



ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
ΤΜΗΜΑ ΛΟΓΙΣΤΙΚΗΣ &
ΧΡΗΜΑΤΟΟΙΚΟΝΟΜΙΚΗΣ
ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ

ΤΙΤΛΟΣ:

«Η σύνθεση του χαρτοφυλακίου ενός στρατηγικού επενδυτή, λαμβάνοντας υπόψιν τους κινδύνους που απορρέουν από τον πληθωρισμό των μισθών –
«Συνταξιοδοτικά Ταμεία»

Ελισσαίος Ν. Αγγελής
A.M. 102291

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Αθήνα, Ιούλιος 2012

Εγκρίνουμε την εργασία του

ΑΓΓΕΛΗ ΕΛΙΣΣΑΙΟΥ

ΔΑΝΙΗΛ ΓΙΑΜΟΥΡΙΔΗΣ

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ΚΑΒΟΥΣΑΝΟΣ ΕΜΜΑΝΟΥΗΛ

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ΔΡΑΚΟΣ ΚΩΝΣΤΑΝΤΙΝΟΣ

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ΒΕΒΑΙΩΣΗ ΕΚΠΟΝΗΣΗΣ ΔΙΠΛΩΜΑΤΙΚΗΣ ΕΡΓΑΣΙΑΣ

«Δηλώνω υπεύθυνα ότι η συγκεκριμένη πτυχιακή εργασία για τη λήψη του Μεταπτυχιακού Διπλώματος Ειδίκευσης στη Λογιστική και Χρηματοοικονομική έχει συγγραφεί από εμένα προσωπικά και δεν έχει υποβληθεί ούτε έχει εγκριθεί στο πλαίσιο κάποιου άλλου μεταπτυχιακού ή προπτυχιακού τίτλου σπουδών, στην Ελλάδα ή στο εξωτερικό. Η εργασία αυτή έχοντας εκπονηθεί από εμένα, αντιπροσωπεύει τις προσωπικές μου απόψεις επί του θέματος. Οι πηγές στις οποίες ανέτρεξα για την εκπόνηση της συγκεκριμένης διπλωματικής αναφέρονται στο σύνολό τους, δίνοντας πλήρεις αναφορές στους συγγραφείς, συμπεριλαμβανομένων και των πηγών που ενδεχομένως χρησιμοποιήθηκαν από το διαδίκτυο».

ΑΓΓΕΛΗΣ ΕΛΙΣΣΑΙΟΣ

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Περίληψη της διπλωματικής εργασίας στην ελληνική γλώσσα

Σε αυτό το επιστημονικό άρθρο ασχολούμαστε με το ευρύτερο θέμα της διαχείρισης των κεφαλαίων ενός επενδυτικού χαρτοφυλακίου σε σχέση με τον κίνδυνο που απορρέει από τις υποχρεώσεις του συγκεκριμένου επενδυτή. Με τον όρο «διαχείριση» εννοούμε την επιλογή αλλά και την κατανομή του διαθέσιμου προς επένδυση κεφαλαίου μεταξύ των διαφόρων επενδυτικών εργαλείων. Σκοπός της διαδικασίας αυτής είναι η μεγιστοποίηση της συνάρτησης χρησιμότητας του επενδυτή.

Υπάρχουν διαφορετικοί τύποι επενδυτών και ο καθένας από αυτούς έχει μια διαφορετική συνάρτηση χρησιμότητας. Για παράδειγμα υπάρχουν επενδυτές που έχουν ως αποκλειστικό σκοπό την μεγιστοποίηση της πραγματικής απόδοσης του χαρτοφυλακίου, μη έχοντας υποχρεώσεις άμεσα συσχετισμένες με την επένδυση. Κατά την διαδικασία της σύνθεσης του χαρτοφυλακίου οι επενδυτές αυτοί ασχολούνται αποκλειστικά με την φύση και τις ιδιότητες των διαθέσιμων επενδυτικών εργαλείων. Στόχος είναι να επιλέξουν με την σωστή στάθμιση αυτά τα εργαλεία που μεγιστοποιούν την απόδοση του χαρτοφυλακίου και ταυτόχρονα είναι συμβατά και με το ύψος του κινδύνου που επιθυμούν να αναλάβουν. Αυτοί οι επενδυτές έχουν συνήθως βραχυπρόθεσμο έως μεσοπρόθεσμο επενδυτικό ορίζοντα. Ένας τέτοιος τύπος επενδυτή είναι τα αμοιβαία κεφάλαια.

Υπάρχουν κάποιοι άλλοι τύποι επενδυτών οι οποίοι έχουν συγκεκριμένες και άμεσα συσχετισμένες με την επένδυση υποχρεώσεις. Ο επενδυτικός στόχος σε αυτή την περίπτωση διαφοροποιείται μερικώς. Οι υποχρεώσεις αυτές είναι εκτιθέμενες σε αντίστοιχους κινδύνους. Ο στρατηγικός αυτός επενδυτής, μέσω της διαμόρφωσης του επενδυτικού χαρτοφυλακίου, πρέπει αφενός να αντισταθμίσει την έκθεση του στους κινδύνους που σχετίζονται με τις υποχρεώσεις και αφετέρου να μεγιστοποιήσει την απόδοση του χαρτοφυλακίου. Η βασική διαφορά σε σχέση με τον προηγούμενο επενδυτή είναι ότι η απόδοση του χαρτοφυλακίου προς μεγιστοποίηση δεν είναι η καθαρή πραγματική απόδοση που αποφέρουν τα επενδυτικά εργαλεία. Είναι η υπερβάλλουσα απόδοση αυτών των εργαλείων σε σχέση με την απόδοση που απαιτείται για να αντισταθμιστούν οι παράγοντες κινδύνου που απορρέουν από την πλευρά των υποχρεώσεων. Σε αυτή την περίπτωση η διαδικασία διαμόρφωσης του επενδυτικού χαρτοφυλακίου γίνεται πιο περίπλοκη. Ο επενδυτής εκτός από την φύση

και τις ιδιότητες των επενδυτικών εργαλείων που αφορούν το κομμάτι του ρίσκου θα μεταβιβάσουν στο χαρτοφυλάκιο, πρέπει να ελέγξει και τις ιδιότητες τους ως προς την αποτελεσματικότητα της αντιστάθμισης των παραγόντων κινδύνου των υποχρεώσεων. Αυτοί οι επενδυτές έχουν συνήθως μακροχρόνιο επενδυτικό ορίζοντα. Ένας τέτοιος τύπος επενδυτή είναι τα συνταξιοδοτικά ταμεία και με αυτόν ασχολούμαστε στο συγκεκριμένο άρθρο.

Σε αυτή τη κατηγορία επενδυτών υπάρχουν περαιτέρω διαφοροποιήσεις οι οποίες αφορούν τον τρόπο διαχείρισης της κατανομής των επενδυτικών κεφαλαίων στα επιμέρους επενδυτικά εργαλεία. Οι «στατικοί» επενδυτές διαμορφώνουν εξαρχής μια συγκεκριμένη κατανομή την οποία δεν αλλάζουν ούτε αναπροσαρμόζουν ποτέ κατά την διάρκεια του χρόνου. Οι «δυναμικοί» επενδυτές αλλάζουν συνεχώς την κατανομή. Υπάρχει και μια τρίτη κατηγορία που είναι ένας ενδιάμεσος τύπος επενδυτή ο οποίος αντιπροσωπεύει καλύτερα την δική μας προσέγγιση και διαμορφώνει αρχικά μια κατανομή την οποία προσπαθεί να διατηρήσει σταθερή κάνοντας αγοροπωλησίες ανάλογα με την κίνηση της αγοράς. Ετσι ο λόγος της αγοραίας αξίας του κάθε επενδυτικού εργαλείου ως προς την αγοραία αξία του χαρτοφυλακίου μένει σταθερός.

