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Financial uncertainty and business investment*

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Abstract — *The paper seeks to contribute to the empirical analysis of financial uncertainty and investment from a Post Keynesian perspective. The paper uses the volatility of the exchange rate, the volatility of the stock market index, and the real gold price as indicators for financial uncertainty. An increase in the volatility of a variable is a sufficient, but not a necessary condition for an increase in uncertainty (regarding this variable). The effects of changes in uncertainty on investment are investigated econometrically for the USA, the UK, the Netherlands, Germany, and France. Financial uncertainty has significant negative effects in the USA and the Netherlands.*

Keywords: business investment, uncertainty, financial instability, Keynesian economics, financial systems

JEL-Classification: E12; E20; E22; E25; E61

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1. Introduction

The recent financial turbulences that began in the subprime mortgage sector illustrate once again that financial markets are important sources for instability in capitalist economies. The question how the real sector and in particular business investment is affected by financial turbulences is subject to an intense and ongoing debate. There are several channels through which these effects may take place, among them is an increase in uncertainty.

Post Keynesians have long highlighted that increased uncertainty may dampen the state of long-run expectations of entrepreneurs and thus negatively affect investment expenditures (Keynes 1973). However, there is a tension between the prominent position uncertainty has in Post Keynesian theory and the lack of empirical research this has given rise to. While Post Keynesians have frequently argued that deregulation since the 1970s, in particular of financial markets, has had a depressing effect on investment expenditures (e.g. Davidson 1998), there are hardly any attempts to measure changes in uncertainty empirically and to evaluate their effects on investment. Ferderer (1993a) and Courvisanos (1997) analyze the effects of changes in business expectations on investment, but simply take the link between uncertainty and business expectations for granted.

The paper seeks to contribute to the empirical analysis of the effects of financial uncertainty on investment expenditures from a Post Keynesian perspective. We henceforth use the term *financial uncertainty* synonymously with uncertainty emanating from financial markets. Three indicators for financial uncertainty will be used. Uncertainty on the foreign exchange market and the stock market will be proxied by volatility measures, the volatility of

the nominal effective exchange rate and the stock market index respectively. We argue that with the volatility of a key variable its degree of *unpredictability* also increases. An increase in the volatility of a variable is a sufficient, but not a necessary condition for an increase in uncertainty (regarding this variable). Finally, the gold price will be used as a summary measure for financial uncertainty because gold is often regarded as a 'safe haven' in situations of increased uncertainty.

The uncertainty variables that will be used are similar to those that a burgeoning New Keynesian literature is using. Conceptually the key difference between the Post Keynesian and the New Keynesian approach regarding uncertainty is in the interpretation of the variable. Whereas for New Keynesians an increase in volatility *is* an increase in uncertainty, for Post Keynesians it *serves as proxy* for uncertainty. In the empirical analysis of uncertainty regarding financial variables New Keynesians have focused on the USA and the UK. This paper's main contribution is that it offers a multi-country approach. The effects of changes in uncertainty on investment will be investigated econometrically for the USA, UK, the Netherlands, France, and Germany. Thus we cover countries with different financial systems

The paper is structured as follows. The following section discusses the theoretical background and highlights differences in Post Keynesian and New Keynesian theory. Section 3 reviews the empirical literature on effects of financial uncertainty and investment. Section 4 presents the estimation strategy and discusses the construction of uncertainty variables. Section 5 discusses the econometric results and section 6 concludes.

2. Theoretical background

Fundamental uncertainty is often cited as core concept in defining Post Keynesian economics. Fundamental uncertainty is a result of the fact that economic processes in the real world do not follow ergodic patterns. Under such circumstances no probability distribution for

outcomes can be given. This inability to give probability distributions does not merely reflect the limited knowledge or information processing abilities of humans but is a reflection of the openness of the historical process in which human societies and economies evolve. "Uncertainty in general refers to situations where probability cannot be measured. This immeasurability arises from the nature of the real world" (Dow 1995, 118).

In Post Keynesian Economics several important implications of the concept of uncertainty have been derived. Firstly, uncertainty is the basis for liquidity preference. Investors keep liquid assets despite their low return to maintain flexibility (Davidson 1994, Chap 6). Secondly, some Post Keynesians have derived a privilege of short-run analysis from uncertainty (Vickers 1993). Thirdly, the possibility of structural breaks and sudden shifts in behavior has been highlighted (Lawson 1985, Keynes 1973, 315f). Fourthly, the rejection of ergodicity necessitates open system analysis in historical time, which has far-reaching methodological implications (Lawson 1985).

Within the Keynesian school of thought important aspects of the concept of uncertainty remain subject to debate. One may distinguish between proponents of fundamental uncertainty and proponents of conditional uncertainty (Ramskogler 2006, Chap. 1). The former emphasize the unpredictable nature of the economic environment and (implicitly) maintain that uncertainty is ontologically constant. From this they derive a predominant role for liquidity preference as a means to cope with uncertainty (Davidson 2002, Dunn 2001). This approach can be contrasted with a group of authors who argue that conventionally and institutionally conditioned decision-making can lead to temporal (conditional) stability (Crotty 1994, Dymski 1994). In this approach the institutional setting determines the (behavioral) impact of uncertainty. We build on the latter group in asserting that institutions and conventional behavior can affect the extent of uncertainty (without being

able to annihilate it). It is thus meaningful (and in line with Keynes) to analyze *different degrees of uncertainty*.[1]

Uncertainty can be caused by different areas of the social structure: politics (Keynes' famous example refers to the outcome of World War II), natural phenomena (what are the effects of global warming?), and financial markets among others. This paper will only be concerned with uncertainty emanating from financial markets. This is not intended to privilege financial markets as the prime source of uncertainty. Rather it is motivated by the specific historic experience of financial deregulation since the 1970s and the increased frequency of financial crises thereafter.[2]

New Keynesian economists have also worked extensively on the effects of uncertainty on investment expenditures (Pindyck 1991). However, New Keynesians, while using the same word, in fact have a different notion of uncertainty. Typically by an increase in uncertainty New Keynesians mean a situation where the standard deviation of a variable increases. To Post Keynesians this qualifies as a situation of *risk* rather than uncertainty.

Why would an increase in the standard deviation (with the expected value of the variable unchanged) matter for investment? Neoclassical theory, on which New Keynesian economics is based, offers a theory of the optimal capital stock rather than a theory of investment. Investment is merely the adjustment of the actual to the optimal capital stock. This adjustment will, if there are sunk costs involved in investment (which realistically speaking will be the case), affect the timing of investment. Increases in uncertainty may lead to the delay of investment (Dixit and Pindyck 1994), though Abel et al (1996) have shown

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[1] "The expectation of life is only slightly uncertain. Even the weather is only moderately uncertain." (Keynes 1937, 214). Keynes viewed the world as consisting of different degrees of uncertainty rather than in a dichotomy of uncertainty and probabilistic certainty (Keynes 1973b, Chap. 3; see also Carabelli 1995).

