. Simek's model does not deal with the distribution of wages, profits, interest and taxes, these are subsumed under net income and their proportion is irrelevant. The model is principally concerned with economic fluctuations and growth, with modeling possible constellations of disequilibrium. Wages, profits, interest and taxes are the surplus that can be distributed after each sector has come up with the necessary replacement expenditure. Sraffa calls the existence of a surplus in his model self-contradictory, as it makes the system under-determined (k independent equations with only k-1 unknowns). In both models the surplus is added to the replacement values. In Sraffa, the emphasis is on price determination as well as rate of profit determination, which is achieved by solving the equation systems. Sraffa's model is concerned with the determination of prices, as are most multi-sector models (see also Leontief), retrieving a positive price vector. The Simek model leaves price determination apart, as it not considered a task relevant for practical purposes. In Simek, prices are determined during the period of reproduction, presumably by supply and demand. They are determined at the macro level. In particular, there is no automaticity in the relation of wages to prices, as firms cannot always pass on higher wages to the consumer in the shape of higher prices, this depends on the macroeconomic environment. The point about prices is whether they rise or fall in the aggregate. If consumer goods prices rise, there is no disequilibrium in the model,

as they appear as part of both effective supply and effective demand. In Sraffa, producer prices rise relative to consumer prices, in Simek we have absolute prices, and both producer prices and consumer prices may rise at the same time.

Sraffa uses the same microeconomic argument with regard to taxes in that higher taxes, just like a higher wage rate, result in higher prices. In his analysis wages and prices also do not move one to one, but this is not due to demand factors but to supply factors where one of the joint products prices rises to make up for an excessive fall in the price of another commodity when the wage falls. I also doubt the usefulness of sophisticated mathematical analyses that result in negative prices and negative quantities of labor. "A change in the wage might create a situation the logic of which requires some of the prices to turn negative." Other authors such as C. F. Manara set up complicated mathematical arguments in support of Sraffa's model, which would work under a set of conditions and assumptions (hypotheses) (Conditions of Viability of the Price System). The Simek model has only positive prices. On the issue of assumptions: the fewer the better. How can a model say something valid about reality, if reality has been abstracted from to the point where it is no longer recognizable? The Simek model works with a minimum of assumptions. It assumes equilibrium in the capital market.

Luigi Pasinetti – A Multi-sector Model of Economic Growth

Pasinetti's model is another example of macro arguments built around microeconomic input-output theory. Pasinetti uses technical coefficients and marries them to demand coefficients of consumption, which is not found in other models. He uses the homogeneity assumption. He works out relative prices as their absolute level cannot be worked out. Initially, there is only one input, labor. The Simek model, by contrast, focuses on capital. There is one lump household sector that demands all final goods, consumption goods and capital (investment) goods. The assumption is that capital goods are required only for the production of consumption goods, while capital goods can be produced from labor alone. Pasinetti further espouses the labor theory of value, prices being proportional to wages, depending on wages. There are no intermediate stages, as sectors are vertically integrated. There are exogenous variables, the model needs either wages or profits to be given. Technology is exogenous, also. There is a successive build-up of complexity and relaxation of assumptions. Inflation plays a role opposite to that in Simek's model. When the general equilibrium condition is violated, inflation ensues. "The two opposite cases as to condition (II.9.3) represent situations of inflation of different types, due respectively to lack of labor and to lack of productive capacity." It is thus a symptom of disequilibrium. In Simek, the rise in producer prices can offset a lack of effective demand, it acts as a *remedy* to disequilibrium.

Nicholas Kaldor – Stability and Full Employment

In Kaldor there is the consumption-goods industry and the investment-goods industry. In a recession, unemployment and unused capacity will be much larger in the investment-goods industry than in the consumption goods industry. The elimination of unemployment would be, then, largely the elimination of unemployment in the investment-goods industries. An increase in activity has to happen in the investment-good industry, therefore. This is similar in the Simek model. By and large, however, the Kaldorian model of the business cycle (The Theory of Economic Fluctuations) is a supply-side model. It draws on the microeconomic distribution between profits and wages, just like Sraffa, Kalecki and other so-called Keynesian economic models (Kaldor's model is called "post-Keynesian theory of growth and distribution"), and in particular on the problem of disproportions between capital and labor, the situation creating problems being scarcity of *equipment* rather than labor. It appears, then, that at the heart of the business cycle, there are some *real* disproportionalities. In Simek, we have *nominal* disproportionalities. It is argued that the government should regulate the propensity to save, which would be to alter the "distribution of income" towards profits, out of which the firm saves. Saving is thus instrumental in this model, and the emphasis is on saving and investment as the triggering force of the cycle, in contrast to Simek's model. The propensity to consume versus save is determined by cultural factors, and very hard to "regulate". An issue is the equality between savings and investment, the absence of which creates problems, whereby the argument is not very clear. In Simek, the equality is 'new saving = new investment', where these come out of the change in output Y'. So we have Y' = S' = I'. So only the new output, or

change in output makes the new saving and investment possible, these are the end result, not the triggering quantities. "Excess capacity" in Kaldor comes not from a lack of aggregate demand but from an excess of machines over labor, a labor scarcity, a pure supply-side problem, and moreover, hard to back up with real economic fact. "As investment activity continues at a high level, excess capacity of equipment is bound to make its appearance". So this is not due to lack of aggregate demand but to over-investment (supply side). Here also, a rise in wages leads to a fall in profits. A macroeconomist would argue that, usually, profits and wages rise together in the course of an economic expansion. Kaldor then depicts a situation in which wages are high and prices are low. How can this happen? "An excess or deficiency of savings could be speedily remedied." Also, the interest rate, the pivotal parameter in neo-classical theory, makes its appearance as the growth-dampening, investment-checking agent. And it has not risen so high due to the high level of demand for loans, but because banks have raised it to ration credit.