Τα επενδυτικά εργαλεία που έχουν συμπεριληφθεί σε παρελθοντικές σχετικές έρευνες είναι τόσο τα παραδοσιακά όπως ομόλογα, γραμμάτια και μετοχές όσο και εναλλακτικά όπως παράγωγα προϊόντα, αμοιβαία κεφάλαια και μετοχικοί δείκτες με έκθεση σε ακίνητη περιουσία. Έως τώρα έχει μελετηθεί τμηματικά αλλά και εξ' ολοκλήρου η συμπεριφορά αυτών των επενδυτικών εργαλείων στο χαρτοφυλάκιο ενός στρατηγικού επενδυτή με υποχρεώσεις. Στην δική μας έρευνα συμπεριλαμβάνουμε και τις έξι αυτές κατηγορίες επενδυτικών εργαλείων.

Όσον αφορά το κομμάτι του κινδύνου που απορρέει από τις υποχρεώσεις ενός τέτοιου επενδυτή και συγκεκριμένα ενός συνταξιοδοτικού ταμείου, η βιβλιογραφία έως σήμερα το έχει αντιληφθεί ως ένα συνδυασμό που βασίζεται στον κίνδυνο επιτοκίων και στον πληθωρισμό των τιμών. Στο συγκεκριμένο άρθρο αγνοούμε τον κίνδυνο των επιτοκίων και ασχολούμαστε με το κομμάτι του πληθωρισμού εστιάζοντας την έρευνα μας αποκλειστικά στα συνταξιοδοτικά ταμεία. Επιχειρούμε να προτείνουμε ένα νέο μέτρο κινδύνου που θα αντικαταστήσει τον πληθωρισμό των τιμών και είναι ο πληθωρισμός των μισθών. Η λογική της πρότασης μας έγκειται στο

γεγονός ότι η βασική υποχρέωση ενός συνταξιοδοτικού ταμείου είναι η περιοδική καταβολή των συντάξεων. Το ποσό της μηνιαίας σύνταξης του κάθε ασφαλισμένου εξαρτάται από τις ασφαλιστικές εισφορές τις οποίες πληρώνει κατά την διάρκεια της εργάσιμης ζωής του. Το ποσό αυτό των ασφαλιστικών εισφορών είναι συνάρτηση του μισθού του εργαζομένου. Υπό αυτό το πρίσμα λοιπόν θεωρούμε πιο εύλογο για ένα συνταξιοδοτικό ταμείο να μετράει τον κίνδυνο μεταβολής των υποχρεώσεων του με βάση τον κίνδυνο μεταβολής των μισθών ή αλλιώς τον πληθωρισμό των μισθών και όχι με βάση τον πληθωρισμό των τιμών.

Ο πληθωρισμός των τιμών μετράται μέσω της μεταβολής του δείκτη τιμών καταναλωτή. Για τον πληθωρισμό των μισθών εξάγουμε την μεταβολή του εργατικού κόστους ανά μονάδα παραχθέντος προϊόντος του ευρύτερου επιχειρησιακού τομέα των Ηνωμένων Πολιτειών Αμερικής. Πριν προχωρήσουμε στα εμπειρικό κομμάτι αυτής της εργασίας, ελέγχουμε την ιστορική σχέση μεταξύ του πληθωρισμού των τιμών και του πληθωρισμού των μισθών μέσω του συντελεστή συσχέτισης τους. Συμπεραίνουμε ότι η κίνηση των δύο μεταβλητών είναι σχετικά παράλληλη και χαρακτηρίζεται από μέτρια συσχέτιση. Παρατηρούμε επίσης ότι η κίνηση του πληθωρισμού των μισθών προηγείται χρονικά της αντίστοιχης των τιμών γεγονός που δείχνει κατά ένα τρόπο ποιο μέγεθος επηρεάζει το άλλο. Για αυτό το κομμάτι της σχέσης μεταξύ των δύο μεγεθών έχει προηγηθεί και σχετική βιβλιογραφία που με μέρος της οποίας είμαστε συνεπείς.

Στο εμπειρικό κομμάτι αυτού του άρθρου χρησιμοποιούμε δεδομένα από το δεύτερο τρίμηνο του 1991 έως το πρώτο τρίμηνο του 2012. Τα δεδομένα μας αφορούν αποδόσεις των έξι επενδυτικών εργαλείων (ομόλογα, μετοχές, γραμμάτια, παράγωγα προϊόντα, αμοιβαία κεφάλαια, μετοχικούς δείκτες ακίνητης περιουσίας), αποδόσεις των δύο μεταβλητών κινδύνου των υποχρεώσεων (πληθωρισμός τιμών και μισθών) και τις αποδόσεις ορισμένων στατικών μεταβλητών οι οποίες εξυπηρετούν την ικανότητα πρόβλεψης του μοντέλου μας. Βασιζόμαστε σε ένα VAR μοντέλο μέσω του οποίου προβλέπουμε δύο βασικές κατηγορίες μεγεθών σε επενδυτικό ορίζοντα από 1 έως 100 τρίμηνα ή 25 έτη.

Αρχικά μελετάμε τις ιδιότητες των επενδυτικών εργαλείων ως προς τον κίνδυνο που ενέχουν, ως προς την διαφοροποίηση που προσφέρουν στο χαρτοφυλάκιο αλλά και ως προς τις αντισταθμιστικές τους ικανότητες τόσο έναντι του πληθωρισμού

τιμών όσο και έναντι του πληθωρισμού μισθών σε διαφορετικούς επενδυτικούς ορίζοντες. Καταλήγουμε στο ότι τα παράγωγα προϊόντα, αν και ενέχουν τον υψηλότερο κίνδυνο για τον επενδυτή, είναι το καλύτερο αντισταθμιστικό εργαλείο έναντι του πληθωρισμού τιμών σε όλους τους επενδυτικούς ορίζοντες ενώ χαρακτηρίζονται από μέτριες αντισταθμιστικές ιδιότητες έναντι του πληθωρισμού μισθών για μακρύ ορίζοντα. Σε αντίθεση με τα παράγωγα προϊόντα, τα αμοιβαία κεφάλαια αν και έχουν υψηλή έκθεση σε ομόλογα και μετοχές, δείχνουν το ίδιο αποτελεσματικά αντισταθμιστικά εργαλεία τόσο έναντι του πληθωρισμού τιμών όσο και έναντι του πληθωρισμού μισθών για επενδυτικό ορίζοντα μετά από τρία και εννέα έτη αντίστοιχα. Συμπερασματικά καταλήγουμε στο ότι οι εναλλακτικές κατηγορίες επενδυτικών προϊόντων προσθέτουν αξία κατά την αντιστάθμιση των παραγόντων κινδύνου των υποχρεώσεων ενώ οι παραδοσιακές κατηγορίες προϊόντων συμβάλλουν στην διατήρηση χαμηλού κινδύνου και καλής διαφοροποίησης του χαρτοφυλακίου του επενδυτή.

Στο δεύτερο σκέλος του εμπειρικού μέρους υπολογίζουμε την βέλτιστη σύνθεση του χαρτοφυλακίου κατά μήκος του επενδυτικού ορίζοντα αλλά και για διαφορετικά επίπεδα κινδύνου που επιθυμεί να αναλάβει ο επενδυτής. Η διαδικασία αυτή λαμβάνει χώρα και για έναν επενδυτή που θέλει να αντισταθμιστεί έναντι του πληθωρισμού τιμών αλλά και για τον αντίστοιχο που επιθυμεί να αντισταθμίσει το χαρτοφυλάκιό του έναντι του πληθωρισμού μισθών. Τα αποτελέσματα για τις δύο περιπτώσεις αντισταθμιστικών επενδυτικών χαρτοφυλακίων είναι σχεδόν πανομοιότυπα. Τα γραμμάτια αποτελούν σε κάθε περίπτωση ένα αξιόλογο ποσοστό στο χαρτοφυλάκιο του βραχυπρόθεσμου επενδυτή καθώς οι σύντομες περιοδικές λήξεις τους και η επανεπένδυση στη συνέχεια ενσωματώνει όλες τις μεταβολές των παραγόντων κινδύνου. Τα ομόλογα προτιμούνται από μέσο-μακροπρόθεσμους επενδυτές και ιδιαίτερα από αυτούς που δεν επιθυμούν να αναλάβουν υψηλό επίπεδο κινδύνου. Οι μετοχικοί δείκτες σε ακίνητη περιουσία αποδεικνύεται ότι έχουν παρόμοιες ιδιότητες με τις μετοχές. Ένα από τα δυο αποτελεί μέρος του χαρτοφυλακίου σε όλους τους επενδυτικούς ορίζοντες και ειδικά στους μακροπρόθεσμους. Τα παράγωγα προϊόντα, με χαμηλά ποσοστά, συμπεριλαμβάνονται στο χαρτοφυλάκιο ιδιαίτερα από βραχυπρόθεσμους και πιο ριψοκίνδυνους επενδυτές. Τα αμοιβαία κεφάλαια δεν είναι ιδιαίτερα ελκυστικά και

απλώς προτιμώνται από επενδυτές χαμηλού κινδύνου σε περιπτώσεις που οι ιδιότητες των παραγώγων προϊόντων είναι κακές.

