

Abrahamsen, Yngve; Hartwig, Jochen

Working Paper

Inventory investment and production in Europe: Is there a pattern?

KOF Working Papers, No. 271

Provided in Cooperation with:

KOF Swiss Economic Institute, ETH Zurich

Suggested Citation: Abrahamsen, Yngve; Hartwig, Jochen (2011) : Inventory investment and production in Europe: Is there a pattern?, KOF Working Papers, No. 271, ETH Zurich, KOF Swiss Economic Institute, Zurich, <https://doi.org/10.3929/ethz-a-006341658>

This Version is available at:

<https://hdl.handle.net/10419/50442>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

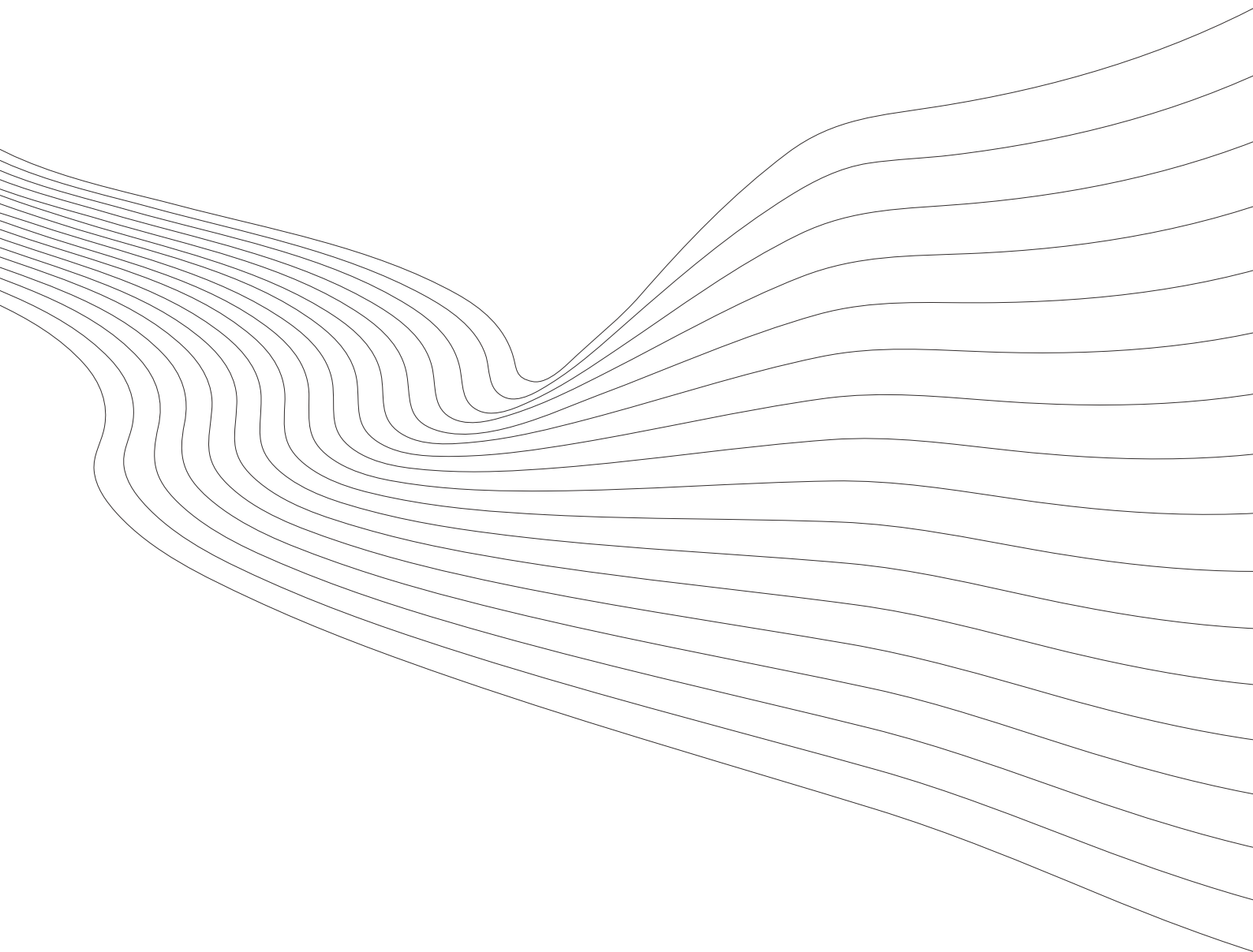
You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

KOF Working Papers

Inventory Investment and Production in Europe:
Is There a Pattern?

Yngve Abrahamsen and Jochen Hartwig



KOF

ETH Zurich
KOF Swiss Economic Institute
WEH D 4
Weinbergstrasse 35
8092 Zurich
Switzerland

Phone +41 44 632 42 39
Fax +41 44 632 12 18
www.kof.ethz.ch
kof@kof.ethz.ch

Inventory investment and production in Europe: Is there a pattern?

Yngve Abrahamsen^a and Jochen Hartwig^{a,b,*}

^a*KOF Swiss Economic Institute at ETH Zurich*

^b*Faculty of Economics, Chemnitz University of Technology*

Abstract

The paper investigates the nexus between inventory investment and the change in aggregate production for 29 European countries over the period 2000-2009. A special interest is taken in the “Great Recession” of 2008/09. For most countries, a fairly uniform pattern emerges. Inventory investment is positively correlated with changes in production and follows the latter with a time-lag of two to three quarters. Therefore, there is no evidence that inventory investment either drives or smoothes the business cycle. Very few countries – Austria, Greece, Spain, and Switzerland – diverge from the typical pattern. This might hint to problems with respect to data quality.

Keywords: Inventory investment, production, business cycle, “Great Recession” in Europe

JEL classification: E22; E32; O52

* Corresponding author. Address: Weinbergstrasse 35, 8092 Zurich, Switzerland. Tel.: +41-44-632-7331. Fax: +41-44-632-1218. E-mail addresses: hartwig@kof.ethz.ch, abrahamsen@kof.ethz.ch

1. Introduction

Research on inventory investment can be sorted along the micro-macro divide or along the theory-empirics divide. Theoretical research is usually microeconomic in nature and integrates inventory investment into the firm's profit-maximization calculus. Two main theory blocks have ensued from this strand of the literature: the production-smoothing model and the (S, s) inventory model (see Blinder and Maccini, 1991, Hornstein, 1998, Ramey and West, 1999). The production smoothing model starts from the assumptions that production is subject to increasing marginal cost and that firms are facing exogenous demand shocks. In this case, firms minimize cost by smoothing production. Hence, this theory predicts production to be less volatile than sales, and inventory investment should be negatively correlated with sales.

The (S, s) inventory theory assumes that firms holding inventories are non-producing firms that order goods from producers. The ordering firm faces a trade-off between the reduced per-unit order cost of increasing order sizes and the foregone interest income of the higher funds needed to pay for larger order sizes. The optimal strategy is then to place an order whenever the level of inventories falls below a critical level s . The order lifts inventories to level S from which sales will reduce it again to level s and so on. If orders are equal to production it follows from this theory that production will be more volatile than sales.

The second strand of the literature is concerned with the empirics of inventory investment and is predominantly macroeconomic in nature. It asks which patterns between inventory investment, production, and sales can be found in the data. This research has uncovered a number of – as Ramey and West (1999) in their review article for the Handbook of Macroeconomics call them – stylized facts. First, inventories move procyclically, which means that inventory investment is positively correlated with sales. Second, production is more volatile than sales. These two findings have been confirmed by Blinder and Maccini (1991), Hornstein (1998), Dimelis (2001), and Wen (2005) for the US, by Chikán and Tátrai (2003), Wen (2005), Chikán et al. (2005), and Chikán and Kovács (2009) for OECD countries, by Wilkinson (1989), Christodoulakis et al. (1995), and Dimelis (2001) for EU countries and by Chikán and Horváth (1999) for a group of 88 developed and developing countries. A recent strand of the literature including Carpenter et al. (1998), Guariglia (1999), Brown and Haegler (2004), Bagliano and Sembenelli (2004), and Guariglia and Mateut (2010) rationalizes the procyclicality of inventory investment by linking the depletion of inventories to financing constraints which are rising during recessions and are becoming less binding during upswings.

That production is more volatile than sales speaks against the production-smoothing model, although Fair (1989) and Krane and Braun (1991) claim to be able to vindicate the latter showing that production is less volatile than sales in a number of manufacturing industries for which data in physical units (as opposed to deflated values) are available. “However, data in physical units are available for precious few industries; so no one knows how general their findings are” (Blinder and Maccini, 1991, pp. 77-8).