Michal Kalecki/Theory of Economic Dynamics

Kalecki's argument also seems to be supply-side driven, in "post-Keynesian" fashion. Prices are determined at the micro level, profit squeeze occurs when the firm's cost becomes too high. We have the Marxist distribution of value-added between the capitalists and the wage earners. Price formation in the industry occurs through

aggregation. The fact that aggregate demand aspects are introduced also, makes Kalecki's theory somewhat all over the place, a unified perspective is hard to find.

In Chapter 11 - Mechanism of the Business Cycle - the model is exposed. It looks static, has a lot of parameters and a lot of assumptions that need to hold. How would, with this wealth of parameters, any practical application be possible? There is no productivity in this model. "The decision to invest is independent of the decision to save." But later Kalecki simply substitutes investment with saving, not very Keynesian. Investment is at the beginning of the cycle. Interestingly, Kalecki uses the output-capital ratio. My study uses this ratio as a measure of capital productivity.

The Classical Dichotomy

Of course there are the nominal and the real variables. It makes sense to talk about real output (the real strength of an economy at constant prices), real wages (purchasing power), and real exchange rates (international comparison). This does not validate the classical dichotomy, however, which claims that changes in nominal variables have no effect on real variables. There is "money illusion" as neo-classical economists would call it, as most people are not trained economists, who adjust for inflation, and make their decisions on the basis of the prices they see. Even if rational agents adjust for inflation, we have a measurement problem: In the macroeconomy, it is nominal quantities that are moved around. Real variables cannot be measured and therefore cannot serve for prediction.

Prices in our model are nominal prices. Producers expand capacity when they see nominal producer prices rise. Nominal variables are "decoupled" from real variables, which causes a lack of effective demand, in the case that prices suddenly fall. Adam Smith draws a distinction between the longer term on the one hand, in which there is more uncertainty, and the short-term transactions and trade on the other. "But though in establishing perpetual rents, or even in letting very long leases, it may be of use to distinguish between real and nominal price; it is of none in buying and selling, the more common and ordinary transactions of human life….though at distant places, there is no regular proportion between the real and the money price of commodities, yet the merchant who carries goods from the one to the other has nothing to consider but their money price." On the other hand, Smith's theory of the universal measure of value, labor, which would later appear in Marx and many others, is incorrect. It is the value-in-use that determines the price of a good, as in today's standard microeconomic theory, not the value-in-exchange. Real prices are a reality behind nominal prices. Real prices are macro and do not influence individual decision-making. We will sometimes adjust for inflation such as when labor contracts are negotiated, or when we lend money and worry about the return (longer-term decisions), but in our every day decisions, we are "money blind". Why would producers ever look at anything but nominal prices, even provided that they operate in a rational manner, more so than consumers? They earn revenue from nominal prices, and cover their cost in nominal prices (they pay nominal wages, nominal interest rates, taxes in nominal terms, etc).

At the time of writing, oil prices are rising phenomenally (disruptions of supply in the Middle East, increased demand in U.S. and China). In neo-classical supply-side theory, this should slow down the world economy as it makes firms' energy costs higher. Yet two of the three relevant economic areas are booming, there is no sign that the high cost of energy is doing much harm.

Aside from modeling the distribution of income between wages and profits and focusing on technical conditions, standard production models also usually deal with relative prices. Relative prices are microeconomic prices. Curiously enough, some of these models invoke Keynes, even though Keynes stands for thinking in macroeconomic terms, with the emphasis on aggregate demand. The post-Keynesian models are supply-side models in disguise (or undisguised). Profit maximization occurs through cost minimization. Real Keynesian-type models would focus on the revenue part of the profit equation. We have in these models one commodity, or two commodities, as well as price, wage and rate of profit determination. The attempt to determine these variables would only make sense if the aim were a planned economy, what other use would it have? Prices here are not determined by the demand for the product, but by production technique, that is on the supply side.

The Simek model can claim to be a true macro model, based on micro foundations. One of the most compelling arguments of the model is that aggregate demand is not the sum of the individual demands, i.e. the total is different from the sum of its parts. This is one of the crucial differences from the classical general equilibrium

model. Carl Walsh writes in a chapter of Principles of Macroeconomics, co-authored with Joseph E. Stiglitz. "We can immediately extend this analysis to the industry and then to the entire economy: as wages increase (at fixed prices), the total amount of labor demanded by all firms together – the market demand for labor – decreases." The simple addition of micro results, which is then declared as the macro result is standard in neo-classical theory. Wages are a case in point. The low wage benefits the individual producer in that it gives him a competitive advantage, and therefore is considered beneficial for the economy as a whole. "Once we have derived the firm's demand curve for labor (which is, naturally, downward sloping) we can derive the total market demand for labor. At a given set of prices, we simply add up the demand for labor by each firm at any particular wage rate. The total is the market demand at that wage.' It is overlooked that well-functioning economies typically have higher wage levels than underdeveloped economies. The aggregate demand aspect of higher purchasing power due to high real wages, which leads to higher profits, does not exist in this world view.