[2] It is, admittedly, not clear whether uncertainty in the fundamental sense has increased since the end of the Bretton Woods system. One could argue that the distribution of uncertainty has changed and that under the flexible-exchange rate arrangements that followed Bretton Woods businesses rather than states carry the burden of uncertainty.

that it may under some circumstances also lead to a (temporary) increase in investment. This has given rise to a substantial empirical literature on uncertainty and investment. The reference system of the competitive market equilibrium itself is not affected, nor is the assumption of rational behavior of individuals (and firms) affected.[3]

The key difference between the New Keynesian and Post Keynesian approach lies in the interpretation of the uncertainty variable. In New Keynesian theory uncertainty *is* the variability of an economic variable. Hence, uncertainty can be measured directly. In contrast, in Post Keynesian theory uncertainty is not directly measurable – it is a latent variable for which an indicator or manifest proxy variable has to be found. This is illustrated in Figure 1, where uncertainty is drawn in an amorphous box with broken lines to highlight that it represents a complex ('soft') social phenomenon. 'Hard' economic measures are drawn in rectangular boxes with solid lines. Note that uncertainty may rise without the proxy variable increasing in value. The volatility of a price variable is thus not equivalent to uncertainty. But if one is willing to assume that with the volatility of a key variable its degree of *unpredictability* also increases, an increase in the volatility of a variable is a sufficient, but not a necessary condition for an increase in uncertainty (regarding this variable). An increase in the volatility of, say, the exchange rate also implies that the uncertainty over the exchange rate has risen. However, there may be an increase in uncertainty (over the exchange rate) that is not expressed in increases in volatility. For example a high current account deficit, a depletion of central bank reserves, or political turmoil may also give rise to increased uncertainty.

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[3] For Post Keynesians uncertainty has more far-reaching consequences. Rather than being some lack of precision of some specific information it is a pervasive feature of the economic world. And it is more fundamental. People do not even know the expected value or its variance. The world is not such that people could form rational expectations. Obviously the above argument applies in different degrees to different areas of social and economic life. If we cross a traffic light at green we can be reasonably certain that other drivers have a similar interpretation of the signal. There will be areas and times when people feel more or less certain about how some economic variables will develop in the future.

Insert Figure 1

In the following we will be using volatility measures (for exchange rates and the stock market) and the real gold price as indicators for uncertainty, however, we stress that these measures are *proxies* rather than the phenomenon (uncertainty) itself. If these proxy variables increase in value, the degree of confidence that individuals have in their forecasts decreases.

3. Empirical literature on financial uncertainty and investment

There already exists a substantial literature on the empirical relationship between uncertainty and investment. However, only a small part of it is concerned with uncertainty emanating from financial markets. Table 1 gives an overview.

Insert Table 1

There are few empirical studies investigating the Post Keynesian concept of the uncertainty and investment relationship. These studies typically deal with an indirect part of the uncertainty-investment relationship, namely the positive relationship between profit expectations and investment. In Figure 1 this represented as separate soft box for business sentiment, which is proxied for empirical research by business surveys. As this relation is not subject of this paper the studies will be summarized only in brief. Anderson and Goldsmith (1997) focus on the impact of profit expectations and the confidence put into these expectations on investments. In the empirical analysis they make use of forward-looking survey data on business executives' expectation. Applying a simple investment function with 'expectation' and 'confidence put into these expectations' (and their lags) as the only

exogenous variables they find that both factors have a high explanatory power and are frequently statistically significant with the correct sign.

Ferderer (1993a) examined the uncertainty-investment link with a Post Keynesian approach on the macro-level. The analysis is done for aggregate investment spending in the USA from 1978 to 1991. He uses the deviation within economic performance forecasts (forecast discord) as an indicator for uncertainty. The uncertainty variable is introduced in two different investment models. The first includes lagged values of real stock returns and the second includes an accelerator term and a cost-of-capital variable. It is shown that the forecast discord explains a significant proportion of the variation in aggregate investment spending. In addition, uncertainty is said to dominate stock returns and interest rates in terms of explaining investment spending.

With a different methodological approach Courvisanos (1997) highlights Keynes behavioural notion of 'susceptibility' of the long-term expectations and links it to a Kaleckian business cycle model. Empirical support is given by case study analysis in the post-war corporate histories of several Australian manufacturing industries. Evidence for the uncertainty-investment relationship is found by comparing historical patterns of capacity utilization, profits and increasing risk measured by leverage ratios. Susceptibility is seen to be explained by two exogenous factors, namely innovation and the role of the state. The compound results in the Post Keynesian literature may be regarded as stylized facts for the expectation-investment relationship. However, these studies do not elucidate the determinants of a variation in the profit expectation. That is, the negative relationship between uncertainty and profit expectation is posited rather than explained.

There is a large empirical New Keynesian literature that investigates the effect of uncertainty on investment (surveyed in Carruth et al 2000). Most of these studies, however, use the volatility of variables such as GDP growth, inflation, and wage costs as uncertainty variables. Only a few use variables which qualify as proxies for uncertainty emanating from

financial markets and, notably, these are often interpreted as proxies for real variables. Pindyck (1986) is the first empirical study in this area. He uses the variance of stock market returns for testing whether uncertainty has an effect on aggregate investment, investment in structures and investment in durable goods. Remarkably, the variance of the stock market returns is interpreted as a measure of aggregate product market uncertainty. The analysis covers the USA for the Period 1963:4 to 1983:4. He finds a significant effect on each dependent variable when the variance of stock market returns is the only independent variable. When a set of additional explanatory variables is applied the uncertainty variable has again a significant effect on aggregate investment and investment in structures, but not on investment in durable goods.