Εφόσον τα αποτελέσματα της σύνθεσης των δύο τύπων χαρτοφυλακίων είναι παρόμοια δεν μπορούμε να εξάγουμε καθαρά συμπεράσματα για το αν ο πληθωρισμός των μισθών έναντι του πληθωρισμού των τιμών είναι βέλτιστο μέτρο για ένα μέρος του κινδύνου των υποχρεώσεων ενός συνταξιοδοτικού ταμείου. Αν τα αποτελέσματα ήταν διαφορετικά, με βάση τη σύνθεση σου αντισταθμιστικού χαρτοφυλακίου έναντι του πληθωρισμού των μισθών θα υπολογίζαμε την απόδοση του αντισταθμιστικού χαρτοφυλακίου έναντι των τιμών. Η διαφορά αυτών των δύο αποδόσεων θα μας έδινε την επίπτωση στον πλούτο του επενδυτή. Μια θετική επίπτωση στον πλούτο θα σήμαινε ότι τα συνταξιοδοτικά ταμεία υποεκτιμούν τις αποδόσεις των επενδυτικών τους χαρτοφυλακίων χρησιμοποιώντας τον πληθωρισμό τιμών σαν μέτρο εκτίμησης του κινδύνου των υποχρεώσεών τους.

Επόμενες μελέτες θα μπορούσαν να προσθέσουν στον πληθωρισμού μισθών και τον κίνδυνο επιτοκίων. Μια πιο πλήρης απεικόνιση του κινδύνου που απορρέει από τις υποχρεώσεις ενός συνταξιοδοτικού ταμείου ίσως οδηγήσει σε σημαντικά διαφορετική σύνθεση του χαρτοφυλακίου η οποία παράσχει στον επενδυτή την ευκαιρία για υψηλότερες υπερβάλλουσες αποδόσεις.

Strategic Asset Allocation under Wage Inflation- Pension Funds

Abstract

This paper determines the optimal strategic asset allocation under wage inflation. Pension Funds are investors with risky liabilities which are subject both to real interest rate and inflation risk. We focus on the “inflation fluctuation” side of risk, suggesting that wage inflation hedging is more optimal than CPI hedging, in the context of Asset-Liabilities Management. Asset classes to invest are both traditional (T-Bills, Government Bonds, Equity) and alternatives (Commodities, Hedge Funds, Listed Real Estate). Based on a VAR model for assets returns, wage inflation and macro-economic state variables we specify the hedging capacity of the assets against wage inflation. The inter-temporal covariance structure between assets and wage inflation combined both with the investment horizon and the investor’s risk-aversion level leads to an optimal asset allocation of the portfolio. We find that use of wage inflation, instead of CPI, in the liabilities risk measuring process, results in a similar optimal asset allocation despite its different risk term structure.

Introduction

Pension Funds are institutional investors with risky liabilities. These liabilities are subject to the risk of both fluctuating inflation and real interest rate. A strategic investor should primarily invest in this combination of assets which effectively provides hedging against liabilities risk. This is the most crucial investment objective. Furthermore, the optimal strategic asset allocation depends on the investment horizon as well as the “risk aversion” level of the investor. Assets which have already been tested for their hedging quality against liabilities risk are both traditional (T-Bills, Government Bonds, Equity, Corporate Bonds) and alternative (Commodities, Hedge Funds, Listed Real Estate, Currencies).

Long-term institutional investors, such as Pension Funds, should identify all these liabilities risks, in order to implement an optimal investment strategy in an Asset-Liabilities Management context. Large part of the literature’s studies, has tested assets quality only against price inflation risk ([Laura Spierdijk-Zaghun Umar 2011](#), [M. Brière and O. Signori 2010](#), [Salvatore Bruno and Ludwig Chincarini 2009](#)), whereas another part has tested it, both against price inflation and real interest rate risk ([R.P.M.M. Hoevenaars et al. 2008](#), [van Binsbergen and Brandt 2007](#), [Goetzmann and Valaitis 2006](#), [Michael J. Brennan and Yihong Xia 2002](#), [Amenc et al. 2009](#)).

On the one hand, [Spierdijk and Umar](#) test traditional asset classes such as T-Bills, Bonds and Stocks against price inflation hedging. They find positive hedging capacity in T-Bills and Stocks both for short and long-run investment horizon. They regard T-Bills as the best hedging tool against CPI due to its short maturity which let it be less susceptible to price inflation changes than stocks. [Bruno and Chincarini](#) use a more wide variety of assets adding to the respective traditional some alternative classes such as commodities, real estate, TIPS (Treasury Inflation Protection Securities) and currencies. They test the hedging quality of these assets against price inflation in an international level (both in Europe and US) and they conclude that the best portfolio is a combination of government bills, government bonds, emerging markets equity and some gold and oil commodities. They find good hedging quality in TIPS only in a 100% weight in the long-run investor portfolio. They propose that hyperinflation

countries investors should include in their hedging portfolio short positions in local currency (against strong currency) as well as bond-indexes and t-bills. [Briere and Signori](#) also focus on the price inflation related part of liabilities and test both traditional and alternative assets hedging capacity against it in different macroeconomic environment. Both in volatile (with countercyclical inflation shocks) and stable (with pro-cyclical inflation shocks) economic regime an investor with short-run horizon should mainly invest in cash. A long-run investor in a volatile economic regime, except of cash, should also add IL bonds, equity, commodities and real estate in the inflation hedging portfolio. The respective investor in a stable economic regime, except of cash, should also mainly invest in nominal bonds and secondarily in commodities and equity with lower weights.

On the other hand, [Hoevenaars](#) approaches the liabilities risk in a more complete way taking into account both the price inflation and the interest rate risk. Far from the traditional assets he includes in its research alternative assets like corporate bonds, commodities, hedge funds and listed real estate. He focuses on the alternative assets properties and tests if their accession to the investor portfolio adds value to the liabilities hedging process. He researches about the best ALM investor's portfolio mix in terms of liabilities hedging quality, risk diversification and investment horizon. He finds that both government and corporate bonds weight should be up to the 50% of the total portfolio as they are the best hedging tool against real rate risk. T-bills weight should be an important part of the total portfolio because they are low risky in the short-run and they have good risk diversification properties with stocks and bonds as well as good price inflation hedging qualities in the long-run. Stocks should have some weight in the portfolio only for an investor with long horizon. Commodities weight should be positive and increasing with the investment horizon as they have the best risk diversification properties and good inflation hedging quality. Listed real estate properties are mainly captured by stocks. Although hedge funds have good inflation hedging properties in the long-run, they have high exposure to stocks and bonds and therefore they are not good in terms of risk diversification. He concludes that alternative assets add value for the long term ALM investor because they have good liabilities hedging properties at all horizons. [Brenan](#) investigates the optimal dynamic strategy for an ALM investor who targets to maximize his power utility. He finds that the best strategy is to invest in cash, stocks and nominal bonds whose

weights depend on the risk aversion degree of the investor which afterwards defines the bond's maturity.