The Simek model has few gross simplifications. Among other things it allows for technical progress by using the distribution coefficients, where many traditional growth models work with constant technical conditions. It is a multi-sector multi-goods model. It would be possible to incorporate capital accumulation into the model by using differential equations. This is not done in the basic model, which uses linear (matrix) algebra, matrix because we have multiple sectors. We are dealing with simple

reproduction. The exercise of applying the model to extended reproduction should be carried out as capital accumulation is central to the market economy or any economy.

Turgot: French Physiocrat

In Reflections on the Formation and Distribution of Riches, Turgot writes "An increase in the money supply will increase prices because more is spent, but since more is spent, less is available to lend, and so interest rates rise: We shall cease to be surprised at this paradox if we remember that the money which is offered on loans is precisely what is saved from one's daily expenditures to be laid by and formed into capital." This contains a demand and a supply argument. The first part of the proposition looks like the quantity theory of money, the second part is doubtful from the perspective of the our business cycle model, as in an expansionary phase, there is ample credit, not least due to the higher interest rates. "This price (the interest rate) is determined, like the price of all merchandise, by the chafering of seller and buyer, by the balance of the offer with the demand. Thus, when there are many borrowers who need money, the interest of money becomes higher; when there are many holders of money who offer to lend it, interest falls." Later it is argued that it may be perfectly possible that prices of commodities and the price of money rise at the same time, the very phenomenon that inflation and the interest rate rise at the same time, namely when the economy is booming and the demand for both goods and loans is high. Maybe this logic is not deep and complicated enough to appeal to neo-classical theory.

Adam Smith/The Wealth of Nations

In the classical tradition, prices "resolve themselves" into three component parts: wages, profits and rent, in varying proportions, and are determined by these. Where is the part on the self interest that leads to the greater good? The most cited passage from the book involves a macroeconomic idea but here, both the micro and the macro level work in the same direction. What is good for the individual is good for the community. This is sometimes true, and sometimes not (fallacy of composition: what is good for the individual can be bad for the total). The fallacy of composition in reverse: what would be good in the aggregate, in our case, disinvestment on the part of producers, to make up for lack of aggregate demand, which has been caused in the first stage of our model through reallocation of resources, will not happen, as it hurts the individual that squanders its assets. In a bank run or capital flight situation, the level-headed would be stupid if he didn't make it for the exit just like everybody else, he would lose his money. "Fear saving" in bad economic times makes sense from the individual's point of view, yet for the aggregate it is disastrous. Simek picks up on the collective good concept and points out that aggregate demand, in certain situations, has the character of a public good. The firm also does not know *when* it would be required to dissave. In Simek, the individual entrepreneur is not supposed to act altruistically. The profit motive is needed for a functioning market economy. Yet the gist of the Wealth of Nations is not at all what neo-liberal economists maintain that Smith, the supposed founder of laisser-faire economics, is all about. There is a lot of text about the common

good, about taxes, the educational system, the justice system, the necessity of regulation, etc.

Wages are not explicitly modeled in Simek's theory on economic fluctuations. As mentioned before, they are part of net income, next to interest, profit, taxes, etc. but, as opposed to the micro models that have been discussed, their proportions are irrelevant for the analysis. This lump variable has no coefficient. This can be considered a weakness of the model, as real wages are an important determinant of growth. Wages are a standard variable in all other growth and cycle models. In Simek's mathematical model they are not crucial, but in other chapters of his book they are dealt with. In the spirit of the model, and in Keynesian tradition, it is the high wages that create more aggregate demand and therefore higher growth, but that are also, and importantly, conducive to higher productivity. (Higher wages lead to the substitution of labor by capital, which increases capital productivity, the other determining variable in the model). Landes (1969) explains the motivator of the industrial revolution in Britain with the "need for labour-saving devices in a textile manufacture whose products lent themselves to mass production; for effective pumping equipment in mines; for ways to make use of mineral fuel in a country with the largest appetite for iron in the world."

Models based on cost, would always argue for low wages as these lower the firm's cost. Wages are one of the three essential variables of neo-classical theory that need to be low, next to interest rates and taxes (the price of labor, the price of capital,

the government). This ignores the pervasive phenomenon that, typically, wages are high in developed and prosperous countries, while they are low in underdeveloped and poor countries. Simek notes that one could argue that higher wages lead to higher prices (a microeconomic argument), which leads to higher growth. The author further remarks that there is no automaticity in this process. However, the lowering of wages – as proposed by the neo-classical model as a solution to problems of lagging output and unemployment – would normally lead to lower prices, and lower prices in Simek's model slow the economy. Further, a wage rule is proposed that on the whole would keep wages constant.

Similarly, in the mathematical model, the government exists only in the form of the taxes, even though government plays an important role in Simek's theory. To the model's defense, it attempts to highlight the mechanism of *economic crises* first and foremost, and, obviously, despite their importance, wages and taxes are not decisive factors. And to Smith's defense, in his time, there were no economic crises of the modern type yet.