Another study using the variance of the stock market index is Episcopos (1995). The analysis covers a broader 1947 to 1993 period for the USA. Here the variance of the stock market index is interpreted as a proxy for profit variability. In the empirical analysis the variance measures are included in an investment equation with the growth in GDP and the growth in real interest rate as exogenous variables. An increasing variance of stock market volatility was again found to have a significant negative impact on investment growth rates. Baum et al (2008) also use stock market returns as the uncertainty measure but they distinguish between own uncertainty and market uncertainty. Own uncertainty is the volatility of the firm's stock returns and market uncertainty is derived from S&P 500 index returns. The analysis is performed for a panel of US manufacturing firms for the 1984 to 2003 period. In the empirical part they estimate a set of regressions of the investment growth rate on these uncertainty variables, Tobins´s q, the cash flow to capital stock ratio and the debt to capital stock ratio. When the two uncertainty variables are applied separately they show a substantial negative impact on aggregate investment. When both uncertainty measures and their interaction are applied simultaneously the findings suggest a substantial negative effect of own uncertainty and the interaction of own and market uncertainty but a positive effect of the

market uncertainty. Hence, irrespective of the different estimation strategy that is prone to influence the findings the latter result contradicts the previous findings.

Goldberg (1993) and Campa and Goldberg (1995) apply the volatility of exchange rates to explain movements in US aggregate and sectoral investment from 1970 to around 1990. Coming from a New Keynesian tradition the variables are interpreted as price variables; i.e. the dollar exchange rate volatility is assumed to be a determinant of measurable risk. As a price variable it is expected to have primarily a negative impact on investment. However, according to the authors exchange rate variability may even have a positive effect on aggregate US investment, namely from the profit convexity in prices and through a possible increase in the share of production of foreign producers located in the US market. Hence, the sign of the effect of exchange rate volatility on investment is undetermined a priori. The empirical analysis finds weakly negative effects on both the aggregate and sectoral level.

A different approach is found in Ferderer (1993b). Rather than computing a backward-looking variance measure he uses the risk premium embedded in the term structure of interest rates. The risk premium is calculated as the differential between interest expectations and actualized interests. The interest expectation is derived from commercial forecast survey reports. The investigation covers the period from 1969:3 to 1989:1 for the USA. For the empirical analysis a short treasury bill and a long bond risk premium are used. They are included as additional explanatory variables in both a neoclassical and a q-model of aggregate investment. As dependent variable the author uses investment in durable equipment and the value of contracts and orders for new plant and equipment separately. The result shows overall a negative and statistically significant impact on investment spending. Furthermore, uncertainty is found to have a larger impact on investment compared to the other explanatory variables.

Another interesting New Keynesian operationalization of uncertainty is found in Carruth et al (1997). They incorporate the gold price and abnormal returns to holding gold to

explain UK investment expenditures of the industrial and commercial company sector from 1965 to 1995. The gold price as an indicator for uncertainty is legitimated by the reference of gold as a low-risk hedge. The movement in its price is assumed to rise as returns on other less safe assets become more volatile. In addition, gold is said to have a global dimension and might therefore be construed as exogenous. However, the authors acknowledge that it is "not possible to provide a compelling theory that links uncertainty and the price of gold" (Carruth et al 1997, 5).[4] In the empirical analysis the gold price is found to have a significant negative impact on UK aggregate investment in both the short- and the long-run.

With respect to our field of interest the literature exhibits some major limitations. First, there is greater number of New Keynesian than Post Keynesian scholars that have empirically analyzed the effects of uncertainty on investment. This is odd, given the conceptual prominence that uncertainty has in Post Keynesian economics. The Post Keynesian concept of uncertainty seems to be too demanding to encourage empirical research. Second, although several studies include variables that qualify as indicators for financial uncertainty, there is no study that focuses on uncertainty emanating from financial markets. Post Keynesians often directly investigate business expectations and New Keynesians are typically eager to interpret financial uncertainty as a proxy for real uncertainty (that can legitimately be included in a fundamental expected returns function). Given the growing importance of financial institutions and products in capitalistic economies (e.g. Stockhammer 2008) this lack of research on financial uncertainty is rather surprising. Third, the studies reviewed almost exclusively analyze the USA (with one study on Australia and the UK each). All studies are one-country studies; all of them are on Anglo-Saxon countries.

[4] This is a sensible statement. As gold is neither a productive input nor a (regular) means of finance for non-financial businesses, it is indeed not clear, why it should enter the calculation of an optimizing firm (which is what New Keynesians assume). We thus conclude that the gold price makes much more sense in a Post Keynesian framework where uncertainty refers to a business sentiment that is fundamentally a social-psychological phenomenon rather than the hard fact of the variance of a price variable.

Whether the results can be generalized for other economies, in particular those with different financial systems, is not clear.

4. Estimation strategy and data

The present paper contributes to the empirical literature dealing with the uncertainty and investment relationship by focusing on uncertainty originating from domestic and international financial markets. We are using indicators for financial uncertainty and estimating their impact on aggregate investment from 1960 to 2005. It is assumed that financial uncertainty has a negative impact via the profit expectations of financial and non-financial firms. The examination is done for five OECD countries. Since financial uncertainty is not directly observable and we are using indicators, the estimation for several countries is necessary for reliability and validity reasons. The next section comprises the specification of the investment model, the description of the financial uncertainty variables and their computation, and the motivation for the chosen countries.

For the empirical analysis we apply the following investment function:

$$I = f(Y, r, UV);$$

where I, Y and r are real private investment, the real GDP and the real (ex post) long-term interest rate respectively. Annual data from 1960 to 2007 for all variables except those for the computation of the uncertainty variables were taken from the AMECO database. UV is the uncertainty variable.

Three *indicators for financial uncertainty* are used. First, the proxy for uncertainty originating from foreign exchange markets is the volatility of the country-specific nominal

effective exchange rate (UEX).[5] Second, as an indicator for uncertainty originating from domestic financial markets the volatility of the respective stock market index (UST) is used. Monthly data for the nominal exchange rates and the stock market indices from 1960 to 2007 are taken from the *OECD Main Economic Indicators* database. Volatility is computed as follows. The twelve-month moving average of the squared changes of the de-trended first logarithm of the variable is taken.[6] Detrending is necessary to prevent a non-stationary bias, which is especially important for UST. The trend is computed by a Hodrick-Prescott-Filter (power=1000).

Third, to have a more general indicator that covers uncertainty from both domestic and foreign financial markets we moreover apply the real gold price (in national currencies deflated by the GDP-deflator) (UGP). Gold as an asset is often regarded as a "save haven" for investments when returns on other assets tend to be uncertain. But what actually drives the gold price is not as clear. The variation in the price may be caused by a real change in demand for gold as a commodity, by demand for a low-risk hedge as a consequence of any kind of uncertainty – political, economical, financial – or by simple speculation. Nevertheless, it seems plausible to assume that the function as a low-risk hedge outweighs the other possible factors.