In this paper we focus on the “inflation fluctuation” side of liabilities risk. We propose the “wage inflation” change as an optimal measure of liabilities risk which should replace the Consumer Price Index (CPI) fluctuation in an ALM context.

Pension Funds have a primary liability which is just the pension payment. The pension level depends on the monthly amount for social security which employees pay to the pension fund. The amount for social security is a fixed or semi-fixed proportion of the monthly wage of the employee. As a result of that, we conclude that changes in wages directly cause changes in the liabilities of the Pension Fund. On the other hand, changes in the Consumer Price Index cause opposite changes in the disposable income of the employee, in an after “payment for social security” basis.

Although this reasoning could sound sensible by itself, there are studies in literature which thoroughly research the relationship between price inflation (CPI) and wages, proving that these variables are not uncorrelated. These studies particularly focus on the causal relationship between these 2 variables and their research outputs vary. Some of them show that prices cause wages ([Hess and Schweitzer 2001](#), [Caporale and Skare 2001](#), [Hess 1999](#), [Mehra 1993-2000](#)), other indicate that wages cause prices ([Farrokh Nourzad 2008](#), [Hoxha 2010 for Germany](#), [Ghali 1999](#), [Hess 1999](#), [Mehra 2000](#)) and just a few of them conclude that there is bidirectional causality between these 2 variables ([Zanetti 2007](#), [Hoxha 2010 for EU27](#), [Hess 1999](#), [Mehra 1993](#)).

[Hess and Schweitzer](#) describe these 2 variables relationship as a “wage-price spiral”. According to this effect when demand increases unemployment falls causing wages increase. This wages increase causes a respective prices jump which leads again to higher wages. They measure wage both with two alternative ways, the wage per unit produced and the wage which includes all compensations which are not related to productivity such as option based compensations and self-employed earnings. They test the direction of the causality between wages and prices and they find more systematic evidence that price inflation helps predict wages. [Caporale and Skare](#) are based on a Vector Error Correction Model (VECM) and through Granger causality tests they find that price inflation positive growth leads to positive employment growth in the short-term and negative employment growth in the long-

term. The effect in wages is downstream to the respective effect in employment growth.

[Nourzad](#) uses two measures for wages, both of them are related to productivity. The unit labor cost (ULC) and the average earnings per unit of output (AHE). ULC is the sum of wages or salaries and the employer's cost of employee benefits, per unit of output. AHE is also adjusted to productivity but it does not include employer's cost for employee benefits. He is based on a Vector Error Correction Model and finds that all the variables are cointegrated. He finds both that ULC causes prices and that it could be used to forecast CPI through "weak" and "strong" exogeneity tests respectively. Based on "super" exogeneity tests he proves that the relationship between ULC and CPI described above is stable and policy invariant. [Hoxha](#), based on data from Germany tests this relationship and finds that wages cause prices in the long-run.

[Hoxha](#), based on data from EU27 repeats the same research and supports that the causality between prices and wages is bilateral both in the long and the short-run. He regards wage as the Labor Cost Index (LCI) which is the nominal value of salaries and wages in industry and services (excluding public administration), adjusted to working days and seasonality. LCI is not adjusted to productivity as he independently measures the last one with the person based labor productivity. Finally [Zanetti](#) finds that price inflation explains "productivity adjusted" wage changes which afterwards effect on CPI again concluding that causality works in both directions.

We conclude from the above researches that the way of measuring the wage is very crucial for the research output. In any case, all these empirical results indicate that there is a relationship between these 2 measures and wage inflation could reasonably replace CPI in the liabilities risk measurement process.

The interest of this paper focuses on 2 key points and its research target is to:

- i. Find what the time series properties of returns on assets and wage inflation imply for the covariance between them at different investment horizons.
- ii. Propose the optimal strategic asset allocation according to these properties, taking into account both the investment horizon and the investor's "risk aversion" degree.

Before deriving the hedging quality of traditional and alternative assets against wage inflation we try explore the relationship between price inflation (CPI) and wage inflation through their historical correlation. We find that correlation between these 2 liabilities risk indexes is up to 0.53 using data from 1969. We also find a little lag in the wage inflation movement against price inflation. This fact could confirm part of the literature which supports that there is a causal relationship from wages to prices between these variables.

To respond to the first two issues of this paper we use a vector-autoregressive (VAR) model for returns both of assets and wage inflation and some state variables. In this way we extract the covariance structure according to the investment horizon which let us find the assets hedging capacity against wage inflation as well as the optimal weights of them in the portfolio, in terms of risk diversification.

We derive that most of the assets appear the same long-run performance against wage inflation hedging with the respective against price inflation hedging except of the commodities which are more highly correlated with CPI than with wage inflation. Furthermore the crucial difference is that all the assets are uncorrelated with wage inflation in the short-run except of nominal bonds whose correlation with wage inflation is low and equal to 0.10. Hedge Funds seem to be a good hedging tool against wage inflation in the long-run but they traditionally have high exposure to stocks and bonds. Therefore they are not the best in terms of risk diversification. Commodities have good hedging qualities against wage inflation like against price inflation. T-Bills also appear good hedging capacity in the long-run though worse than this of hedge funds and commodities. In summary alternative assets have better hedging qualities in the long run and nominal bonds are the only moderate solution against wage inflation hedging in the short-run.

Data

For this paper empirical research part we use quarterly data from US. Specific data used for assets, liabilities and state variables are described below.

- Assets: we form the total asset menu including both traditional asset classes such as t-bills, government bonds and stocks and alternative asset classes like commodities, hedge funds and listed real estate. For t-bill we use the yield to maturity of the “90-days US Treasury (constant maturity, middle rate)” which is extracted through calculations from its nominal rate. For government bonds we calculate the return of the “US Benchmark 10-Year Government Index” which includes coupon payments. In a similar way we calculate the return of the “US-DS Market” equity index which includes payments for dividends. Hedge fund returns are based on the “HFRI” fund of funds conservative index return series. HFRI is an index which represents the whole industry and it makes sense for us because we address hedge funds as a unified asset class despite the different style sectors they may include. HFRI returns index is equally weighted and net-of-fees offering in this way wide diversification across these different style sectors. Commodities returns are based on the “Standard and Poors GSCI” index which represents a composition of all world-production weighted commodity sector returns. Investment in GSCI index is a long-term unleveraged investment in fully-collateralized nearby commodity futures with full reinvestment. For listed real estate we are based on the “FTSE EPRA NAREIT North America” return index. This index represents listed real estate logarithmic returns of publicly traded companies on NYSE, AMEX, NASDAQ and Toronto stock exchange.

All these data are found in Datastream. Data for t-bills, equity and government bonds start in 1982:1, 1973:1 and 1980:1 respectively. Commodities time series start in 1970:1 but the first observation for hedge funds and listed real estate is in 1990:1. The final dataset used is unified and starts from 1990:2 when we have available observations for all the asset variables and ends in 2012:1. Although we could use different duration’s data in order to define the risk and the hedging properties of the assets, we could not do the same thing to find the portfolio weights which give us the optimal asset allocation for the investor. As a consequence of that, we use a uniform

dataset for all the variables and in this way the results of the first key point of this paper are going to be confident to the results of the second key point.

- Liabilities: in this paper we focus on the inflation fluctuation part of the liabilities side and propose that the variable of the price inflation should be replaced with the variable of wage inflation. To reach this finding we test assets hedging properties both against price and wage inflation. Therefore we use data both for these two variables.

Based on the literature about the relationship between prices and wages we conclude that is very crucial to find these specific variables which represent better wages and prices respectively.