Leontief/Input-Output Analysis

Technical coefficients, present in Leontief's input-output analysis, are seen as a coarse simplification of reality, as production processes are not linear. It is conceded that they serve well to represent structured and multi-level processes.[14] They are good for static analysis. However, they indicate the proportion of inputs for the production of a unit of

[14] Paul Simek, Mathematical Appendix, P. 2

a commodity in one sector. Leontief also has the circular flow accounting (identity between National Income received and National Income spent, but here we run into the scale problem due to the use of the technical coefficients. In the model, we have a set of linear equations. Empirically determined input coefficients describe the factor proportions necessary of product i to go into sector j, $x = _{ij}$. Simek defines the technical coefficients in the same way. These coefficients are arranged into a "structural matrix". From this a set of n equations is obtained, each setting the output of one sector equal to the combined inputs of the products from the other sectors. In neo-classical fashion, these are called general equilibrium relationships. It is the equilibrium between total output, call it supply, and the "final bill of goods", call it demand. This household sector is exogenous. In Simek there is no distinction between endogenous and exogenous, everything is endogenous. This is also because there is a time period overlap built in, to express time dynamics. Leontief freely concedes this shortcoming of his model.

Oskar Lange/Marxian formulation of input-output model

'Organic composition of inputs', the ratio of the values of used up means of production c to the value of labour input v, some sort of capital-labor ratio. This ratio does not play a role in the Simek model. There is a technology sector and a consumer good sector, like also in Oskar Lange we have the two divisions. The gross national product has two parts and there are "interbranch flows between them", the labor and the surplus

(roughly v and m of the technology sector go into the capital c (means of production) of the consumer goods sector and so they affect the conditions of equilibrium. Not so in Simek where surpluses are collected in one lump term. But then the technological goods sector income is added to the consumer goods sector income and terms are rearranged. Similarities between the models cannot be overlooked, the model is basically the Leontief input-output system of equations, because of the idea of reproduction, simple or extended. But Simek uses the distribution coefficients. There are investment coefficients in the Lange model, as there is an emphasis on growth, coming about through investment, and with the planning objective in mind, these all need to be determined. Investment appears to be a determining variable. Technical conditions of production and input proportions are important. In Simek, from the very start, the costs of production, which are also the prices, are incorporated in the model and they are the protagonists. Even though Lange speaks about value of surplus, and indicates the value in zloty, prices play no role whatsoever later in the story. The emphasis is everywhere on labor, the systems of equations are solved for labor. Labor is the most important factor in Marxist theory, and also, the plan requires specific values. The analysis then degenerates into a highly mathematical treatment of the influence of investment on growth. In particular it is not clear how trigonometric functions would be helpful in modeling the business cycle as they necessarily imply a period of some constant length, while business cycles in reality are always of different length, and unpredictable.

Simek's model works with the distribution coefficients, those that define the proportions of inputs in an *output* stream. "What matters is what comes out at the end"[15]. Simek derives the distribution coefficients with a mathematical trick (division and multiplication with the same value, the output of a specific sector). A very convenient result is that the assumption of constant returns to scale that the neo-classical model cannot do without, simply can be dispensed with (factor proportions are determined before the process, what happens to them after is just not important), and therefore aggregation is possible without tying oneself into a knot. Things do not change any more as this is about proportions in the output stream. The distribution coefficients make possible the inclusion of technical progress. In neo-classical growth models such as the Solow model, technical conditions are typically exogenous and held constant. If anything they grow at a constant rate. "The model takes as given the behavior of the variable that it identifies as the driving force of growth." In the Simek model one of the determining variables is precisely productivity growth, therefore it is crucial that technical progress be possible in the model. The distribution coefficients are useful for dynamic macroeconomic analysis as they allow aggregation, which the technical coefficients do also, but with the distribution coefficients, we don't need the assumption of *constant returns to scale*, which is so aloof from reality. Aggregation across many sectors is possible and considerations on scale are not relevant.

In Leontief, returns are constant, as in the neo-classical general equilibrium model. In standard microeconomics, in production with one variable input, returns are

[15] Helmut Kohl, former German Bundeskanzler, at the close of the longwinded Maastricht negotiations on European unity

diminishing. Increasing returns, as happens often in real life, particularly in the service industry, of which a major part of current advanced economies consist, does not usually appear in traditional models. The Simek model's use of capital productivity as a determining variable implies *increasing returns to scale*. If capital productivity increases, growth is higher.

In Simek, the distribution coefficients are then also ordered into a matrix as in Leontief, but there are many sectors, both producer good sectors and consumer good sectors. There is also a surplus produced and to be distributed, which is not important, however, for the analysis. Leontief has n production sectors and one final demand sector, called households. This household/final goods sector is called exogenous in Leontief. The chapter says that something has to be exogenous since if all variables were endogenous, the (static) system would be closed, which it cannot be as there is inter-temporality, relationships between inputs and output across periods of time. Simek does not make the distinction between endogenous and exogenous factors, according to Leontief's logic exogeneity is not necessary as different time periods are taken account of, two time periods overlap, and therefore the next period is already modeled, there is a connection into the future. Generally, in neo-classical models there is exogeneity of some variables, usually the government and its actions (taxes, the money supply, etc.) is exogenous.