The developments of UEX, UST and UGP over time by decade are shown in Table 2. The values for the 2000s are not strictly comparable since they end in 2005 and thus exclude the turbulent year 2007. Exchange rate volatility experienced a sharp increase in the 1970s and 1980s and a reduction thereafter. In part this is due to the introduction of the Euro. Stock

[5] The nominal effective exchange rate is the growth of the trade weighted exchange rates of OECD partner countries. The weights are computed by the average export and import shares of OECD trading partners; the weights were computed for each decade separately. The trade statistics are taken from the OECD Monthly Statistics of International Trade and the exchange rates from the OECD Main Economic Indicators.

[6] Computing a twelve-month moving average means that uncertainty in month t is the average standard deviation of the percentage change of the underlying variable from month t-12 to month t-1.

market volatility shows different patterns across countries. Volatility increased moderately in the USA into the 1980s and dropped thereafter. Similarly in the UK and France volatility peaked in the 1980s (in the UK already in the 1970s) and fell thereafter. In Germany and the Netherlands stock market volatility broadly follows an increasing trend. The real gold price increased sharply into the 1980s and moderated somewhat thereafter.

Insert Table 2

The analysis will be performed for Germany, France, the USA, the UK and the Netherlands. These countries have been chosen to ensure that they contain a wide range of characteristics. The economies differ (at least) along two dimensions with respect to our subject: their degree of openness and their financial systems. France, the USA and the UK have been relatively closed during the first half of the period under investigation,[7] but only the USA can be regarded as relatively closed today. The Netherlands is a small and open economy.[8] Germany, while a large economy, has always had an export-oriented manufacturing sector. The five economies differ substantially with respect to their financial systems. The financial system of Germany is (until very recently) one of the prime examples of a bank-based financial system, while those of the USA, UK and the Netherlands are market-based. France constitutes an intermediate case (Demirgüc-Kunt and Levine 2001). One would expect exchange rate volatility to have a stronger impact in small open economies (or in large, export-oriented economies like Germany) and the stock market volatility as well as the gold price to matter in market-based financial systems. Bank-based financial systems typically imply close relations between banks and firms, where banks aim at providing a

[7] France and UK had an export share between 10 and 20 per cent between from 1970 to 1995. The export share rose steadily to about 30 per cent in 2005.

[8] The export share was already at the 20% mark and has steadily risen to0.56 per cent in 2005.

steady flow of finance to businesses they trust. This implies that they will serve as buffers against shocks from financial markets.

5. Empirical Results

The time series contained in the investment equations were first tested for unit roots. For I, Y, UEX and UGP the ADF tests rejected the null hypothesis that they are I(0) for all countries. For UST the ADF-tests were inconclusive: the null of stationary is rejected in three out of five countries. However, visual inspection suggests that they are not stationary, hence, UST is treated as I(1) for all countries.

To facilitate comparison the same specification is estimated for all countries. As the variables are I(1) and we expect cointegration, error correction models (ECM) were applied. To avoid multicollinearity problems only one uncertainty proxy is included at a time. Two lags of the explanatory variables were included because the initial regressions suffered from autocorrelation problems. The critical values for ECM cointegration (for 50 observations and three cointegrating variables) are 3.82 and 3.45 at the 5% and 10% level (Banjeree et al. 1998). Only a third of the regressions estimated pass the test at the 10% level or better. In the Netherlands and the USA we find cointegration in three and two specifications respectively, for the UK and France in one specification. For the countries where cointegration tests rejected cointegration difference specification were estimated,[9] which confirmed the results of the ECM specifications qualitatively.

Table 3 summarizes the results of the estimations. Irrespective of the uncertainty variable used, the estimation of the investment function show similar results for the standard explanatory variables Y and i. Hence, these common characteristics and slight deviations will be summarized at first. The long-term coefficient on demand is positive and statistically

[9] Available from the authors upon request.

significant at the 1%-level for almost all five countries irrespective of the uncertainty variable that has been included. The long-term elasticity of aggregate investment with respect to GDP is typically close to 1, which is what one would expect because investment shares are rather stable over long periods. The effect of the long-term interest rate is weak. For cases where the cointegration condition holds, a statistically significant long-term impact could only be found for the USA and the Netherlands when UEX and UST is applied respectively. As financial uncertainty and the interest rate may be correlated, we prefer the specifications that include the interest rate.

Insert Table 3.1

Insert Table 3.2

Insert Table 3.3

In the specification with UEX as the uncertainty variable (Table 3.1), the USA and the Netherlands pass the cointegration test (at the 10% level). UEX is statistically significant (at the 1% level) in these cases and has a negative effect on investment. The coefficient estimates are -13.44 and -17.57 respectively. Difference specifications for the countries where the test failed to reject the null of no cointegration, give statistically significant (at the 10% level) effect of (the first lag of) ΔUEX in the UK.

When UST is used as the uncertainty variable (Table 3.2), cointegration is found only for the Netherlands. There UST is statistically significant at the 1 % level with the expected sign. In difference specifications for the other countries statistically significant negative effects were found for the USA (at the 1% level contemporaneous ΔUST) and the UK (at the 5% level for the second lag of ΔUST).

With UGP as the uncertainty variable the cointegration is passed in the USA, and the Netherlands (Table 3.3). The coefficient estimate is only statistically significant in the USA. Difference specifications do not indicate statistically significant effects for the other countries.

Using volatility measures as indicators for uncertainty, the effects of the uncertainty variable are not straightforward to interpret. Therefore, it will be helpful to compare the standardized coefficients on all explanatory variables. To do so the coefficient estimate for each variable is multiplied by the standard deviation of the respective variable and divided by the standard deviation of the dependent variable (standardizing each variable such that it has a mean of zero and a standard deviation of unity will give the same results). Table 4 reports the result of these calculations. For consistency they are performed for all countries, even in the absence of cointegration.

Insert Table 4

In accordance with the literature (Chirinko 1993, Ford and Poret 1992) demand is playing the key role in determining investment in all economies irrespective to the applied uncertainty variable. A standard deviation of GDP growth explains one and a third standard deviations of investment growth for Germany, France and the USA, and about one standard deviation of investment growth for the UK and the Netherlands. As far as the uncertainty variables are significant (and we find evidence for cointegration) they explain between 9% and 15% of the standard deviations of investment growth. The standardized effects of the uncertainty variables are systematically higher than those of the long-term interest rate.

The findings match our expectations regarding country characteristics only partially. Clearly uncertainty seems to be more important in countries with a market-based financial system. Most consistently we find clear evidence that uncertainty plays an important role in the USA and the Netherlands, with some evidence for the UK. No evidence was found for

Germany and France. This suggests that financial systems play a crucial role in the transmission of financial uncertainty. Remarkably openness seems to have little effect on the impact of exchange uncertainty. UEX had a statistically significant effect in the USA (a relatively closed economy) and in the Netherlands, but none in export-oriented Germany.