Against the backdrop of this literature, our contribution clearly belongs to the second strand. Our aim it is to investigate the nexus between inventory investment and the change in aggregate production for Europe. To our knowledge, ours is the first study for Europe since Wilkinson (1989) to use quarterly data in the analysis and the first study at all to use a large sample of 29 European countries – all 27 EU countries plus the two larger EFTA countries Norway and Switzerland. Also, our study is the first which covers – and actually focuses on – the “Great Recession” of 2008/09. This complies with Dimelis’ (2001, p. 4) claim that “(f)luctuations of inventory investment become particularly interesting over the contraction ... of the cycle”.

The paper is connected to another strand of literature which is, up to now, not very broad. This strand focuses on scrutinizing the quality – or plausibility – of official macroeconomic data. As the production process of macroeconomic data inside the statistical offices is often not transparent for the general public, bystanders usually have no choice but to take for granted the published data. The press sometimes accuses statistical agencies of “book-cooking” (especially those in the US, see for example Grant, 2000 or Häring, 2010). Academic papers on the other hand tend to pay lip-service to the known measurement problems (if at all) and then speedily move to using the official data in empirical applications. Hardly anybody addresses the question “how good” the official macroeconomic data really are. (Note that this statement is not compromised by the fact that there is a strand of literature evaluating the quality of *real-time* macroeconomic data by comparing them with final estimates because this strand does not question the quality of final estimates.)

Our own research forms an exception in this respect. Prior work was motivated by intelligence we had received that the Swiss Federal Statistical Office (OFS) makes unusually strong hands-on calibrations to the first incoming values from the “Statistic on value added”, which is the most important data source for the supply-side calculation of GDP in Switzerland. So our research focused on developing plausibility checks for Swiss GDP and productivity growth figures (see for instance Abrahamsen et al., 2005, Hartwig, 2008). Although such checks cannot “prove” or “disprove” the official data, they suggested that

official figures understate the “true” average Swiss labor productivity growth rate by one third. The present paper also aims at contributing to a better understanding of the quality of macroeconomic data, arguing that a striking divergence of single countries from a typical European pattern – provided such a pattern emerges – speaks in favor of low data quality or an inadequate modeling of inventory investment in the respective country rather than a different behavior of economic agents.

The paper is organized as follows. The next section illustrates the course of production in our 29 countries over the “Great Recession” of 2008/09. In section 3 we then describe the changes in inventories and investigate whether a typical pattern between changes in production and inventories existed over the recession period as well as over the last decade. This approach is new in that it focuses on the change in inventories as such. Thus far, lacking availability of quarterly data had prevented such a focus for Europe. Instead, the discussion of the macroeconomic significance of inventories centered on the “inventory impulse” rather than on the change of inventories (“inventory investment”) as such. The inventory impulse is the change in inventory investment, in other words, the inventory impulse is the second derivative of the aggregate level of inventories, in relation to GDP. While our preferred measure, inventory *investment*, falls on the supply side – it reflects entrepreneurial decisions to expand or to curb production, to produce to stock or to stop production temporarily in order to deplete inventories – the inventory *impulse* falls on the demand side: it is the contribution of inventory investment to GDP growth calculated from the demand side. We turn to the inventory impulse in section 4, but rather for the sake of completeness. The magnitude which is really interesting from the point of view of the business cycle is inventory investment, which we cover in section 3. Section 5 adds additional insight, showing how a comparison of real and nominal inventory investment can be used to check the plausibility of GDP growth rates. Section 6 concludes.

2. The “Great Recession” of 2008/09

Most European countries experienced a sharp economic downturn over the period 2008/09. For EU27 countries and the two larger EFTA countries Norway and Switzerland, Figure 1 shows the cumulated loss in production from the beginning of the downturn onward (as bars) as well as the duration of the downturn (as diamonds). Only Poland got off lightly without a substantial decline in GDP. Also in Slovakia, production dropped only during one quarter. This drop amounted to as much as 8.1% (not annualized) however.

We define the duration of the GDP decline as the period of time between the beginning of the contraction and the quarter in which GDP hit rock bottom. Therefore, a quarter with an increase in GDP still belongs to the contraction period if it is followed by a quarter in which GDP declines again, provided that the decline is more pronounced than the previous increase. For example, Romania recorded an increase in GDP by 2.4% in the third quarter of 2009. Because GDP dropped again by 2.5% in the next quarter, the contraction period, according to this definition, lasted until the fourth quarter of 2009. Instead of a decline in GDP of 9.3% over three quarters, we therefore record a decline of 9.5% over five quarters for Romania in Figure 1.

<Insert Figure 1 around here>

As the Figure shows, the extent and the duration of the GDP decline are not closely correlated. The recession was most pronounced in those West European countries in which housing market bubbles burst (Spain, Ireland, the UK, Denmark, and Sweden), and the collapse was extremely pronounced and mostly also long-lasting in the Baltic countries. Apart from Poland, the two EFTA countries Switzerland and Norway had the smallest decline in GDP. Also in terms of the duration of the recession, these two countries fared relatively well as only six countries in our sample had a shorter recession than them.

Figures 2a) to 2f) show the course of production for all 29 countries over the 2007-2009 period. In the five largest EU member countries, the contraction set in during the second quarter of 2008; in most other countries it began somewhat later. The Central Eastern European countries were hit last. In most countries (18 out of 29), the strongest drop in production occurred in the first quarter of 2009. For nine countries, the fourth quarter of 2008 was the worst. Norway and Cyprus, who fared relatively well during the recession, record the strongest drop in value added in the second quarter of 2009.

<Insert Figures 2a) to 2f) around here>

3. Inventory investment and change in GDP

In order to determine the relationship between inventory investment and the change in GDP we need data from the National Accounts on the change of inventory levels at previous year's (constant) prices in national currency. For our analysis it would be desirable to cleanse the data from the "net acquisition of valuables", which is irrelevant for the business cycle.

However, as too few countries report this category separately, we use data on the change of inventories including the net acquisition of valuables. Research on European inventory investment was hampered so far by the fact that not all European countries provide these data on a quarterly basis. Some countries, e.g. Switzerland, only report the inventory *impulse* (see section 4 below). Nevertheless, based on Eurostat data it is possible to calculate consistent time series for the change in inventory levels for all countries under investigation.

To this end, we draw on data on gross investment and gross fixed investment at constant prices. We calculate investment at previous year's prices – “real” investment – from nominal levels and real chained growth rates. Inventory investment results according to the following formula:

$$I(inv)_{q,y}^{py-1,sa} = I(tot)_{q,y}^{r,sa} \frac{\sum_{i=1}^4 I(tot)_{i,y-1}^{nom,orig}}{\sum_{i=1}^4 I(tot)_{i,y-1}^{r,orig}} - I(gfcf)_{q,y}^{r,sa} \frac{\sum_{i=1}^4 I(gfcf)_{i,y-1}^{nom,orig}}{\sum_{i=1}^4 I(gfcf)_{i,y-1}^{r,orig}} \quad (1)$$

I(inv):	Inventory investment
I(tot):	Gross investment
I(gfcf):	Gross fixed investment
py-1:	Previous year's prices
sa:	Seasonally adjusted
q:	Quarter
y:	Year
r:	Real
nom:	Nominal
orig:	not seasonally adjusted

In order to exclude the influence of seasonal factors on stock-keeping we use seasonally adjusted investment data. Bulgaria, Romania, and Sweden only publish non-seasonally adjusted data on the needed investment figures. Hence, we adjusted them ourselves using the Census X11 procedure. In order to make the data comparable across countries and over time we express the inventory changes in percent of GDP at previous year's prices. The resulting time series indicate by how much the price-adjusted inventory levels rose or decreased during a quarter.

Figure 3 shows the annualized cumulated depletion of inventories during the “Great Recession” for our 29 countries. Quarters with an increase in inventories still count as belonging to the depletion phase if the increase is smaller than the depletion in their neighboring quarters. Therefore, for instance, the second and the fourth quarter of 2008 still

count as belonging to the depletion phase for Romania despite positive inventory investment. However, the depletion of the fourth quarter of 2009 is disregarded because it was smaller than the inventory accumulation since the second quarter of 2009. The figure shows that, except for Austria and Spain, all countries recorded a depletion of inventories at least during one quarter in the last recession.

<Insert Figure 3 around here>

Figures 4a) to 4h) show the quarterly change in inventories over the period 2007-09 for groups of countries. Inventory investment is again reported at constant prices in percent of GDP at constant prices of the same quarter.