The concept of equilibrium is a definition. It is born out of a desire for harmony and closure. If things are in equilibrium, everybody is happy and there is no need for

change or effort. Anything can be declared an equilibrium. The general equilibrium proposes a "natural" order to which things revert. This ignores the fact that there is no order in nature in the human sense, order in human social systems needs to be imposed, it is not automatic. There is cybernetics, the science of the regulated systems. An example for this misconception: The market price is the result of a negotiation between buyer and seller, and this so-called equilibrium may not last very long. Either side may feel jilted. Relating to the value-in-exchange theory, Adam Smith and others after him proposed the existence of a *natural price* as opposed to the prevailing market price. There is no natural price, no deeper reality behind what we see. In a free market economy, with free agents, prices are what people are willing to pay at any given moment, and what sellers are willing to accept, a very fleeting "equilibrium". The Simek model uses market prices.

Every now and then, the market economy, by its very nature, experiences a lack of demand. In a laissez-faire kind of environment, this results in a crisis, a recession. In Simek's model, government intervention can smooth this out by closing the aggregate demand gap (it would raise producer prices, the PPI). Alternatively capital productivity (Y/K) can rise. Where does this lack of demand come from? It is not the Keynesian "animal spirits" that every once in a while turn down. These are structural problems that come with a market economy, a "functional defect of the laissez-faire economy". This could be triggered by too little money in circulation. Paul Krugman explains this with a wonderful example, the baby-sitting co-op: "there came a time when relatively few coupons were in circulation – too few – in fact, to meet the co-op's

needs". In the Simek model, the trigger is a reallocation of resources in the producer goods sector.

John Maynard Keynes

In its irony towards the classical theory regarding its inconsistency with real life data, the General Theory reads similar to Paul Simek. Yet Keynes' argument seems tame and incomplete. In the second chapter of the General Theory the revolutionary distinction between the micro and the macro level is made with the example of nominal and real wages. Where classical economists regard the real wage as equilibrating the supply of and demand for labor, Keynes points out that the real wage is a macro phenomenon, determined by the general price level. "The general level of real wages depends on the other forces of the economic system", over which workers have no control, and therefore do not incorporate in their wage negotiations. The classical assumption that workers supply labor according to the real wage is thus far removed from reality. But then he argues that real wages rise because of the microeconomic phenomenon of "increased marginal return to a given capital equipment", not because the price level rises slower or even falls, as is observed in recession, which would be the macroeconomic explanation. The argument sticks with the microeconomic theory that with a given organization, equipment and technique, real wages and the volume of output are uniquely correlated, not because (macro), in an expansion of output, prices will rise, or prices will rise, which causes an expansion of output (Simek), and therefore the real wage falls but because of the microeconomic proposition of the inverse relation

between the real product wage w/p, which considers the price of that particular products of the firm, and the level of employment in that firm. What good is it to measure the real wage in terms of the price of one good? It is a supply-side argument and does nothing to explain the fact that usually, unemployment is lower in the face of rising wages. There is a contradiction.

Keynes' position on interest rates is far from clear. On the one hand he rejects the classical notion of the interest rate equilibrating demand for investment and saving out of a given income. The propensity to save is based on a given income. On the other hand, the interest rate will exercise a "great though not a decisive, influence on the rate of investment". There is vagueness in the phrase "would not deny that the rate of interest may perhaps have an influence on the amount saved out of a given income". Keynes does not argue with the classical proposition that the level of income and the rate of interest "must be uniquely correlated" even if he stresses that *changes in the level of income* are the determining factor. The interest rate is in the end one of the determinants of the system, next to the propensity to consume and the marginal efficiency of capital. In fact, "the scale of investment is promoted by a low rate of interest". And the interest rate is also the opportunity cost of capital (the marginal efficiency of capital has to equal the interest rate).

The difference between Simek and Keynes is furthermore that Keynes argues extensively with psychology, expectations, optimism, pessimism, human nature, morality – as opposed to neo-classical theory where we have the robot, the rational

superhero. In Simek, assumptions on agent psychology are not necessary as this is not motivating for any disturbances, disturbances are structural. Psychology comes second. At the origin of disturbances are structural problems arising from reallocations in different types of incomes that naturally come with a market economy, not due to mistaken behavior on the part of economic agents. Market psychology will then exacerbate the problems. Importantly, prices in the Simek model are *flexible*, they are not sticky and Keynesian-type. This is a realistic assumption. Prices *are* flexible in the market economy, as opposed to wages that tend to be bound up in explicit and implicit labor contracts. It is not the rigidities and imperfections that work against full employment, to put it with Friedman, it is the "natural outcome of a fully operative market process". Disturbances are immanent in the system. Keynes has taken over the classical model and just modified some of its more outrageous assumptions. He was not the revolutionary that people held him to be. Simek criticizes that there has not been any change of paradigm.

The general equation of saving in the Simek model says that new output equals new net investment and equals new saving, Y'=I'=S'. This is mathematically derived in the model. It is not the same as the omnipresent S=I. The Simek equation sets the *change* in output equal to the *change* in investment and the *change* in saving. Thus new saving and new investment are determined by a change in output. Once the economy is on the growth path, it will no longer need rising producer prices and productivity, as now there is the new saving. In Keynes, also, investment and saving are the *result* of the productive process, not its beginning. Current investment is the

"current addition to the value of the capital equipment which has resulted from the productive activity of the period". And saving equals investment, for all the traditional reasons. But then, consumption (and therefore saving) is determined by psychological factors, the marginal propensity to consume. A further item of microeconomic theory, in Keynes there is a *supply price*, which in the short term is determined by marginal prime cost. There is a lengthy consideration of cost, the user cost, which determines the supply price.