6. Conclusion

The paper investigated the effect of financial uncertainty on investment expenditures for five countries that vary substantially the structure of their financial system and in their degree of openness. As proxies for financial uncertainty the volatility of exchange rates and of the stock market index as well as the real gold price were used. Overall we found statistically and economically significant effects of financial uncertainty in countries with market-based financial systems. Its effects are clearly smaller and less robust than those of demand, but they are typically larger than those of real interest rates.

These results raise further questions, but have immediate policy conclusions. The results are novel in that a multi-country approach was used. They call for further research in how the role of financial systems and financial uncertainty interact. We are hesitant to draw strong conclusions from the small group of countries that were investigated, but the general direction of the policy conclusions are important enough to be outlined briefly: if market-based financial systems lead to stronger effects of financial uncertainty, then the shift to financial deregulation and the pressures to adopt market-based financial systems, will have important implications for economic stability – economies are likely to be more unstable. To compensate a re-regulation of financial market would be desirable.

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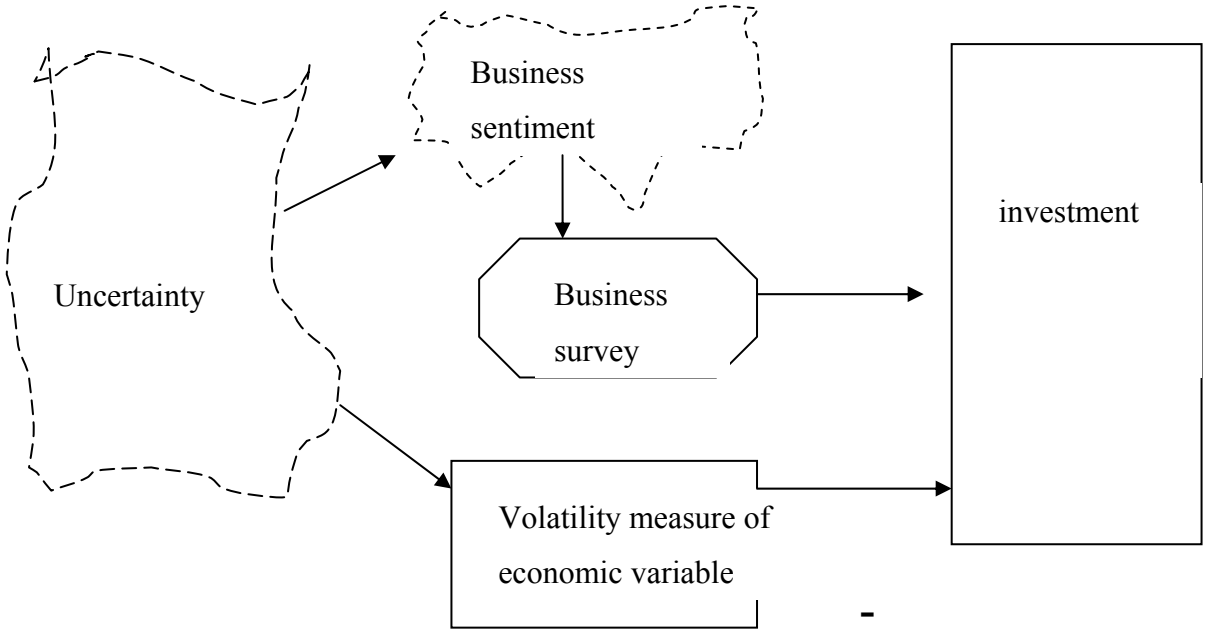
Figures and Tables

Figure 1: Causal Chain of Uncertainty-Investment Relationship



Note. Uncertainty and business sentiment are drawn in amorphous shapes with broken lines to highlight that they are complex social phenomena. Rectangular boxes with straight lines represent 'hard' economic variables. For Post Keynesians uncertainty is a latent background variable and volatilities are proxy variables. For New Keynesians the volatility of an economic variable is uncertainty itself.

Table 1: Overview of empirical studies on the effects of financial uncertainty

Study	Country	Model fundamentals	Uncertainty proxy	Uncertainty effect	Level of dependent var.
Ferderer (1993a)	USA	I=f(real stock price returns) I=f(output, cost of capital)	Cross-forecaster standard deviation of macroeconomic forecast (forecast discord)	negative	macro level
Anderson Goldsmith (1997)	USA	I=f(BEF,WEIGHT)*	Survey data on executive expectations	negative	sectoral level
Courvisanos (1997)	AUS	historical patterns of profits, capacity utilization	leverage ratios	negative	sectoral level
Pindyck (1986)	USA	I=f(stock returns)	Variance of stock market returns	negative	macro level
Episcopos (1995)	USA	I=f(output, cost of capital)	variance of stock market index	negative	macro level
Baum, Caglayan and Talavera (2008)	USA	I=f(Tobins q, cash flow/capital stock, debt/capital stock)***	Variance of (a) firms own and (b) S&P 500 stock returns	(a) negative (b) positive	firm level
Goldberg (1993)	USA	I=f(output, cost of capital)	Exchange rate volatility	weakly/ negative	macro and sectoral level
Ferderer (1993b)	USA	I=f(real capital costs) I=f(average q)**	Risk premium embedded in the term structure of interst rates	negative	macro level
Carruth, Dickerson and Henley (1997)	UK	I=f(output, cost of capital)	Gold price	negative	sectoral level

Note:

* BEF is the business executive forecast and WEIGHT is the confidence associated with that forecast.

** Average q is the ratio of the market value of the firm to the replacement cost of its assets.

*** Tobin´s q is the ratio of the market value of an additional unit of capital to its replacement cost.

Table 2: Descriptive statistics for the uncertainty variables

Volatility of (the logarithm of) the nominal effective exchange rate (UEX)

	Germany	France	USA	UK	Netherlands
1960s	0.006	0.007	0.002	0.006	0.003
1970s	0.014	0.015	0.012	0.016	0.009
1980s	0.010	0.010	0.018	0.024	0.008
1990s	0.009	0.008	0.015	0.019	0.008
2000-05	0.006	0.005	0.014	0.014	0.005

Volatility of (the logarithm of) the stock market index (UST)

	Germany	France	USA	UK	Netherlands
1960s	0.043	0.037	0.037	0.046	0.034
1970s	0.038	0.059	0.040	0.071	0.048
1980s	0.056	0.069	0.048	0.046	0.046
1990s	0.053	0.051	0.025	0.033	0.043
2000-05	0.069	0.048	0.037	0.033	0.050