<Insert Figures 4a) to 4h) around here>

Most European countries experienced a strong depletion of inventories over the course of the recession, which lasted for several quarters. The depletion predominantly started in the first quarter of 2009, and it was not yet over by the end of that year in 17 countries. 25 out of 29 countries show a fairly similar pattern in this respect which is in line with the “stylized fact” that inventories move procyclically. The pattern found for European countries also supports the literature quoted earlier which explains the procyclicality of inventory investment by linking the depletion of inventories to financing constraints during recessions. Given that the “Great Recession” coincided with the most severe financial crisis since the 1930s, it is not surprising that entrepreneurs aimed at securing a liquid position by selling off stocks.

However, there are also four “outliers” in our data. In Greece and Switzerland, the drop in inventories did not start until the fourth quarter of 2009. During the first three quarters of that year, which were already characterized by de-stocking in almost all other countries, Greek and Swiss firms heavily accumulated inventories according to official data (see Figure 4g). Austria and Spain, for their part, recorded no de-stocking at all during the crisis. Data coming from the Austrian and Spanish statistical agencies suggest that firms in these two countries permanently accumulate inventories, independently of fluctuations in overall production (see Figure 4h). We interpret the findings for Austria, Greece, Spain and Switzerland, which clearly depart from the typical pattern for Europe as a whole as well as from “stylized facts”, to the effect that these countries have problems with respect to the quality of at least some of their official macroeconomic data.

Moving from descriptive to inductive statistics, we do a cross-section regression of cumulated inventory depletion (see Figure 3) on cumulated GDP decline (see Figure 1) during 2008/09. (The two countries without inventory depletion – Austria and Spain – are not considered.) The correlation is positive and statistically significant (see Table 1). The correlation coefficient between cumulated GDP-decline and cumulated inventory disinvestment is 0.56 ($= \sqrt{R^2}$).

<Insert Table 1 around here>

The results reported so far support well-known stylized facts, in particular that inventory investment and GDP move procyclically. However, whereas most of the studies cited in the introduction use annual data and are hence unable to examine what happens over the course of the year, our quarterly data allow us to take a closer look at the timing of the respective declines over the course of the “Great Recession”. Figure 5 shows that inventories are typically depleted only after the decline in GDP has set in. The two only exceptions to this rule are Romania and, again, Switzerland, where it is vice versa. We conjecture that this anomaly is once again a consequence of low data quality.

<Insert Figure 5 around here>

In search of patterns, we ask whether there is a typical lag-length in Europe between a decline (increase) in GDP and a decline (increase) in inventories. To answer this question, we calculate the correlation between the rate of change of GDP and the change in inventories for different lags. For each country, Table 2 indicates the lag (number of quarters) which maximizes that correlation. The calculation is done for two periods: 2007-2009 and 2000-2009. The shorter time period covers only 12 observations, which requires some cautiousness in the interpretation of differences between the single countries.

<Insert Table 2 around here>

As changes in GDP and in inventories typically move in the same direction, the correlation coefficients are typically positive. Again, Greece, Spain, Switzerland, and Austria (the latter only for the period 2000-2009) depart from this pattern. In most cases, lags of two or three quarters maximize the correlation. If changes in inventories lag behind changes in GDP –

which is the typical case – the lags in Table 2 have a positive sign. In this respect Cyprus is another outlier because the change in GDP has the highest correlation with inventory change in the *previous* quarter over the period 2007-2009.

Apart from the correlation, which measures the average reaction of inventory changes to changes in production, we consider the relation between the quarter with the *strongest* GDP contraction during the last recession and the quarter with the strongest decline in inventories. Figure 6 shows that also from this perspective the depletion of inventories lags behind the drop in production. Only in Latvia, Lithuania, and Romania no lag can be observed; and Cyprus as well as Switzerland are again special cases because the strongest inventory disinvestment anteceded the strongest contraction in GDP. As was mentioned earlier, Austria and Spain recorded no inventory disinvestment at all during the “Great Recession”.

<Insert Figure 6 around here>

Another interesting question is what happened to inventories over this period of two to three quarters between the beginning of the GDP contraction and the beginning of inventory disinvestment. This question can be answered by comparing Figures 2a) to 2f) with Figures 4a) to 4h). We notice that most countries accumulated inventories at the early stage of the recession. Therefore, the production smoothing theory of inventory investment can claim some empirical support from European data, which is restricted to the very short run, however. During the first one or two quarters of the “Great Recession”, European firms used inventories as buffer stocks, which means that sales dropped more than production initially. As the crisis continued, however, firms changed their behavior. At the climax of the crisis during the first quarter of 2009, inventories were sold off, and production dropped more than sales. These findings confirm Wen’s results that inventory investment is procyclical around business-cycle frequencies, but “countercyclical at very high frequencies (e.g., 2–3 quarters per cycle)” (Wen, 2005, p. 1534). Hornstein (1998) comes to a similar conclusion.

4. The contribution of changes in inventories to GDP growth

So far, we concentrated on changes in inventories as such, which are a decision variable for entrepreneurs. Depending on an entrepreneur’s assessment of the duration of a change in economic activity, a co-movement or a counter movement of inventories may appear rational. If a contraction in sales is assessed as being temporary, and if a full compensation in its

aftermath can be expected, it is reasonable to increase inventories. If, however, a long slump is on the horizon, inventories will be depleted.

Another perspective starts from the demand (or appropriation) side of National Accounting. In order to calculate GDP from the demand side final domestic demand (consumption and investment) and exports must be added, which yields total demand, and imports must be subtracted. Finally, the inflows to and the outflows from inventories must be accounted for. For the growth rate of GDP from one period to the next, however, not the change in inventories (inflows minus outflows), but the change of this change is relevant. GDP grows *ceteris paribus* if inventory accumulation is larger or inventory depletion is smaller than in the previous period.

The change in inventory change is called “inventory impulse”. The inventory impulse can at times account for a large percentage of the GDP growth rate, in other words, the inventory impulse and the GDP growth rate can at times be of a similar magnitude. Against this background it is sometimes claimed that variations in inventories, or the inventory cycle respectively, are a main driver of the business cycle. This is problematic, however. GDP measures production; and variations in inventories need not be accompanied by changes in production. When changes in inventories are caused by unexpected fluctuations in demand, production does not react initially. A strong link between the inventory impulse and the GDP growth rate will only exist in cases where large parts of the economy intentionally increase or reduce their stocks of domestically produced goods. For small open economies on the other hand, which do not produce but rather import intermediate products, we observe a (negative) correlation between the inventory impulse and the current account balance rather than a correlation between the inventory impulse and changes in production.

Figure 7 shows the largest negative inventory impulse during the 2008/09 recession along with the largest GDP decline for our sample of countries. In eleven out of 29 countries, both occurred during the same quarter. In another 11 countries, the largest inventory impulse lags behind the largest GDP contraction. In 9 out of these 11 countries, the lag is only one quarter. In the remaining 7 countries, the largest inventory impulse leads the largest GDP contraction. Switzerland records the largest lead of four quarters.

<Insert Figure 7 around here>

5. Nominal and real inventory investment

In a first stage, inventory investment is calculated nominally (i.e. at current prices) as the difference between the value of inventories at the end and at the beginning of an observation period. In a closed economy, this value is equal to the difference between production and usage. In order to distinguish changes in the volume of inventories from changes in prices inventory investment is also recorded at constant prices. In the current European System of National Accounts, “real” inventory investment is defined as inventory investment at previous year’s prices. To calculate real inventory investment, inventory levels at the beginning and at the end of a period are deflated with adequate price indices to the mean price of the previous year.

So far, we focused on inventory investment at previous year’s prices which is also the relevant magnitude for the calculation of real GDP. An increase or decrease in stocks solely due to price changes was disregarded. However, a comparison between real and nominal inventory investment can be useful to check the plausibility of the official data. Notably, at low inflation rates there should be no significant difference between nominal and real inventory investment. On the other hand, if price changes, e.g. for commodities, are large, we should expect a divergence, which should show up synchronously in all country data.

For approximately half of the countries in our sample the differences between real and nominal inventory investment data are indeed small. Thirteen countries however record marked differences between the two magnitudes in 2009. These 13 countries fall into four groups (see Figures 8a to 8d). In Belgium, Luxembourg, Slovakia, and Switzerland, real inventory investment had a much higher share in real GDP in 2009 than nominal inventory investment had in nominal GDP. This could be a hint that real GDP growth has been over-estimated due to an over-estimation of real inventory accumulation or an under-estimation of real inventory depletion. In Bulgaria, Estonia, and Hungary on the other hand, the difference between real and nominal inventory investment tended to be negative. In Greece, Finland, and Cyprus as well as in Romania, Latvia, and Lithuania, positive and negative differences alternated over the course of the year with a divergent pattern between the two groups of countries.