With regard to the *significance* of saving, the Simek model works in the spirit of Keynes, Chapter 16 of the General Theory: "Prospective yield wholly depends on the expectation of future effective demand in relation to future conditions of supply." The prospective yield of the marginal new investment is not increased by the fact that someone wishes to increase his wealth, since it depends on the expectation of a demand for a specific article at a specific date. Higher saving does not lead to more employment, on the contrary. Economists who place the emphasis of their models on saving, are not Keynesian in type, but rather classical, based on Adam Smith's notion on saving: "parsimony, and not industry, is the immediate cause of the increase of capital … if parsimony did no save and store up, the capital would never be the greater. Parsimony tends to increase the exchangeable value of the annual produce of the labor and land." In Simek there is no correlation between saving and income, or it might be even negative. Saving is a determined variable, which helps the economy grow when it

is already on the growth path, which makes it self-sustaining. There is little risk that saving will become too high because with the upturn comes some price inflation.[16]

Falling prices may not be an unambiguous indicator for an economic downturn. It is always microeconomic thinking that more individual saving would lead to more growth. In regards to the later topic of this dissertation, Jeffrey Sachs, who proposes convergence theory, and all of neo-classical theory, recommends all developing countries to save and accumulate capital. Save out of what? Aside from the fact that these economists often forget that people need to be able to read and write (human capital) in order to operate a computer (you cannot put a computer in between two banana trees and hope it will create some growth), capital accumulation is at the beginning of the growth cycle in most authors, whereas in Simek, and building on Keynes, it comes at the end. Saving and investment are the determined variables and not the determining ones.

Does the producer price index predict what will happen to consumer prices? In undergraduate textbooks it is taught that sooner or later higher producer prices will be passed on to consumers. Is there any evidence? Maybe it is because there is overlap in the composition of the baskets. The Brazilian producer price index (basket) for instance makes up 60% of the consumer price index (basket). I hypothesize that producer prices are a leading indicator and consumer price inflation follows with a lag, when the economy is booming.

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[16] Simek, Mathematical Appendix

The determination of prices from a set of equations, a central theme in many multi-sector models, is not an issue in Simek's circular flow model. The author considers it a futile exercise. Leontief solves for the prices of each product in the system of equations, but the point of the exercise is not clear and there is no follow-up on it. In Simek, prices serve to put down the value or magnitude of income, they are not being solved for, their importance is of a macro type. In Walras' general equilibrium model, there is one set of equations expressing equality between the prices of the various consumer goods and their respective costs of production. Price and quantity determination is at the heart of all textbook microeconomics (Marshallian partial equilibrium analysis). The determination of the prices of goods and services is based on the theory of exchange. It is only possible if a numéraire is chosen. Neo-classical theory usually operates with the long term, without ever specifying what the long term is (who knows), and equilibrium prices would therefore be long-term prices. Naturally, as this model is not interested in some theoretical long-term results that may never obtain, price determination is not important.

Simek's model does not yield much on technical progress other than that productivity needs to rise for a growth period to set in. It is clear that the model is not using total factor productivity, based on the Cobb-Douglas production function. The author means capital productivity. The fact that labor productivity is not explicitly modeled is objectionable, as it is human capital that propels development. It is the case, however, that capital productivity can only grow when firms seek to substitute machines for labor, and they will only do this when labor becomes scarce, and therefore

too expensive. Labor also becomes more expensive the more productive it is, therefore enhanced capital productivity is the result of enhanced labor productivity. I dismiss at this point the Theory of Real Business Cycles that among other shortcomings assumes that recessions are due to declines in productivity, which rarely occur. Simek also departs from Smith, Keynes, Marx, etc. in regard to the importance of labor, and the labor theory of value with the "unit of labor as the sole physical unit which we require in our economic system." Ironically, the dogged pursuit of the labor theory of value puts Marx in the company of classical supply-side microeconomic theory. Value-in-exchange is a supply-side interpretation of prices, value in use is determined by demand. This distinction is also related to nominal prices on the one hand and real prices on the other. If it is postulated that there is a value in exchange, then real prices are regarded as the relevant quantity. The Simek model deals with nominal prices. Nominal comes from nomen, Latin for "name". There is the aspect of definition. When a buyer says this is so and so much worth to me, he defines the value of the good. A "real" variation in the price for instance would be, as in Say, p. 298, when supply becomes enlarged due to lower labor costs. His maxim: a country is rich and plentiful, in proportion as the price of commodities is low". This stands in direct contrast to the Simek model, and all experience with progress and development: The price level is higher or much higher in advanced countries than in the underdeveloped countries in the world, the most miserable countries having the lowest (absolute) prices.

The other side – Milton Friedman

Friedman says money did not matter in Keynes. Absolutely not true. In Simek, money also matters. Changes in the real quantity of money can affect aggregate demand even if they do not alter interest rates – by the wealth channel, ascribed to Haberler and Pigou. This is a demand channel, along the lines of Krugman: "Print a lot of yen. Dump them over Tokyo". (Krugman's advice on how to deal with Japan's stagnation in the 1990s). People have physically more money in their hands and can spend it and thus create more aggregate demand. This can only be a remedy for extreme situations of total lack of demand, in normal times it would simply lead to consumer price inflation, which is not the aim. Simek subscribes to the quantity theory of money and assigns Friedman's money rule a prominent role in economic policy, possibly a larger role than Friedman himself intended it to have. In this, he is more Friedman than Friedman himself.