(Logarithm of the) Real Gold Price in local currency (UGP)

	Germany	France	USA	UK	Netherlands
1960s	4.299	3.313	3.585	3.082	4.086
1970s	4.947	4.364	4.689	4.395	4.866
1980s	6.118	6.011	6.021	6.005	6.109
1990s	5.673	5.686	5.855	5.835	5.672
2000-05	5.703	5.703	5.777	5.759	5.703

Table 3.1: Regression results for investment function with UEX

Dep: Δln I	Germany		t-stat.	FRA		t-stat.	USA		t-stat.	UK		t-stat.	NDL		t-stat.
ln Y(-1)	0,17	**	*2,70*	0,22	**	*2,47*	0,33	***	*4,09*	0,31	**	*2,66*	0,45	***	*3,63*
r(-1)	-0,29		*-0,58*	-0,04		*-0,19*	-0,34	**	*-2,08*	0,34		*1,27*	*-0,15*		*-0,56*
UEX(-1)	-1,40		*-1,34*	-1,13		*-1,42*	-3,09	***	*-3,15*	-1,70		*-1,61*	-8,58	***	*-2,96*
ln INV(-1)	-0,18		*-2,39*	-0,17		*-2,07*	-0,23	*	*-3,67*	-0,26		*-2,75*	-0,49	*	*-3,75*
Δln Y	2,09	***	*9,10*	2,10	***	*7,73*	2,32	***	*16,48*	1,86	***	*5,77*	2,30	***	*6,51*
Δ ln Y(-1)	0,24		*1,03*	0,55	*	*1,77*	0,36	**	*2,41*	0,42		*1,21*	0,12		*0,30*
Δ ln Y(-2)	0,25		*1,09*	0,41		*1,37*	-0,18		*-1,01*	-0,10		*-0,26*	0,68	*	*1,80*
Δ r	-0,35		*-1,04*	-0,03		*-0,10*	-0,10		*-0,36*	-0,30		*-1,19*	*0,01*		*0,04*
Δ r(-1)	-0,28		*-0,70*	-0,26		*-0,94*	0,95	***	*3,30*	-0,37		*-1,33*	*0,79*	**	*2,23*
Δ r(-2)	-0,41		*-1,18*	-0,23		*-0,95*	0,70	***	*2,91*	-0,17		*-0,78*	*-0,13*		*-0,36*
Δ UEX	-0,74		*-0,44*	0,81		*0,56*	-1,79		*-1,65*	1,17		*0,94*	-7,39		*-1,61*
Δ UEX(-1)	-3,10	***	*-1,84*	-1,32		*-1,16*	1,82		*1,51*	0,15		*0,14*	7,85	*	*1,89*
Δ UEX(-2)	0,99		*0,55*	0,27		*0,21*	1,03		*0,74*	1,45		*1,25*	-1,17		*-0,23*
R^2	0,86			0,86			0,95			0,75			0,82		
DW	1,68			1,32			1,17			1,74			2,52		

long-term effects:

Dep: Δln I	Germany	FRA	USA	UK	NDL
Y	0,90	1,31	1,43	1,18	0,91
r	-1,57	-0,23	-1,46	1,30	-0,30
UEX	-7,57	-6,64	-13,44	-6,54	-17,57

Note: *, ** and *** indicate statistical significance at the 10%, 5% and 1% level respectively.

Table 3.2: Regression results for investment function with UST as uncertainty variable

Dep: Δln I	Germany		t-stat.	FRA		t-stat.	USA		t-stat.	UK		t-stat.	NDL		t-stat.
ln Y(-1)	0,20	***	*3,18*	0,28	***	*3,40*	0,13	**	*2,11*	0,21	**	*2,15*	0,50	***	*4,22*
r(-1)	0,17		*0,29*	0,00		*-0,03*	-0,33	**	*-2,21*	-0,11		*-0,31*	*-0,75*	**	*-2,41*
UST(-1)	-0,81	**	*-2,71*	-0,13		*-0,46*	-1,24	***	*-4,21*	-0,53		*-1,36*	-1,87	***	*-3,21*
Ln INV(-1)	-0,21		*-2,75*	-0,21		*-2,65*	-0,09		*-1,85*	-0,20		*-2,35*	-0,51	**	*-4,15*
Δln Y	2,02	***	*8,90*	2,27	***	*7,54*	2,19	***	*15,51*	1,70	***	*5,05*	2,46	***	*6,51*
Δ ln Y(-1)	0,14		*0,58*	0,38		*1,33*	0,12		*0,80*	0,64	*	*1,71*	0,77		*1,67*
Δ ln Y(-2)	0,44	*	*1,84*	0,69	**	*2,37*	-0,36	**	*-2,20*	0,22		*0,53*	0,49		*1,16*
Δ r	-0,33		*-0,97*	0,06		*0,17*	-0,42		*-1,63*	-0,25		*-0,85*	*-0,28*		*-0,82*
Δ r(-1)	-0,83		*-1,67*	0,07		*0,25*	0,85	***	*3,44*	0,21		*0,60*	*0,98*	**	*2,58*
Δ r(-2)	-0,81	*	*-1,95*	-0,14		*-0,54*	0,75	***	*3,32*	0,10		*0,40*	*-0,39*		*-0,94*
Δ UST	-0,56		*-1,57*	0,17		*0,67*	-0,63	**	*-2,06*	-0,40		*-0,97*	-0,81		*-1,61*
Δ UST(-1)	0,32		*0,97*	0,16		*0,52*	0,38		*1,60*	0,69		*1,43*	1,57	***	*3,41*
Δ UST(-2)	0,41		*1,25*	0,29		*0,89*	0,36		*1,31*	0,72		*1,46*	0,70		*1,29*
R^2	0,86			0,83			0,96			0,75			0,81		
DW	1,84			1,30			1,45			2,04			2,09		

long-term effects:

Dep: Δln I	Germany	FRA	USA	UK	NDL
Y	0,95	1,33	1,39	1,06	0,98
r	0,79	-0,02	-3,54	-0,55	-1,46
UEX	-3,87	-0,63	-13,47	-2,65	-3,65

Note: *, ** and *** indicate statistical significance at the 10%, 5% and 1% level respectively.