<Insert Figures 8a) to 8d) around here>

6. Conclusion

The “Great Recession” has hit European countries with a varying intensity, and also the inception of the contraction varied between the first quarter of 2008 and the first quarter of 2009. The five largest economies were hit early, namely in the second quarter of 2008. Depletion of inventories typically lagged two to three quarters behind the contraction of production. In countries that were hit late by the recession, the lag was reduced to one quarter. The lagging behind of inventory investment could already be observed in the decade before the “Great Recession”, from which follows that the inventory cycle cannot be a driver of the business cycle.

Over the first one or two quarters of the recession, inventories were typically built up, which yields evidence that over the very short run, inventories are used to smooth production. Beyond this very short run, however, inventories move procyclically with production in European countries, which reflects a well-known “stylized fact” uncovered by inventory investment research.

A small number of countries deflect from the typical pattern. We conjecture that this is due to low data quality or an inadequate modeling of inventory investment in the respective statistical agencies rather than due to a different behavior of economic agents in these countries. Greece and Switzerland record inventory investment figures that move in the opposite direction than those of most other countries. Both countries report a strong inventory buildup during the “Great Recession”. In Austria and Spain, firms have built up inventories for years now, according to official data, irrespective of economic conditions.

Furthermore, for a couple of countries we found discrepancies between nominal and real inventory changes. These might come as a result of divergent price adjustment of production on the one hand and the demand components on the other hand. Seven of the 29 countries we looked at showed systematic positive or negative discrepancies in 2009. If price adjustment of production is the problem, then the official statistics overstate the “true” 2009 GDP growth for Belgium, Luxembourg, Slovakia, and Switzerland, while they understate it for Bulgaria, Estonia, and Hungary.

Our analysis leads to the conclusion that statistical agencies in several European countries should reconsider their statistical modeling of inventory investment and adapt it where appropriate. Notably, inventory investment should be estimated independently and not just be taken as the difference between GDP calculated from the supply side and the components of final demand. Otherwise, inventory investment figures are automatically contaminated by the

statistical discrepancies between production and demand. Without unsoiled inventory investment figures, however, we risk misinterpreting business cycle developments.

Acknowledgements

We would like to thank Heinz Hollenstein, Bruno Parnisari, Peter Steiner, and Jan-Egbert Sturm for stimulating comments on an earlier draft. The usual disclaimer applies.

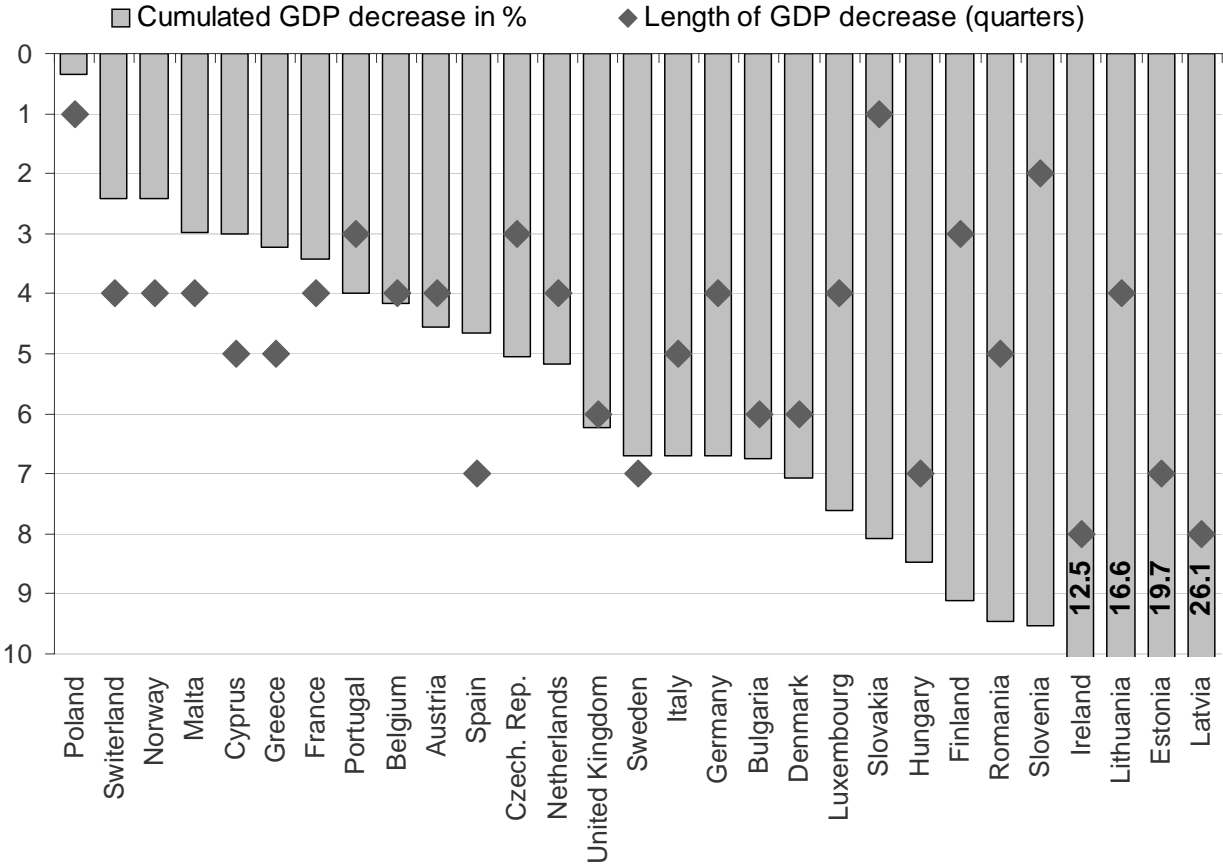
References

- Abrahamsen, Y., Hartwig, J., Schips, B., 2005. Die Kontroverse um den Produktivitätsfortschritt in der Schweiz nähert sich ihrem Ende. *Konjunktur* 68, A1–A18.
- Bagliano, F. C., Sembenelli, A., 2004. The cyclical behaviour of inventories: European cross-country evidence from the early 1990s recession. *Applied Economics* 36, 2031–2044.
- Blinder, A. S., Maccini, L. J., 1991. Taking stock: A critical assessment of recent research on inventories. *Journal of Economic Perspectives* 5, 73–96.
- Brown, W., Haegler, U., 2004. Financing constraints and inventories. *European Economic Review* 48, 1091–1123.
- Carpenter, R. E., Fazzari, S. M., Petersen, B. C., 1998. Financing constraints and inventory investment: A comparative study with high-frequency panel data. *Review of Economics and Statistics* 80, 513–519.
- Chikán, A., Horváth, C., 1999. A multi-country analysis of aggregate inventory behavior. *International Journal of Production Economics* 59, 1–11.
- Chikán, A., Kovács, E., 2009. Inventory investment and GDP characteristics in OECD countries. *International Journal of Production Economics* 118, 2–9.
- Chikán, A., Kovács, E., Tátrai, T., 2005. Macroeconomic characteristics and inventory investment: A multi-country study. *International Journal of Production Economics* 93–94, 61–73.
- Chikán, A., Tátrai, T., 2003. Developments in global inventory investment. *International Journal of Production Economics* 81–82, 13–26.
- Christodoulakis, N., Dimelis, S. P., Kollintzas, T., 1995. Comparisons of business cycles in the EC: Idiosyncracies and regularities. *Economica* 62, 1–27.
- Dimelis, S. P., 2001. Inventory investment over the business cycle in the EU and the US, *International Journal of Production Economics* 81–82, 13–26.

- Fair, R. C., 1989. The production smoothing model is alive and well. *Journal of Monetary Economics* 24, 353–370.
- Grant, J., 2000. Bundesbank mocks US IT book-cooking. *Financial Times*, September 4.
- Guariglia, A., 1999. The effects of financial constraints on inventory investment: Evidence from a panel of UK firms. *Economica* 66, 43–62.
- Guariglia, A., Mateut, S., 2010. Inventory investment, global engagement, and financial constraints in the UK: Evidence from micro data. *Journal of Macroeconomics* 32, 239–250.
- Häring, N., 2010. Der Statistik-Schmu der Amerikaner. *Handelsblatt*, June 4.
- Hartwig, J., 2008. Trying to assess the quality of macroeconomic data – the case of Swiss labour productivity growth as an example. *Journal of Business Cycle Measurement and Analysis* 4, 37–61.
- Hornstein, A., 1998. Inventory investment and the business cycle. *Federal Reserve Bank of Richmond Economic Quarterly* 84, 49–71.
- Krane, S., Braun, S., 1991. Production smoothing evidence from physical production data. *Journal of Political Economy* 99, 558–581.
- Ramey, V. A., West, K. D., 1999. Inventories. In: Taylor, J. B., Woodford, M. (eds.), *Handbook of Macroeconomics*, Vol. 1, Amsterdam: North-Holland, 863–923.
- Wen, Y., 2005. Understanding the inventory cycle. *Journal of Monetary Economics* 52, 1533–1555.
- Wilkinson, M., 1989. Aggregate inventory behavior in large European economies. *European Economic Review* 33, 181–194.