For price inflation representation some researchers have used variables like Harmonized Index of Consumer Prices (HICP, [Hoxha 2010](#)), Personal Consumption Expenditure Deflator (PCED, [Nourzad 2008](#)) and Gross Domestic Product Price Deflator (GDPPD, [Hess & Schweitzer 2001](#)). Despite this, it has been proved in the biggest part of the literature that Consumer Prices Index (CPI) is the more reliable index which represents the price changes in the best way. We use the Consumer Price Index (CPI-U All Urban, All Items) which is a measure of the average change over time in the prices of consumer items, goods and services that people buy for day-to-day living. The CPI is a complex construct that combines economic theory with sampling and other statistical techniques and uses data from several surveys to produce a timely and precise measure of average price change for the consumption sector of the American economy. CPI-U is the most frequently reported statistic in the media. It is based on the buying habits of the residents of urban or metropolitan areas in the United States, a segment of the population which accounts for about 87 percent of the U.S. population.

An important conclusion extracted from the same literature is that wages should be directly adjusted to productivity ([Hess & Schweitzer 2001](#), [Nourzad 2008](#), [Zanetti 2007](#), [Xoxha 2010](#)). Variables have been used that represent wages are Unit Labor Cost, Average Earning per Unit of Output and Labor Cost Index. We are based on the Unit Labor Cost (ULC) of the Business sector of US. Unit labor costs show the growth in compensation relative to that of real output. These costs are calculated by dividing total labor compensation by real output. Changes in unit labor costs can be approximated by subtracting

the change in productivity from the change in hourly compensation. Unit labor costs measure the labor compensation cost required to produce one unit of output and are derived by dividing compensation per hour by output per hour. Thus, increases in productivity lower unit labor costs while increases in hourly compensation raise them. If both series move equally, unit labor costs will be unchanged.

Data for ULC and CPI are from Datastream. Although there is enough availability in terms of time, the data period we use is the same with the respective of the assets. It starts in 1990:2 and ends in 2012:1.

- **State Variables:** we add five state variables in our VAR model in order to help it predict the excess returns. These are the dividend yield, the nominal rate, the real rate, the term spread and the default spread ([Hoevenaars 2009](#)). For the dividend yield we use the returns of the “US-DS Market Dividend Yield”. As nominal rate we use the return of “90 days US Treasury constant maturity-middle rate”. The data for these two state variables are from Datastream. We extract the real rate abstracting the price inflation growth from the nominal rate we found above. We calculate term spread as the difference between the yield to maturity of the 10-year government bond (data found from Datastream) and the yield to maturity of the 90-days t-bill we extracted before to use this as an asset variable. Finally we construct default spread by abstracting the yield to maturity of the 10-year government bond from the middle rate of the US corporate bond seasoned by Moodys with BAA (data found from Datastream). Some of these state variables have been also used before [Hoevenaars \(2009\)](#) by [Campbell and Shiller \(1991\)](#), [Brandt and Santa-
Carla \(2006\)](#), [Campbell et al. \(2003\)](#) and [Campbell and Viceira \(2005\)](#). State variables data period is the same with the respective of assets and liabilities.

Data summary statistics

In table 1 we have the report of the summary statistics for all our data. Data period is common for all the data. It starts from 1990:II and ends in 2012:I. We use the same data period in our vector autoregressive (VAR) model too. The mean, the standard

deviation and the Sharpe Ratio figures are annualized. The rest figures such as min, max, skewness and kurtosis are reported in a quarterly basis.

The ULC average return is lower than the CPI but it is regarded as more risky in terms of volatility. T-Bills have the highest average return and the lowest standard deviation of the asset variables. CPI and the asset variables data are negatively skewed indicating that the positive future returns will be probably small and frequent while the negative future returns will be high but infrequent. ULC is positively skewed and therefore we expect frequent low negative returns. Commodities, hedge funds and listed real estate have kurtosis figure greater than 3 while the respective figures for t-bills, government bonds and equity are lower than 3.

We should remark here that alternative assets distributions have fatter tails than the traditional assets and as a result of that there is less risk of extreme returns. This is important evidence that alternative asset classes should be included in the investor's portfolio through the asset allocation process. The second important evidence of the summary statistics report is that the two measures of liabilities fluctuation risk, ULC and CPI, seem to have different characteristics in terms of risk which may lead to different asset allocation structure.

Table. I

Estimation Base		Annual	Annual	Quarterly	Quarterly	Quarterly	Quarterly	
Variables		Mean	Stdev	Min	Max	Skewness	Kurtosis	Start Data
Normal	ULC-Business Sector Growth	0.015	0.018	-0.019	0.039	0.634	2.148	1990: II
	CPI Growth	0.026	0.010	-0.024	0.017	-2.569	14.491	1990: II
	T-bill (YTM)	0.142	0.045	0.000	0.084	-0.168	-1.074	1990: II
	10-Year Gov. Bonds incl. coupons	0.070	0.070	-0.089	0.109	-0.276	0.337	1990: II
	Equity Index incl. dividends	0.091	0.150	-0.275	0.185	-1.029	2.416	1990: II
	Commodities	0.044	0.239	-0.538	0.298	-1.515	5.395	1990: II
	Hedge Funds	0.062	0.055	-0.129	0.088	-2.080	9.005	1990: II
	Real Estate	0.119	0.201	-0.380	0.210	-1.420	3.362	1990: II
State	Dividend Yield	0.080	0.013	0.010	0.039	0.750	0.102	1990: II
	Nominal Rate	0.139	0.043	0.000	0.081	-0.183	-1.083	1990: II
	Real Rate	0.112	0.042	-0.010	0.071	-0.280	-1.140	1990: II
	Term Spread	0.069	0.026	-0.008	0.037	-0.144	-1.281	1990: II
	Default Spread	0.093	0.017	0.014	0.055	1.803	4.123	1990: II

Model

In our VAR model we predict the nominal annualized expected returns of assets and liabilities and we define the annualized covariance matrix.

$$\Sigma^{(\tau)} = \frac{1}{t} * Var_t[x_t^\tau + \tau] = \begin{pmatrix} \Sigma_{AA}^\tau & \sigma_{AL}^\tau \\ \sigma_{AL}^{\tau'} & \sigma_L^{(\tau)2} \end{pmatrix}$$

Through the covariance matrix above we estimate the results of the first empirical part of our paper. $[x_t^\tau + \tau]$ represents the cumulative nominal returns over t periods. The relationship between τ and Σ^τ is the assets and liabilities term strucrure of risk. σ_{AL}^τ represents the covariance of assets and liabilities which indicates the assets hedging qualities against liabilities at different horizons.

In the second empirical part of our paper we compute the optimal asset allocation for the investor's portfolio under price inflation but also under wage inflation in order to compare our findinds. In our VAR model we are based on the type below to compute the optimal portfolio weights.

$$\alpha_t^{(\tau)} = \frac{1}{\gamma} * \left(\left(1 - \frac{1}{\gamma} \right) * \Sigma_{AA}^{(\tau)} + \frac{1}{\gamma} * \Sigma_{AA} \right)^{-1} * (\mu_t^{(\tau)} + \frac{1}{2} * \sigma_A^2 - (1 - \gamma) * \sigma_{AL}^{(\tau)})$$

Basically this portfolio contains two other subportfolios, the speculative (PSP) and the liabilities hedging one (LHP).

Estimation Results

Historical relationship between wage inflation and CPI

It is proved by the literature that there is a stable relationship between wages and prices in terms of causality. Far from the direction of the causality, the fact that these two variables seem to be interdependent to some extent is encouraging for our research purpose. In order to measure the degree of the interdependence between Unit Labor Cost changes and Consumer Price Index changes we test their correlation. We use data from 1969:2 until 2012:1. The correlation variable is up to 0.53. On the one hand this level of correlation is enough high to be sufficient in order to indicate that there is a relationship between these two figures. On the other hand it seems supportive for our research goal which is to propose the replacement of the CPI with wage inflation as a measure of part of the liabilities risk for a pension fund. If the correlation of these variables was higher than 0.7 it would probably be meaningless to propose the one's replacement with the other. The higher the correlation degree the most properties of one's variable are captured by the other.