Table 3.3: Regression results for investment function with UGP as uncertainty variable

Dep: Δln I	**Germany**	*t-stat.*	**FRA**	*t-stat.*	**USA**	*t-stat.*	**UK**	*t-stat.*	**NDL**	*t-stat.*
Ln Y(-1)	0,18	*1,55*	0,35 ***	*3,34*	0,37 ***	*4,11*	0,53 ***	*2,89*	0,43 ***	*3,15*
r(-1)	-0,07	*-0,11*	0,13	*0,55*	-0,28	*-1,22*	0,08	*0,24*	*-0,24*	*-0,56*
Ln UGP(-1)	0,00	*-0,08*	-0,01	*-0,96*	-0,03 **	*-2,59*	-0,03 *	*-2,04*	-0,02	*-0,71*
Ln INV(-1)	-0,21	*-1,60*	-0,27	*-3,06*	-0,24 *	*-3,79*	-0,41	*-3,07*	-0,46 *	*-3,55*
Δln Y	1,96 ***	*7,62*	2,26 ***	*8,07*	2,32 ***	*15,10*	1,67 ***	*4,85*	2,24 ***	*5,67*
Δ ln Y(-1)	0,07	*0,25*	0,25	*0,88*	0,35 **	*2,33*	0,50	*1,43*	0,31	*0,78*
Δ ln Y(-2)	0,30	*1,19*	0,64 **	*2,31*	0,02	*0,13*	0,01	*0,01*	0,35	*0,85*
Δ r	-0,20	*-0,44*	0,18	*0,56*	0,25	*0,66*	-0,32	*-1,21*	*-0,13*	*-0,32*
Δ r(-1)	-0,32	*-0,66*	0,00	*-0,02*	1,26 ***	*4,22*	-0,27	*-1,02*	*0,86* **	*2,12*
Δ r(-2)	-0,45	*-1,19*	-0,14	*-0,55*	0,90 ***	*3,33*	-0,08	*-0,35*	*-0,12*	*-0,29*
Δ UGP	0,01	*0,57*	0,02	*1,06*	-0,01	*-0,67*	-0,05	*-1,34*	-0,01	*-0,20*
Δ UGP(-1)	-0,02	*-0,96*	0,00	*0,15*	0,02	*0,88*	-0,01	*-0,23*	-0,05	*-1,46*
Δ UGP(-2)	-0,01	*-0,21*	0,00	*0,22*	0,01	*0,53*	0,01	*0,28*	-0,02	*-0,61*
R^2	0,83		0,84		0,95		0,75		0,78	
DW	1,55		1,24		1,46		1,74		2,09	

long-term effects:

Dep: Δln I	**Germany**	**FRA**	**USA**	**UK**	**NDL**
Y	0,85	1,31	1,54	1,31	0,94
r	-0,33	0,48	-1,17	0,19	-0,52
UEX	-0,01	-0,04	-0,11	-0,06	-0,05

Note: *, ** and *** indicate statistical significance at the 10%, 5% and 1% level respectively.

Table 4: Standardized Effects

	investment growth		standardized effect per standard deviation of investment growth		
	mean	sd	Y	r	UEX
GER	1.8%	4.4%	1.29	-0.09	-0.14
FRA	3.6%	4.1%	1.28	-0.01	-0.09
USA	3.9%	5.4%	1.24	-0.07	-0.17
UK	3.1%	4.9%	0.99	0.10	-0.15
NDL	2.8%	5.0%	1.08	-0.03	-0.16

	investment growth		standardized effect per standard deviation of investment growth		
	mean	sd	Y	r	UST
GER	1.8%	4.4%	1.37	0.04	-0.31
FRA	3.6%	4.1%	1.30	0.00	-0.03
USA	3.9%	5.4%	1.21	-0.16	-0.40
UK	3.1%	4.9%	0.89	-0.04	-0.18
NDL	2.8%	5.0%	1.16	-0.12	-0.18

	investment growth		standardized effect per standard deviation of investment growth		
	mean	sd	Y	r	UGP
GER	1.8%	4.4%	1.22	-0.02	-0.02
FRA	3.6%	4.1%	1.28	0.03	-0.11
USA	3.9%	5.4%	1.34	-0.05	-0.23
UK	3.1%	4.9%	1.10	0.01	-0.21
NDL	2.8%	5.0%	1.09	-0.05	0.04

Appendix

Table A1: Variable definitions

Notation	OECD Notation	Description	Source
EXCHEB	-	Real Effective Exchange Rates	OECD Main Economic Indicators
Gold Price			BBK statistics
Share Prices		2000=100 All shares	OECD Main Economic Indicators
C	CPV	Private consumption, real	
I	IPV	Private investment, real	
r	IRLR	Long-term real interest rate, deflated by GDP deflator	
M	MGSV	Imports, real	
P	PGDP	GDP deflator	
P_M	PMGS	Import price deflator	
P_X	PXGS	Export price deflator	
R	-	Gross operating surplus, real, deflated by GDP deflator	
RULC	-	Real unit labor costs	
ULC	ULC	Nominal unit labor costs	
W	-	Compensation of employees real, deflated by GDP deflator	
X	XGSV	Exports, real	
Y	GDPV	GDP, real	
YW	GDPV	Trade weighted GDP of main trading partners, real	

Table A.2: Unit Root Test

	Variable	level lags	level sign.	level prob.	diff lags	diff sign.	diff prob.
Germany	ln inv	1	-1,58	0,48	0	-4,32	0,00
	ln y	1	-2,36	0,16	0	-4,26	0,00
	ln r	0	-0,58	0,87	0	-5,73	0,00
	ln ugp	1	-1,96	0,30	1	-5,06	0,00
	r	0	-3,60	0,01	1	-6,16	0,00
	uex	2	-2,08	0,25	1	-5,84	0,00
	ust	0	-3,66	0,01	1	-6,87	0,00
France	ln inv	1	-1,71	0,42	0	-3,59	0,01
	ln y	0	-6,96	0,00	0	-3,55	0,01
	ln r	0	-2,37	0,15	0	-4,86	0,00
	ln ugp	1	-1,96	0,30	1	-5,06	0,00
	r	0	-1,93	0,31	0	-7,44	0,00
	uex	2	-1,86	0,35	1	-6,99	0,00
	ust	1	-2,71	0,08	1	-6,48	0,00
USA	ln inv	2	-0,42	0,90	1	-5,80	0,00
	ln y	0	-1,84	0,36	1	-4,95	0,00
	ln r	0	-1,05	0,73	0	-6,10	0,00
	ln ugp	1	-1,96	0,30	1	-5,06	0,00
	r	0	-1,46	0,55	0	-5,83	0,00
	uex	2	-1,98	0,29	1	-7,05	0,00
	ust	3	-2,60	0,10	3	-4,77	0,00
UK	ln inv	1	-0,47	0,89	0	-4,71	0,00
	ln y	2	0,01	0,95	1	-5,31	0,00
	ln r	3	0,34	0,98	2	-6,23	0,00
	ln ugp	1	-1,96	0,30	1	-5,06	0,00
	i	0	-3,52	0,01	0	-8,42	0,00
	uex	2	-2,21	0,20	1	-8,94	0,00
	ust	2	-2,25	0,19	1	-6,85	0,00
Netherlands	ln inv	1	-1,49	0,53	0	-4,74	0,00
	ln y	1	-2,02	0,28	0	-3,48	0,01
	ln r	0	-0,07	0,95	0	-6,83	0,00
	ln ugp	1	-1,96	0,30	1	-5,06	0,00
	r	0	-1,76	0,39	0	-7,35	0,00
	uex	2	-1,89	0,33	1	-6,01	0,00
	ust	7	-3,99	0,00	1	-8,24	0,00