Figure 1

Extent and length of GDP decrease 2008-2009



Source for all data: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database. We used the vintage of the database from April 8th, 2010, which was the first to cover the whole year 2009 for all countries.

Figure 2a

GDP volume (chained), big countries

(Non-annualised quarter on quarter change, in %)

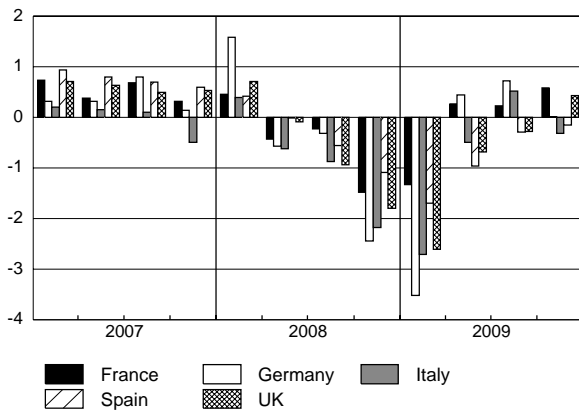


Figure 2b

GDP volume (chained), small Central European countries

(Non-annualised quarter on quarter change, in %)

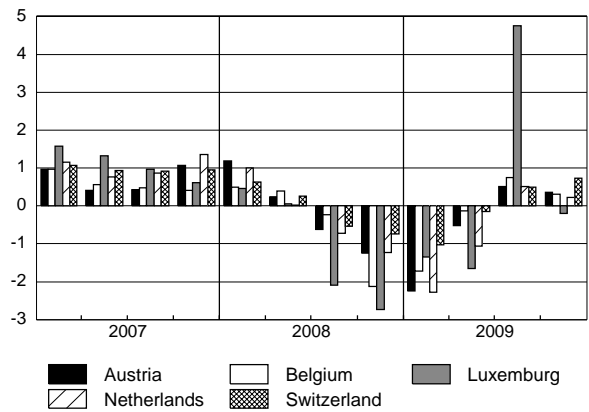


Figure 2c

GDP volume (chained), Southern Europe and Ireland

(Non-annualised quarter on quarter change, in %)

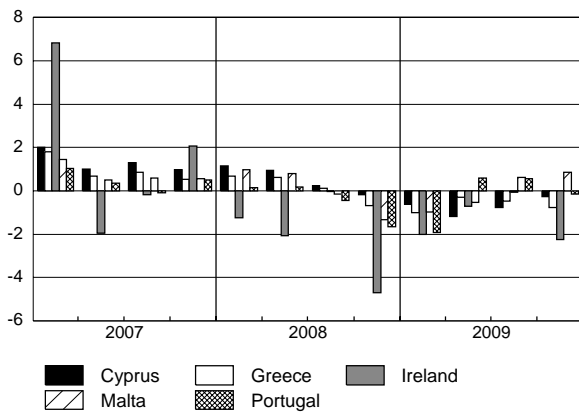


Figure 2d

GDP volume (chained), Nordic countries

(Non-annualised quarter on quarter change, in %)

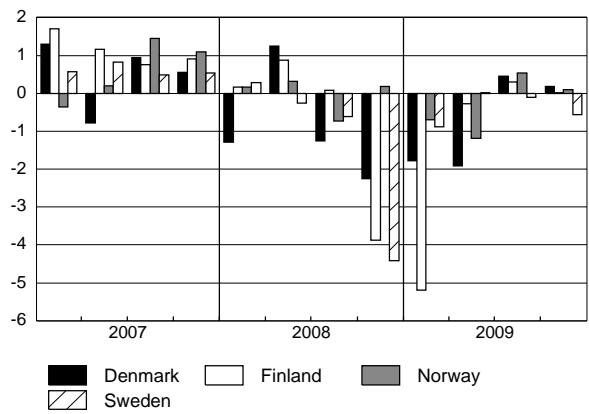


Figure 2e

GDP volume (chained), Central Eastern Europe

(Non-annualised quarter on quarter change, in %)

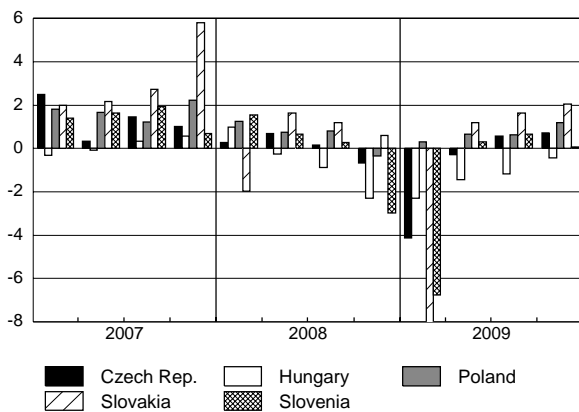


Figure 2f

GDP volume (chained), Baltics, Bulgaria and Romania

(Non-annualised quarter on quarter change, in %)