There appears to be an inconsistency in Friedman in that on the one hand he *rejects* an interest rate policy, specifically the pegging of the interest rate. "'Fine-tuning' is a marvelously evocative phrase in this electronic age, but it has little resemblance to what is possible in practice". Today everybody speaks about fine-tuning the economy via raising and lowering the interest rate. Arguing with the interest rate is micro, arguing with the money supply is macro. Friedman argues for a monetary rule that will roughly expand the money supply in step with increases in output. On the other hand, however, his theoretical underpinning is supply-side/microeconomic.

Friedman explains the *Gibson paradox* (the uneasy fact (uneasy for neo-classical theory) that investment rises with rising interest rates, not with falling ones), by offering no less than four different channels through which the quantity of money is related to the interest rate, three of them are decidedly demand-related: The impact of higher cash balances on "other spending" and relative prices, therefore higher incomes through the circular flow, which will increase demand for loans. Also rising prices, which reduce the real quantity of money, which makes interest rates rise. Rising prices also induce borrowers to pay higher interest (because they will be able to) and lenders to demand higher rates, the Fisher effect. A phenomenon often to be observed in supply-side theory: Supply-side explanations simply are not sufficient to explain certain empirical facts, and so a little (or lot of) demand theory is needed. The business cycle is not explicitly mentioned in Friedman, logically, because in neo-classical theory it doesn't really exist. It is rather a *time lag* that puts the empirical facts so at odds with academic theory. In Simek, higher interest rates are a result of higher demand for loans in the expansionary phase of the cycle. In Friedman, the central bank will tighten when some inflation is anticipated, which brings rates down. Because central bank money supply tightening brings economic activity down, and as a result rates fall. In his discussion about tight and easy monetary policy, the decisive demand link is not apparent. Friedman later completely abandons the demand aspects and focuses on the opportunity-cost-of-holding-money principle, which leads to the famous Chicago rule: The nominal rate of interest should be zero and in order to achieve this, we must create deflation. This is the exact opposite of what the Simek model proposes. It is supply-side theory in that low prices are taken to lower the firms' cost and therefore stimulate

output. On the one hand, Friedman and Schwartz put the blame for the Great Depression at the doorstep of the young Federal Reserve in that it decreased the money supply by about one third in the wrong moment, on the other Friedman advocates the neutrality of money and deflation. How to make sense of this contradiction? The answer seems to lie in the fact that Friedman argues *microeconomically*. If there were any doubts about this, the following example will clear them: When Brazil embarked on a policy to bring down the rate of price inflation, Friedman perceives the resulting unemployment to have risen not due to the Phillips curve, i.e. slower aggregate demand, but to the fact that wages were too high, as workers had not adjusted their expectations (note that he argues sticky wages, which is a Keynesian idea) and therefore firms would release workers. Unemployment is high because there are the unions with their wage demands and there is the minimum wage. We have the neo-classical voluntary labor supply, and we have a temporary trade-off between inflation and unemployment that is due to unanticipated inflation. Friedman has revealed himself as a pure supply side economist.

Friedman finds an extraordinary stability and regularity in the relationship between the stock of money and prices, which is the focus of his theory, while in Simek the most important and stable relationship is that between prices and output/income.

Joan Robinson/Exercises in Economic Analysis

The transition to the growth path in our model starts by a reallocation of resources from the consumer goods sector to the producer goods sector. This reallocation is desired and follows a rise in producer prices. (by the mathematical formulation of the model this causes a lack of effective demand). This is one of the possible unfavorable constellations of the market economy. It is *not* capital accumulation that comes first. In Joan Robinson, for instance, it *is* capital accumulation. The G family or economy (in her Exercises in Economic Analysis Robinson uses the family as a prime unit to represent an economy. Later, in the discussion of the capitalist economy, even if it is conceded that aspects of the family model cannot easily be applied to the macroeconomy, the gist is precisely that). The families suddenly rouse themselves and decide to embark on a programme of investment. "If they are already fully extended the only way to start investment is to switch some resources from providing for consumption." This looks like Simek's reallocation of resources from the consumer goods sector to the producer goods sector, but in Simek's model, and somewhat counter-intuitively, this is unfavorable and leads to a demand gap, while in Robinson, it is the start of growth.

Robinson takes an extreme position on the question of mathematics. It is hard to follow her verbal description of graphs. There are often several possible outcomes, seemingly arbitrary. There are various technical conditions, and various types of economic behavior can lead to pretty well any pattern of development. One of Robinson's families does not even have to curtail consumption. The emphasis on saving is pervasive. As in neo-classical theory, saving seems to be the starting point of