Table A.3.1 Difference specifications (with UEX as uncertainty variable)

	USA	UK	NL	France	Germany
c	-0,027	-0,026	0,017	-0,015	-0,033
t-stat	*-1,554*	*-1,235*	*0,520*	*-0,917*	*-1,267*
Δln Y	2,325	1,874	2,016	1,954	1,946
t-stat	*12,408*	*5,495*	*4,828*	*7,050*	*8,615*
Δ ln Y(-1)	0,173	0,456	-0,322	0,120	0,090
t-stat	*0,900*	*1,284*	*-0,731*	*0,405*	*0,353*
Δ ln Y(-2)	-0,582	-0,339	-0,231	-0,081	-0,108
t-stat	*-2,742*	*-0,835*	*-0,555*	*-0,333*	*-0,484*
Δ i	-0,374	-0,309	0,041	0,001	-0,329
t-stat	*-0,962*	*-1,200*	*0,093*	*0,002*	*-0,858*
Δ i(-1)	1,002	0,371	0,814	-0,094	-0,292
t-stat	*2,004*	*1,462*	*1,550*	*-0,270*	*-0,653*
Δ i(-2)	-0,613	0,185	-0,417	0,328	0,759
t-stat	*-1,694*	*0,751*	*-0,998*	*1,260*	*2,191*
Δ UEX	-0,984	1,579	-9,813	-0,717	-0,763
t-stat	*-0,722*	*1,496*	*-2,005*	*-0,591*	*-0,409*
Δ UEX(-1)	1,318	-2,459	7,731	-2,486	-3,697
t-stat	*0,633*	*-1,842*	*1,074*	*-1,427*	*-1,383*
Δ UEX(-2)	-0,114	0,970	-4,587	1,239	3,979
t-stat	*-0,074*	*0,969*	*-0,945*	*1,041*	*2,148*
DW	0,791	1,800	2,188	1,247	1,691
R^2	0,88828318	0,65620926	0,60894718	0,79671898	0,78085014

Table A.3.2 Difference specifications (with UST as uncertainty variable)

	USA	UK	NL	France	Germany
c	0,041	-0,010	0,026	-0,045	-0,029
	2,593	-0,409	0,668	-2,043	-1,144
Δln Y	2,051	1,704	2,054	2,141	1,768
t-stat	*14,038*	*4,998*	*4,574*	*6,890*	*7,546*
Δ ln Y(-1)	-0,020	0,743	-0,005	-0,022	0,059
t-stat	*-0,139*	*1,944*	*-0,010*	*-0,068*	*0,213*
Δ ln Y(-2)	-0,593	-0,204	-0,580	-0,039	-0,114
t-stat	*-3,760*	*-0,516*	*-1,199*	*-0,132*	*-0,454*
Δ i	-0,368	-0,103	-0,256	0,104	-0,246
t-stat	*-1,262*	*-0,355*	*-0,554*	*0,313*	*-0,592*
Δ i(-1)	1,080	0,320	0,819	0,062	-0,586
t-stat	*2,841*	*1,182*	*1,495*	*0,159*	*-1,180*
Δ i(-2)	-0,675	-0,187	-0,489	0,217	1,130
t-stat	*-2,495*	*-0,625*	*-1,112*	*0,749*	*2,416*
Δ UST	-0,978	-0,481	-0,584	0,209	-0,614
t-stat	*-3,599*	*-1,180*	*-1,004*	*0,680*	*-1,467*
Δ UST(-1)	0,001	1,220	0,320	-0,209	0,797
t-stat	*0,003*	*1,904*	*0,463*	*-0,489*	*1,636*
Δ UST(-2)	-0,376	-1,052	-0,783	0,067	-0,353
t-stat	*-1,428*	*-2,179*	*-1,377*	*0,198*	*-1,063*
DW	1,399	2,095	2,025	1,036	1,776
R^2	0,935	0,668	0,566	0,712	0,748

Table A.3.3 Difference specifications (with UGP as uncertainty variable)

	USA	UK	NL	France	Germany
c	-0,072	-0,018	-0,101	-0,139	-0,130
	-2,542	-0,592	-0,999	-2,772	-2,832
Δln Y	2,413	1,805	2,253	2,344	2,090
t-stat	*13,803*	*5,056*	*5,249*	*7,414*	*9,131*
Δ ln Y(-1)	0,222	0,579	-0,082	0,164	-0,071
t-stat	*1,248*	*1,541*	*-0,200*	*0,519*	*-0,300*
Δ ln Y(-2)	-0,460	-0,438	-0,267	0,369	0,163
t-stat	*-2,390*	*-1,007*	*-0,646*	*1,172*	*0,695*
Δ i	-0,564	-0,449	-0,146	0,085	-0,399
t-stat	*-1,475*	*-1,624*	*-0,352*	*0,277*	*-1,027*
Δ i(-1)	0,794	0,321	0,870	-0,121	-0,445
t-stat	*1,668*	*1,238*	*1,736*	*-0,331*	*-1,027*
Δ i(-2)	-0,557	0,205	-0,904	0,205	0,251
t-stat	*-1,685*	*0,825*	*-2,031*	*0,762*	*0,665*
Δ UGP	0,004	-0,053	0,002	0,024	0,019
t-stat	*0,225*	*-1,464*	*0,075*	*1,211*	*0,932*
Δ UGP(-1)	-0,028	0,066	-0,077	-0,035	-0,049
t-stat	*-0,992*	*1,132*	*-1,753*	*-1,097*	*-1,612*
Δ UGP(-2)	0,034	-0,013	0,090	0,027	0,052
t-stat	*1,757*	*-0,366*	*3,110*	*1,257*	*2,542*
DW	0,891	1,983	2,240	1,137	1,783
R^2	0,901	0,643	0,638	0,749	0,796

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