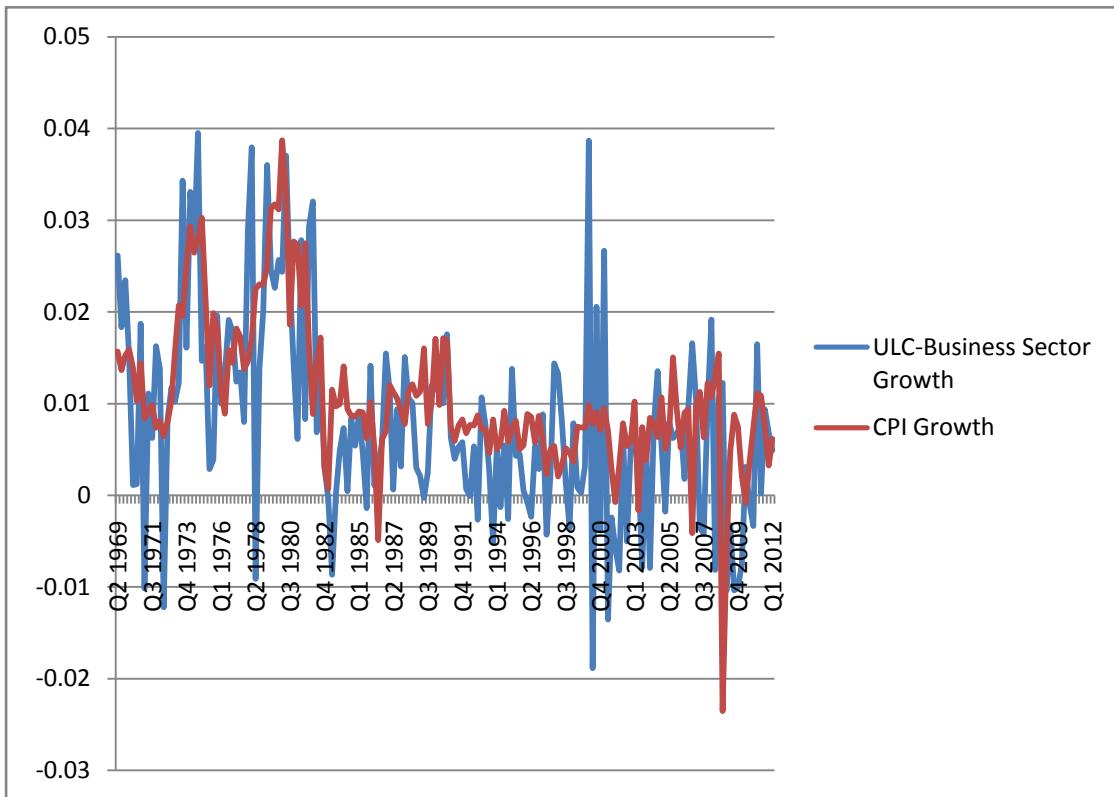
It is obvious from the chart 1 below that the wage inflation movement is almost parallel to the price inflation movement. We can also admit that there is a little lag in the wage inflation movement against this of price inflation. This could be a slight indication about the causality direction between these two variables which moves from wages to prices. It means that the CPI properties are not unique and are captured by the ULC. In table 1 there are the summary statistics for the two variables. We find that ULC standard deviation is equal to 0.22 and greater than the respective of the CPI which equals to 0.16. Based on that, we could think that the ALM investors may have underestimated this part of liabilities risk until now using CPI to measure that.

The historical correlation structure between ULC and CPI is the first encouraging evidence that our paper goal makes sense.

Table.2

<u>Summary Statistics</u>	Mean	Standard Deviation	Max	Min	Correlation
ULC Business	0.03231	0.02215	0.03950	-0.01886	0.53058886
CPI	0.04305	0.01597	0.03870	-0.02353	

Chart.1



Historical Correlation overview

In table 3 there are the correlation coefficients between all the variables of our model. The figures are based on data from 1990:II until 2012:I. The correlation between CPI and ULC is up to 0.12 and seems remarkably low compared to the respective figure of 0.53 which is extracted by the dataset (1969-2012). In the dataset period we use for our VAR model we observe successive intense changes of the Unit Labor Cost around 2000 as well as a sharp fall of price inflation between the second and the third quarter of 2008. CPI decrease in 2008 reflects the pick of the US financial crisis when the investment bank “Lehman Brothers” goes bankrupt due to its high funding exposure to the subprime mortgage market. The extreme returns of this period described above, make the 2 liability variables (ULC and CPI) seem more uncorrelated than in a full dataset testing.

T-bills correlation both with CPI and ULC is up to 0.27 meaning that they have exactly the same hedging capacity against the two variables. T-bills seem to be historically the best and unique choice for wage inflation hedging through the highest

correlation figure of 0.27. For price inflation hedging, equity and real estate are as efficient as t-bills with the correlation coefficient around 0.27-0.31. However hedge funds and commodities have the best hedging qualities against CPI with the correlation figures equal to 0.52 and 0.78 respectively.

High correlation observed between equity and both “hedge funds” and “listed real estate”, 0.65 and 0.69 respectively, is absolutely expected as these two alternative asset classes are highly exposed to equity straightly or equity indexes. Correlation between hedge funds and commodities are high and equal to 0.51 because the first include the last in their investment asset mix. Hedge funds are also exposed to t-bills leading to a 0.37 correlation coefficient between them.

Nominal and real rate correlations with t-bills approximate 1.00 as both these two state variables extraction is based on the t-bills return. That's why the correlation between nominal and real rate is nearly equal to 1.00 too.

Table.3

Correlation Matrix	ULC	CPI	T-bill (YtM)	Gov. Bonds (10-year)	Equity	Commodities	Hedge Funds	Real Estate	Dividend Yield	Nominal Rate	Real Rate	Term Spread	Default spread
ULC	1.00												
CPI	0.12	1.00											
T-bill (YtM)	0.27	0.27	1.00										
Gov. Bonds (10-year)	0.04	-	0.14	-0.02	1.00								
Equity	-0.06	0.27	0.18	-0.12	1.00								
Commodities	0.07	0.78	0.11	-0.29	0.25	1.00							
Hedge Funds	0.10	0.52	0.37	-0.19	0.65	0.51	1.00						
Real Estate	-0.03	0.31	0.00	-0.08	0.69	0.36	0.50	1.00					
Dividend Yield	0.06	0.05	0.15	0.11	-0.05	-0.12	-0.03	-0.15	1.00				
Nominal Rate	0.27	0.27	1.00	-0.02	0.18	0.11	0.37	0.00	0.15	1.00			
Real Rate	0.25	0.04	0.97	0.01	0.12	-0.07	0.25	-0.07	0.14	0.97	1.00		
Term Spread	-0.25	0.18	-0.72	-0.11	-0.13	-0.05	-0.21	0.05	0.33	-0.72	-0.71	1.00	
Default spread	-0.21	0.44	-0.66	0.24	-0.45	-0.36	-0.56	-0.37	-0.04	-0.67	-0.58	0.40	1.00

Return dynamics of VAR model variables

In table 4 we report the parameter estimates of our VAR model which uses as variables the equity index, the 10-year nominal government bond, the commodities index, the hedge fund index, the real estate index, the term spread, the default spread, the dividend yield, the CPI return and the nominal rate of the 90-days t-bill. Table 5 reports the respective t-statistics for the variables we used in the VAR model. We regard confidence level equal to 95% for our estimations.

We find that the coefficients of the 4 state variables (on their own lags) are strongly statistically significant. Coefficient value is 0.86 for the term spread, 0.9 for the default spread, 0.92 for the dividend yield and 0.91 for the nominal rate. All these statistically significant coefficients are close to 1.00 indicating that the return series of the state variables are very persistent, fact that means stability for the VAR model we are based on.

Default spread predictability against term spread is absolutely expected because the first calculation is based on the last. Far from default spread with t-statistic equal to 3.671 (coefficient 0.325), CPI return through a little bit lower but still strong significance level of 2.936, could predict the next period term spread figure to the same direction (coefficient 0.319). In the same way it seems reasonable that CPI return has good predictability against default spread despite it is lower than against term spread (t-statistic 1.680).