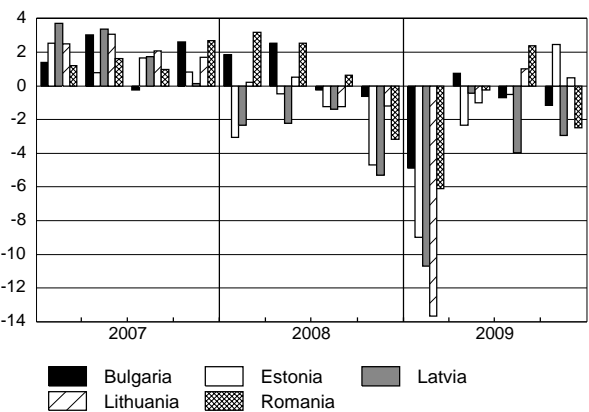


Figure 3
Extent and length of inventory depletion 2008-2009

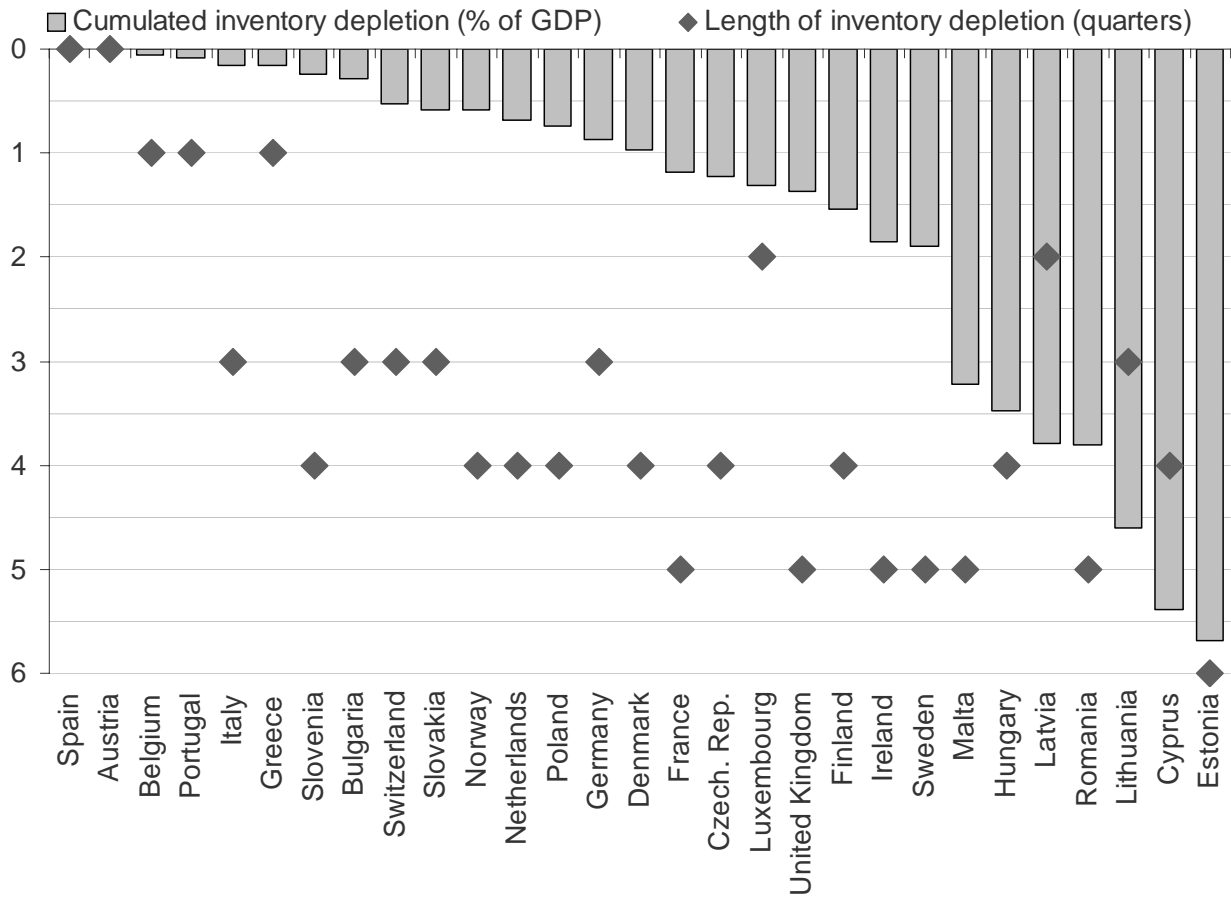


Figure 4a
Inventory investment, big countries
(% of GDP at previous year's prices)

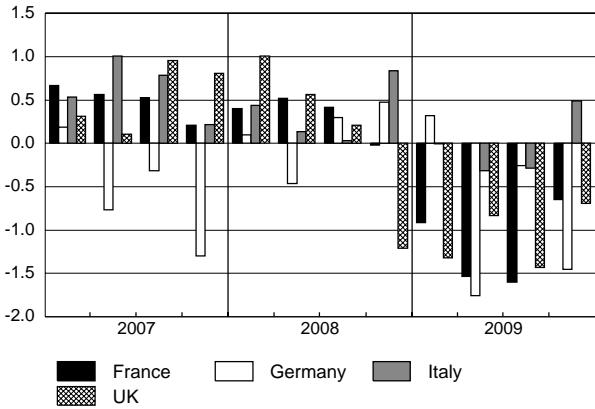


Figure 4b
Inventory investment, Benelux
(% of GDP at previous year's prices)

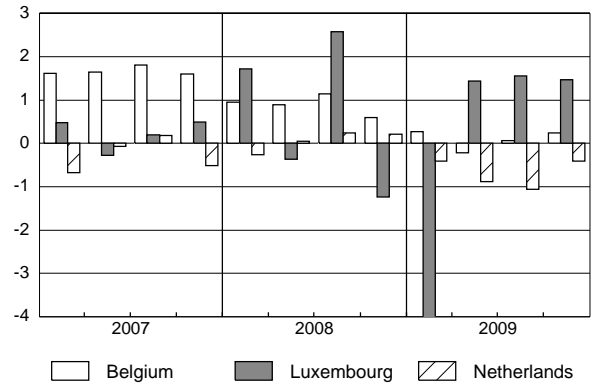


Figure 4c
Inventory investment, Southern Europe and Ireland
(% of GDP at previous year's prices)

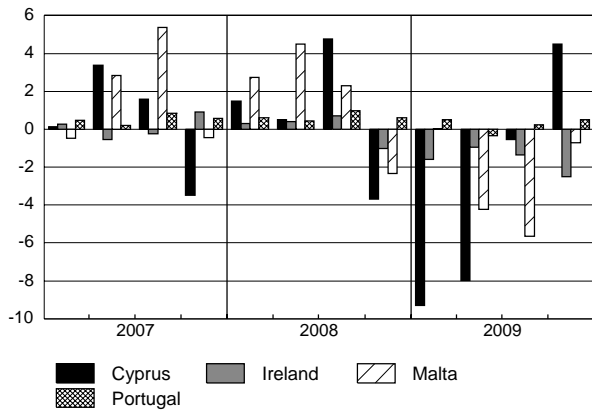


Figure 4d
Inventory investment, Nordic countries
(% of GDP at previous year's prices)

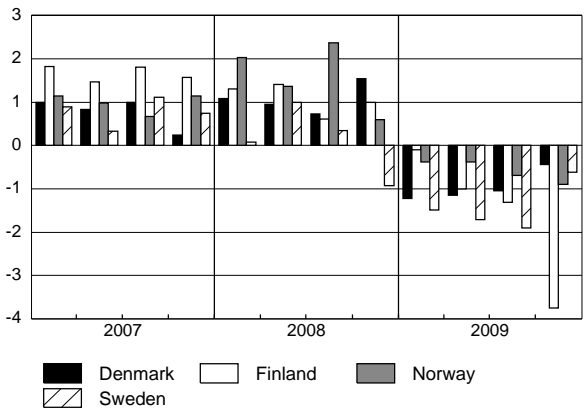


Figure 4e
Inventory investment, Central Eastern Europe
(% of GDP at previous year's prices)

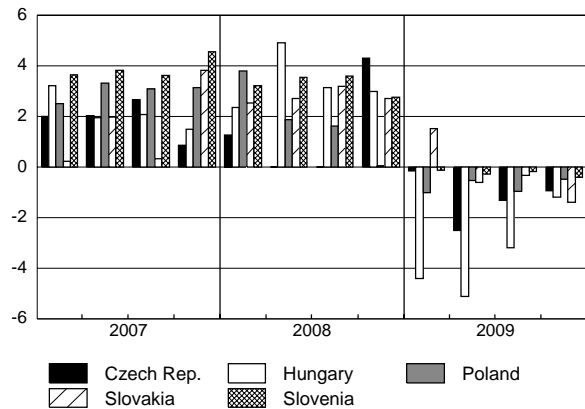


Figure 4f
Inventory investment, Baltics, Bulgaria and Romania
(% of GDP at previous year's prices)

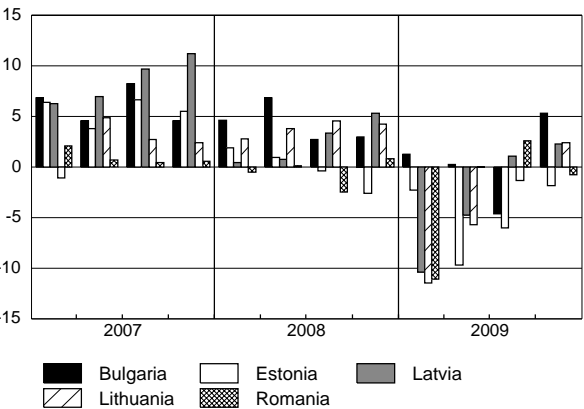


Figure 4g

Inventory investment, Greece and Switzerland

(% of GDP at previous year's prices)

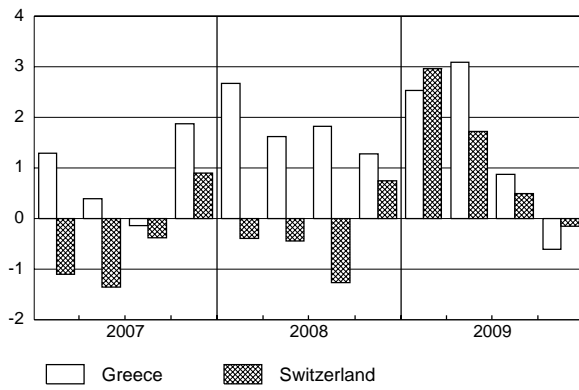


Figure 4h

Inventory investment, Austria and Spain

(% of GDP at previous year's prices)