the cycle. Of two economies that have the same growth ratio, the one with the lower propensity to save has a lower real wage and a lower degree of mechanization. Other pieces from microeconomics: The rate of profit is largely determined by the rate of investment. Firms should carry out the requisite rate of investment (Who determines what is the "requisite" rate?). This is not Keynesian where saving and investment are the determined variables and not the determining ones. In Simek, saving not only does *not* correlate with growth; the two variables may even be negatively related. Too much saving lowers effective demand (fear saving). The Keynesian animal spirits start off or slow down investment. It is the firms who are "eager to invest" or "slack". Excess capacity does not come about through lack of aggregate demand but through over-investment. And the animal spirits do not appear to come from anywhere. Robinson has "de-mechanisation". So that prices drift above capacity level. The effect is to reduce output below capacity and employment declines, a microeconomic cost argument. It also reminds the reader of the negative productivity shocks from real business cycle models, something that has to be found yet. Robinson works with one-commodity models, which Simek rejects. What can be said about the world if there is one good in the model, or two? Simek's model has an indefinite number of goods and sectors. Robinson's model on the exchange economy is microeconomic also. There is another representative agent. Prices are relative prices. Prices in the Simek model by contrast are not relative prices, they are absolute prices, macro prices. "When a number of commodities are subject to cyclical movements and the cycles are reacting upon each other, pretty well anything may happen". Simek asserts that a model is only a model if it predicts a specified sequence of events that must necessarily occur after an event

triggers them, it is not "anything goes". And then Robinson makes up a Utopian economy.

A further important theme of the model is the (lack of) equilibrium between effective supply and effective demand. We have Say's Law, which was formulated mathematically by Walras: There is never any excess supply, as supply creates its own demand, due to the circular flow. Robert Mundell explains that if money is not counted as just another commodity as classical theory does it, then Say's Law is not true. The existence of money makes it not true, or true only if there is equilibrium in the money market. The Simek model has the circular flow and it has equilibrium in the money market, but there *is* excess supply

Léon Walras has this to say on science: "The primary concern of the economist is not to provide a plentiful revenue for the people or to supply the State with an adequate income, but to pursue and master purely scientific truths." These truths, of course, have to be established by mathematics. Yet while it would be agreed that that an economic theory needs to be formulated mathematically, mathematics is a means, the economist's communication tool, it is not an end. If we don't use mathematics as a tool to express our ideas, but let us guide by its logic under some impossible assumptions, the result may well be "pure", but completely useless. Walras's general equilibrium theory is a case in point. This law is said by Keynes to hold only in a pure exchange economy, without money, *in the sense of Walras*. Simek claims that Say's Law does not hold

either in a pure exchange economy, that is the law does not hold even in the sense of Lange. In this, the model is once again unusual and more Keynesian than Keynes.

Interestingly, and again very unorthodox, the Simek model does not make the distinction between growth and cycle. By extension, there is no distinction between structural and cyclical unemployment. It is just the economic crises that interrupt growth and hold economies back.

Chapter 6

Conclusion

The point of this study is to provide a back-up for findings that point towards a positive correlation between price changes and output changes with low and moderate inflation, and thus make a contribution to the "optimal rate of inflation" debate. Generally, the consumer price index is used for such analysis. There is sufficient evidence that the relationship between prices and output is nonlinear, that there is a breakpoint above which the sign of the correlation changes.

I examine the correlation of producer and wholesale prices with output changes for 14 Latin American countries. My findings can be summed up as follows:

- Producer/wholesale prices generally relate positively to real output changes. For four countries, there is a positive correlation from the start. For 8 out of 12 countries, the correlation turns positive when changes in the CPI are included in the regression. I have hypothesized omitted variable bias, the omitted variable being consumer price changes.

- The relationship between producer price changes and changes in output is nonlinear. This confirms findings by other researchers for inflation of consumer prices.

- The evidence for a causal link between producer prices and fluctuations in GDP is mixed. Granger causality from producer prices to output changes could not be established when just changes in producer prices and GDP changes were included. However, when all three variables (changes in PPI, changes in the CPI and changes in GDP) were included, results were more in accordance with my prediction. This confirms the existence of omitted variable bias when changes in the CPI are not accounted for. The Wald test tests for the *significance* of the lagged variables, not for the sign. For the four Central American economies and Uruguay, all small heavily agricultural countries, the fit improves with a one-year lag of producer prices. The lagged producer price relationship is less negative, as there is a lag involved in output expansion, such as planting, sheep and cattle raising. There may be a dialectic relationship. It may be that more investment in capital goods drives up their prices, which then makes producers expand output. Nominal price changes seem to drive real quantity changes. This happens *other things not constant*.

- I have shown that output is more responsive to absolute nominal prices than to relative prices, to the PPI/CPI. Producer prices have been shown to lead consumer prices. In conventional theory, this would be through the mark-up relationship. I suggest it works through the change in output, from producer prices to output to consumer prices. Further research would be required to confirm this result. If the positive effect of producer prices on output can be confirmed by others, then this finding could be used for prediction, or even for

monetary policy. However, as Levine and Zervos (1993) point out, there are difficulties in treating coefficients as elasticities, as this implies that there is causality. They refer to cross country regressions, however.

My research was inspired by Paul Simek's model on GDP fluctuations. The Simek model does not provide a causal explanation for growth, as opposed to neo-classical growth models. It is descriptive. It establishes correlations between changes in output and changes in producer prices and capital productivity, but these are spurious. In the case of the former nominal GDP is driven up by higher producer prices, in the latter the dependent variable is collinear to the independent variable. Simek's main focus is on the investment–saving-output link, not on the variables that drive output change. The Simek model works with nominal quantities throughout, and I have used real GDP changes in this study. The model may provide a back-up to the puzzle of positive inflation aspects, though. Further research is required.

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