CPI marginally significant negative coefficients -3.157 and -0.190 predict that equity and t-bills next period returns respectively will fall. This finding is confident to the macroeconomic theory. Dividend yield positive significant coefficient of 4.138 indicates a perfect explanatory quality against equity which is fully expected. Default spread coefficients against t-bills, equity and real estate are negative and equal to -0.318, -3.213 and -3.230 respectively. They are statistically significant with t-statistic figures equal to -3.456 (t-bills), -2.343 (equity) and -1.683 (real estate). The default spread coefficient against real estate is marginally significant due to the index exposure to equity. Finally, although the term spread coefficient is significant, it is not a strong predictor against equity (t-statistic -1.652) by itself because it is just a part of the default spread explanatory quality.

Table.4

	t					
	Coefficient	Term spread	Default Spread	DY	CPI_ret	T-bills
t+1	Equity	-1.974	-3.213	4.138	-3.157	-1.188
	Nominal_Bond	0.911	-0.113	-0.137	-1.134	0.616
	Commodities	0.175	-1.173	-1.646	4.564	-0.031
	Hedge Funds	0.111	-0.397	0.150	-0.297	0.347
	REITS	0.539	-3.230	0.598	-1.651	-0.564
	Term spread	0.861	0.325	0.095	0.319	0.017
	Default Spread	0.015	0.900	-0.071	0.172	0.007
	DY	0.023	-0.002	0.915	0.062	-0.001
	CPI_ret	-0.063	-0.109	0.110	0.127	-0.016
	T-bills	0.035	-0.318	-0.060	-0.190	0.912

Table.5

	t					
	T-statistics	Term spread	Default Spread	DY	CPI_ret	T-bills
t+1	Equity	-1.652	-2.343	2.508	-1.878	-1.492
	Nominal_Bond	1.603	-0.173	-0.174	-1.416	1.624
	Commodities	0.088	-0.518	-0.604	1.643	-0.024
	Hedge Funds	0.251	-0.781	0.245	-0.476	1.175
	REITS	0.323	-1.683	0.259	-0.701	-0.506
	Term spread	11.169	3.671	0.894	2.936	0.333
	Default Spread	0.202	10.756	-0.705	1.680	0.154
	DY	0.849	-0.081	24.828	1.646	-0.077
	CPI_ret	-0.775	-1.171	0.978	1.115	-0.302
	T-bills	0.439	-3.456	-0.546	-1.683	17.079

Term structure of assets and liabilities

Term structure of risk

In this paper section we compute the annualized volatilities across different investment horizons in a quarterly basis. We use data from 1990:II until 2012:I and we try to find the time diversification properties of each asset class. We test for different investment horizons using quarterly periods with a maximum period of 100 quarters or 25 years. An asset-liabilities (ALM) investor is officially interested in the return of assets in excess of the liabilities return because his major investment goal is to hedge the portfolio against liabilities risk. As a result of that we should ideally compute the volatility of each asset class based on the respective asset return over the liabilities return. However in this paper we don't incorporate all the aspects of liabilities risk but we focus on the inflation fluctuation side in order to propose the replacement of price inflation with wage inflation as an optimal measure of this aspect of risk. Therefore we test time diversification of each asset based on their nominal returns in order to ensure our findings relevance.

In graph 2 we observe the standard deviation level of all the six asset classes across time. Our results are confident to the official characteristics of each kind of asset. At a glance the less risky asset across time is the nominal bond except of the short-term horizon until 1 year when the t-bill has the lowest volatility. From an overall lower to a higher risk degree we meet nominal bonds, hedge funds, real estate, t-bills, equity and commodities respectively as expected.

In graphs 3-8, we have the standard deviation per asset class. T-bills are the less risky asset for a short-term investor through a volatility figure near to zero for the first four quarters. The reason is that the investor has the possibility to reinvest in a rolling basis after 90 days. We remark that t-bills volatility is continuously increasing across time from 0.4% after 23 quarters to 0.9% after 85 quarters. It happens because the reinvestment risk increases as the investment horizon increases due to the real interest rate risk outstanding.

Nominal bonds volatility is around 0.1% for 1 year investment horizon, it decreases to 0.04% after 5 years and it tends to be flat below 0.02% after 20 years. Major driver for the volatility of the nominal bond is the volatility of the term spread. Term spread,

as we have described in a previous part of this paper, is the difference between the yield to maturity of the 10-year government bond and the yield to maturity of the 90-days t-bill. The increasing term spread volatility across the investment horizon combined to the increasing t-bill volatility lead nominal bond to gradually being the less risky asset across time. The term spread volatility is reported in graph 12.

Equity volatility is flat around 0.5% during the short horizon of 1 years, it is increasing at 0.6% until 4 years and then falls to 0.4% after 17 years indicating a mean reverting behavior. Although dividend yield has a positive impact on the equity future returns and consequently to the firm cash flows, the current equity returns should decrease in order to hedge any possible discount rate increase which is not equivalent to the cash flows increase (Campbell and Vuolteenaho 2004). Therefore dividend yield has an adverse impact on equity volatility, especially in the long term. Dividend yield volatility is reported in graph 10. Far from the dividend yield, default spread which uses “equity like” bonds as a calculation base, has a positive impact on the equity future returns and an opposite impact on its long term volatility. Default spread volatility is reported in graph 9.

Time diversification in listed real estate is similar to the equity one but always lies in higher risky levels across investment horizon. Graph 7 which represents the NAREIT volatility has the same curve with the respective equity graph. The only difference is that the mean reversion in the long-run is less than the equity one. This finding is confident to the “[Hoevenaars 2009](#)” output. The general similarity makes sense because NAREIT is an equity based index. NAREIT volatility is increasing at around 1.25% until 3 years and then gradually falls at 1% after 16 years.

Hedge funds term structure is mainly affected by t-bills increasing to 0.25% until 14 years investment horizon and being more flat after that. In terms of volatility hedge funds are less risky than t-bills because they are exposed to nominal bonds too.

Commodities as the most risky asset overall, report increasing volatility degree 2.5% until 10 years which is turned to a nearly flat term structure after this investment horizon. Their returns are mostly explained by t-bills through our VAR model.