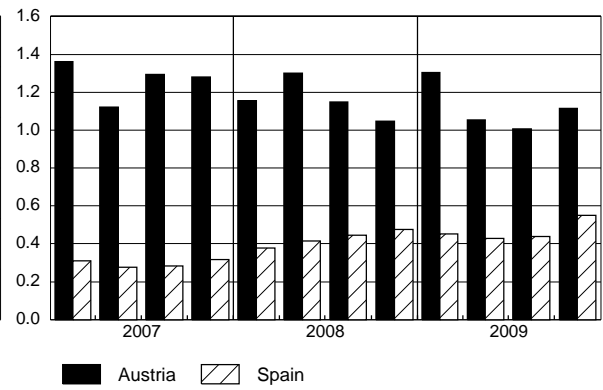


Figure 5
Time lapse of GDP decrease and inventory depletion 2008-2009

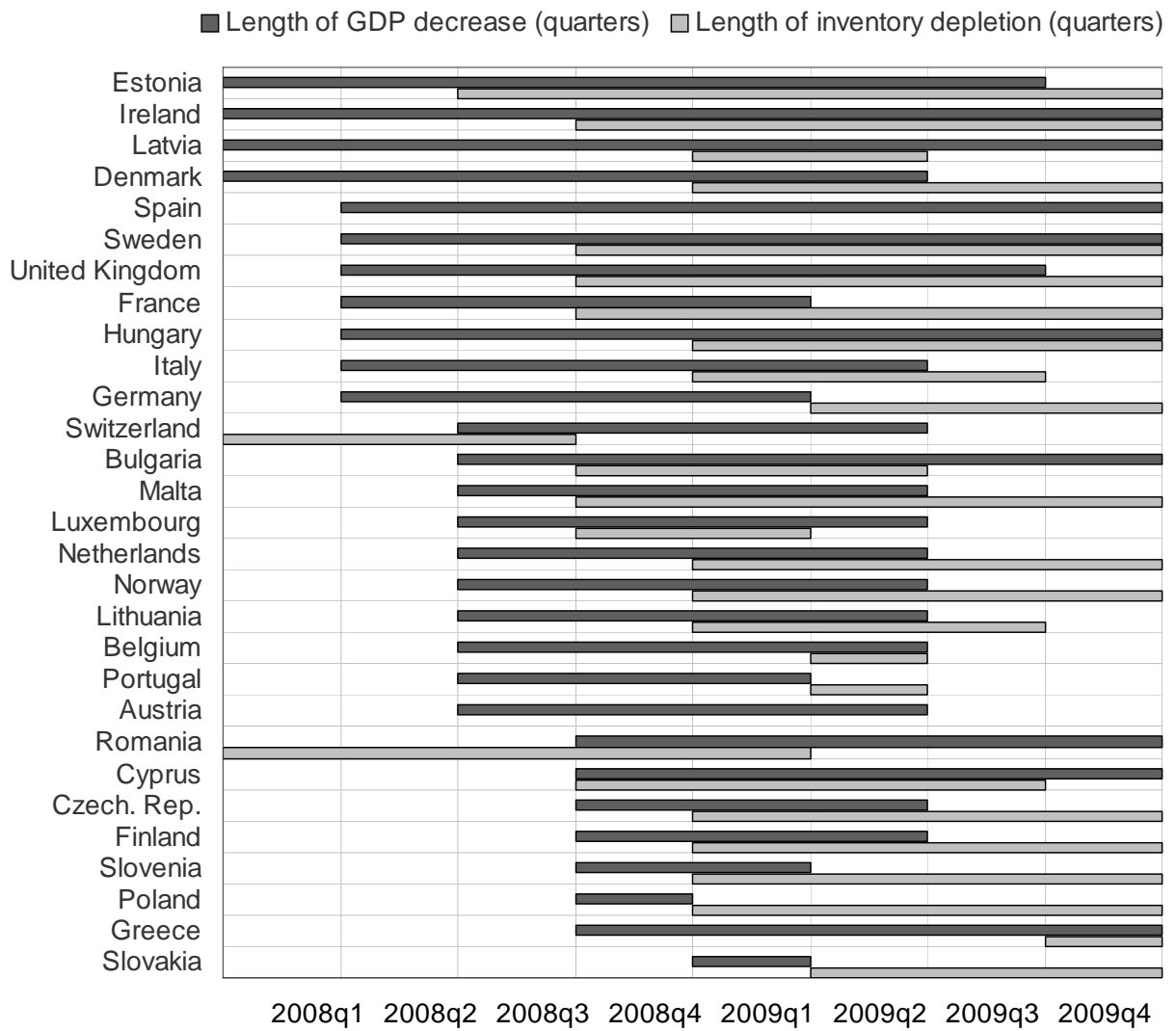


Figure 6
 Largest GDP decrease and largest inventory depletion 2008-2009

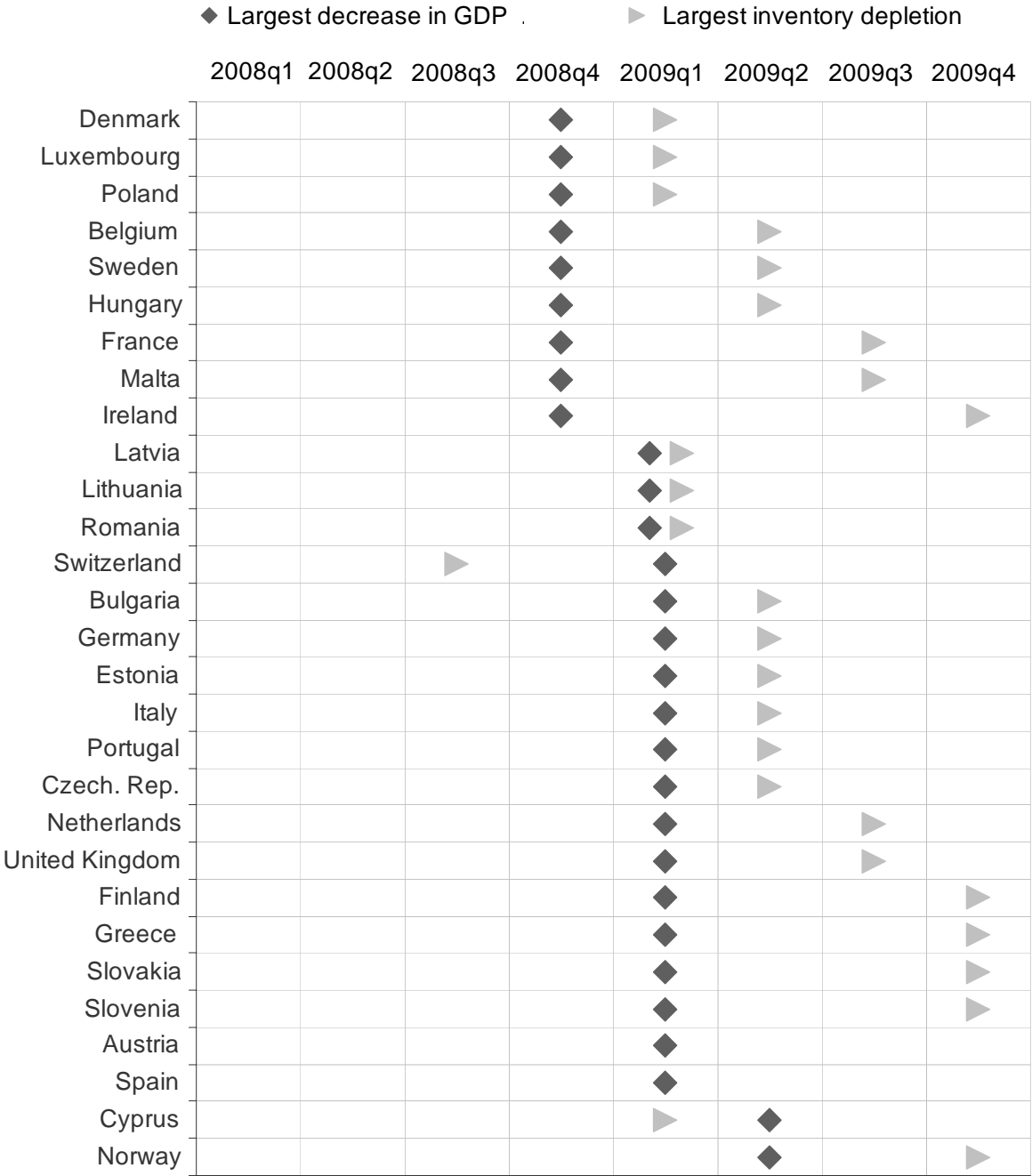


Figure 7
 Largest GDP decrease and largest negative inventory impulse 2008-2009

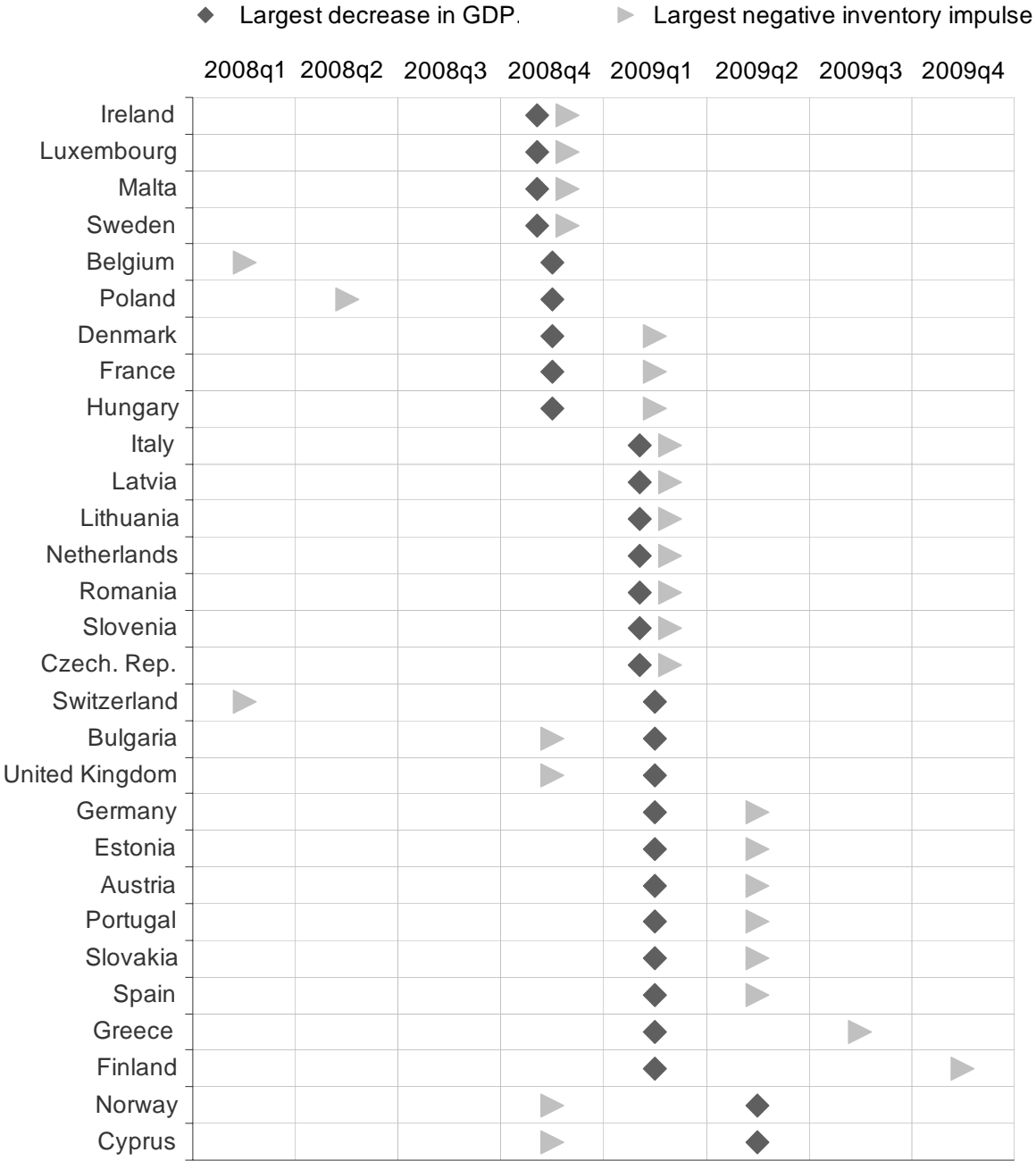


Figure 8a

Difference between real and nominal inventory investment
(in PP of GDP)

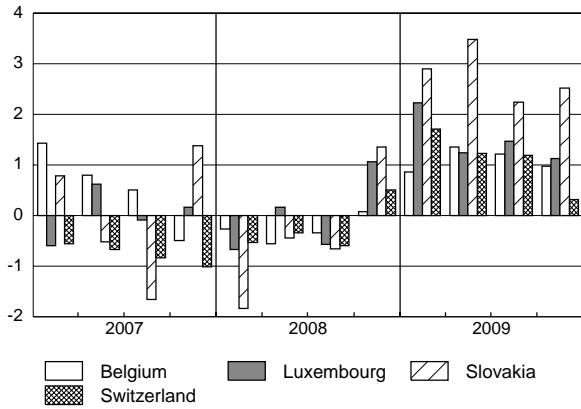


Figure 8b

Difference between real and nominal inventory investment
(in PP of GDP)

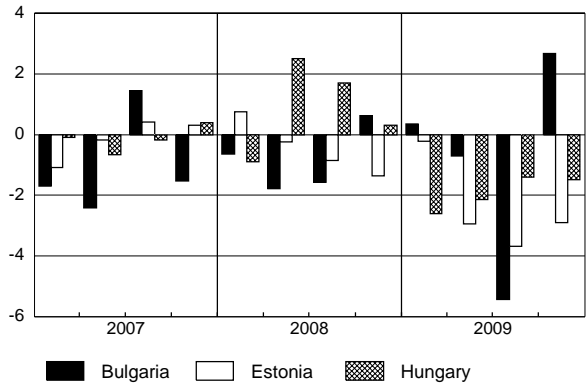


Figure 8c

Difference between real and nominal inventory investment
(in PP of GDP)

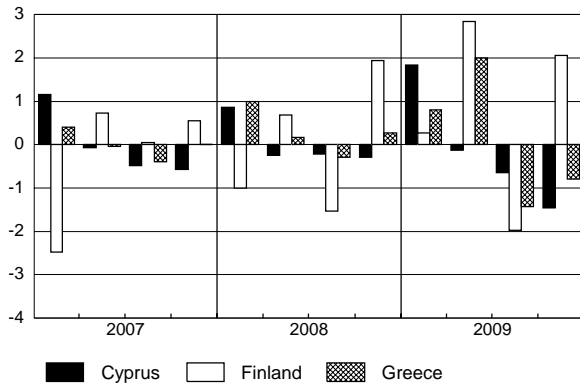


Figure 8d

Difference between real and nominal inventory investment
(in PP of GDP)

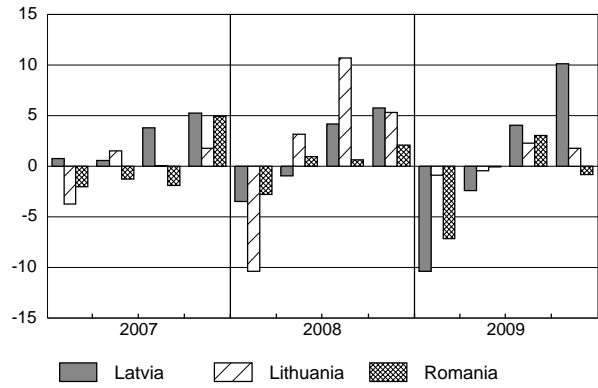


Table 1: GDP growth and inventory depletion <i>(cross-section OLS regression, 2008-2009, 27 countries)</i>	
Dependent Variable: Cumulated inventory depletion	Coefficient (Standard error)
Intercept	-0.458 (0.465)
Cumulated GDP decrease	0.167* (0.050)
R ²	0.310
Adj. R ²	0.283
S.E. of regression	1.432
Sum squared residuals	51.24
F-statistic	11.25
Prob(F-statistic)	0.0025
* significant at 5%	

Table 2: GDP growth and inventory investment: Maximum correlation				
	2007-2009		2000-2009	
	Lag	Correlation	Lag	Correlation
Hungary	1	0.907	1	0.705
Poland	1	0.898	1	0.720
Finland	3	0.895	3	0.748
France	2	0.864	2	0.747
Belgium	2	0.860	2	0.512
Denmark	2	0.849	2	0.480
Estonia	2	0.839	2	0.704
United Kingdom	2	0.807	2	0.722
Malta	2	0.802	1	0.386
Latvia	1	0.785	1	0.491
Netherlands	2	0.763	2	0.640
Lithuania	0	0.758	0	0.574
Italy	2	0.725	2	0.326
Norway	2	0.715	3	0.329
Slovenia	3	0.713	2	0.468
Bulgaria	1	0.706	1	0.393
Romania	0	0.693	0	0.510
Portugal	2	0.665	3	0.431
Ireland	3	0.664	3	0.593
Cyprus	-1	0.643	0	0.408
Czech Republic	2	0.637	2	0.579
Austria	2	0.554	-2	-0.158
Sweden	3	0.534	3	0.324
Slovakia	3	0.522	3	0.354
Germany	4	0.489	4	0.369
Luxembourg	1	0.419	0	0.223
Switzerland	1	-0.749	1	-0.579
Greece	-3	-0.752	-3	-0.521
Spain	-1	-0.912	-1	-0.434
Countries in descending order of correlation coefficient 2007-2009				