Chart.2

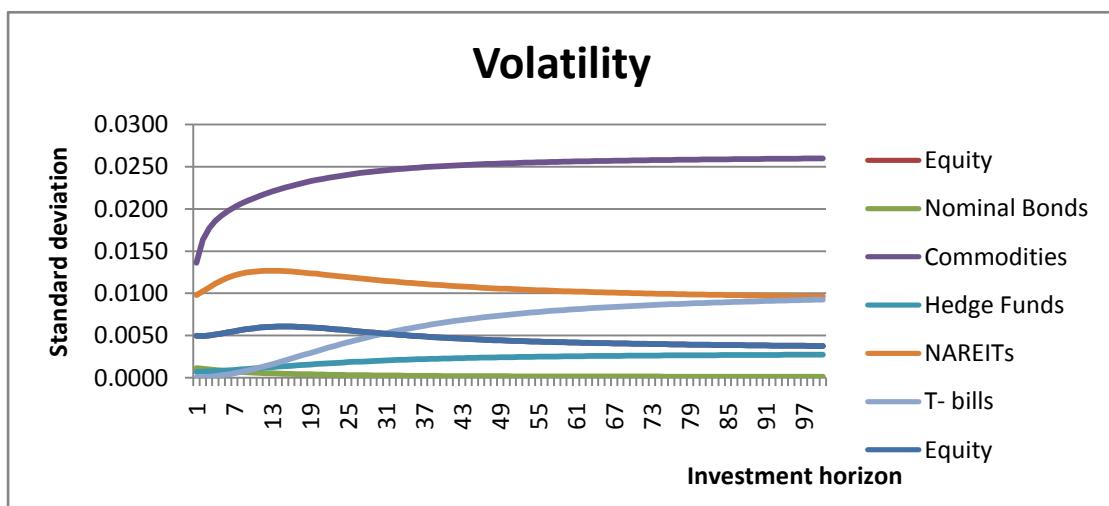


Chart.3

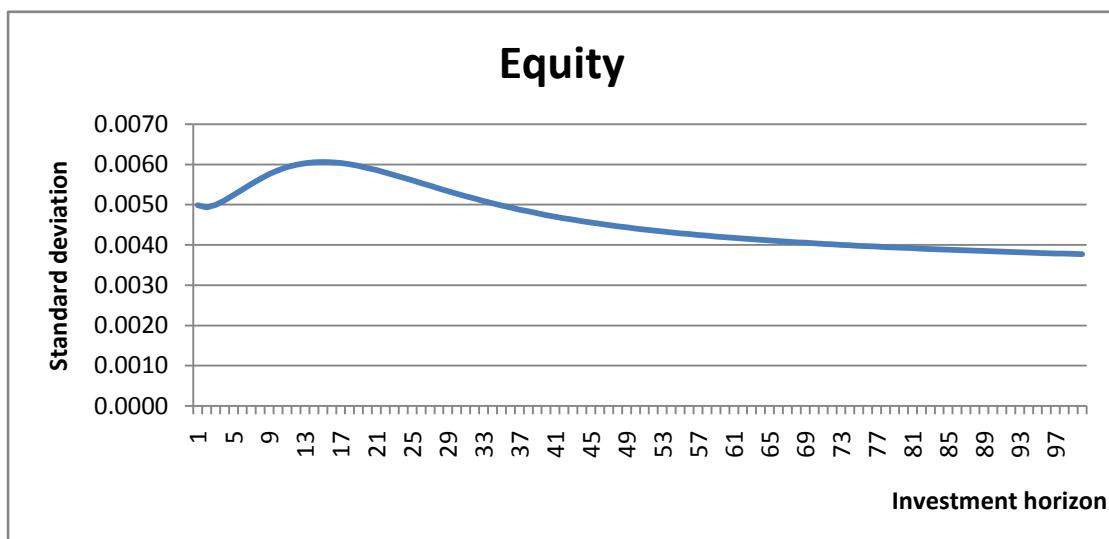


Chart.4

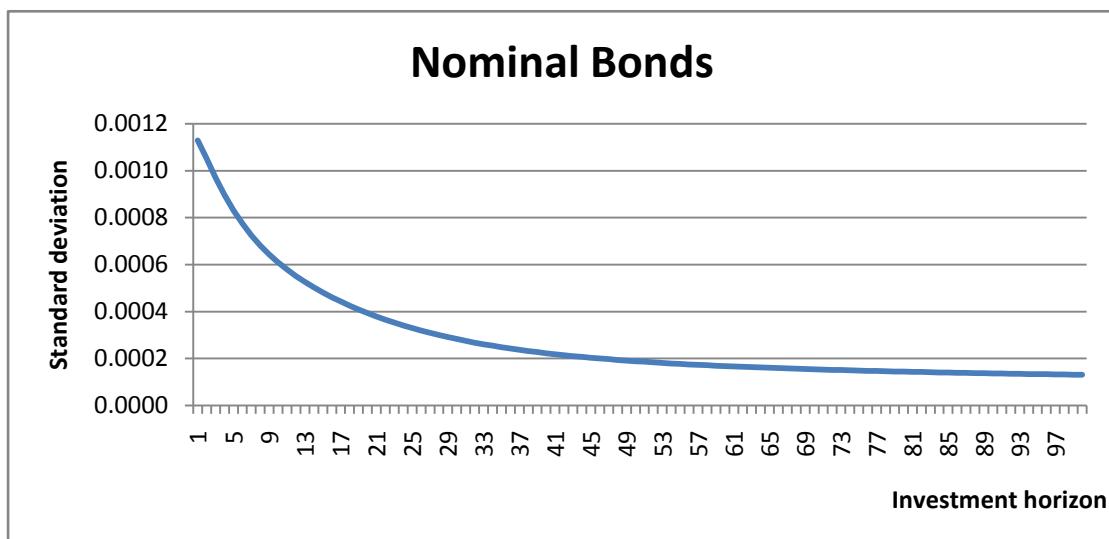


Chart.5

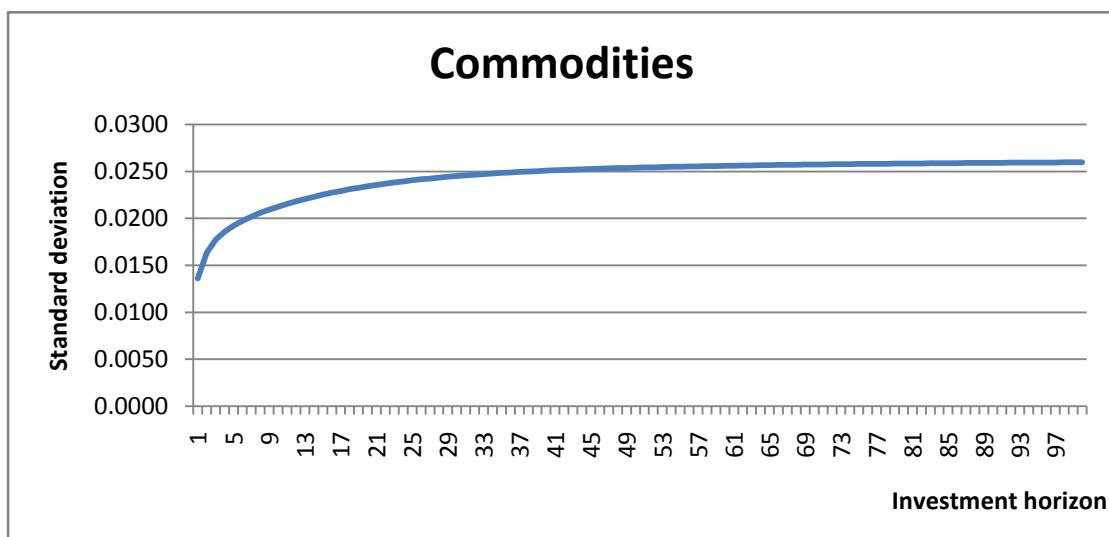


Chart.6

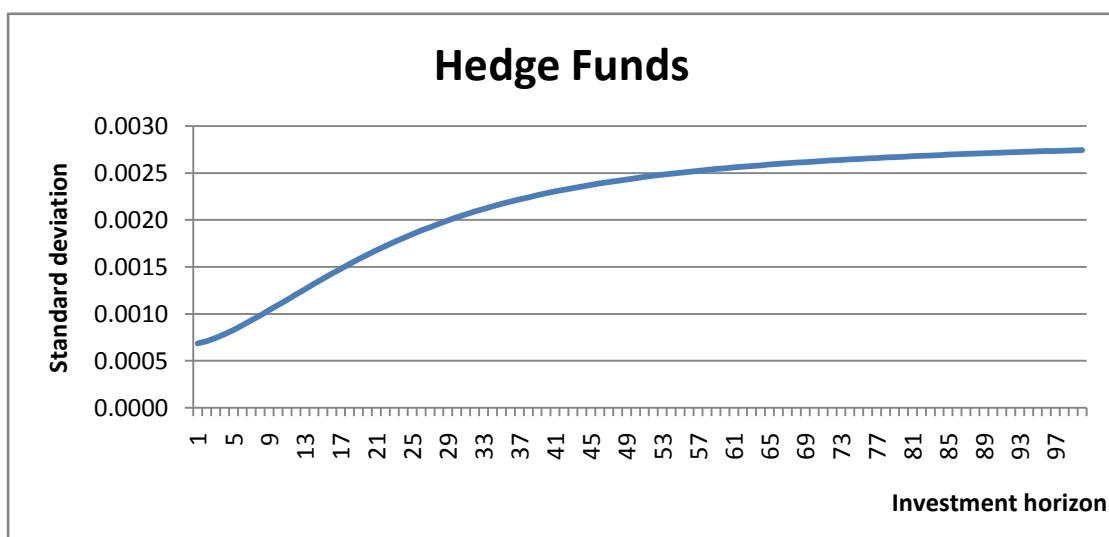


Chart.7

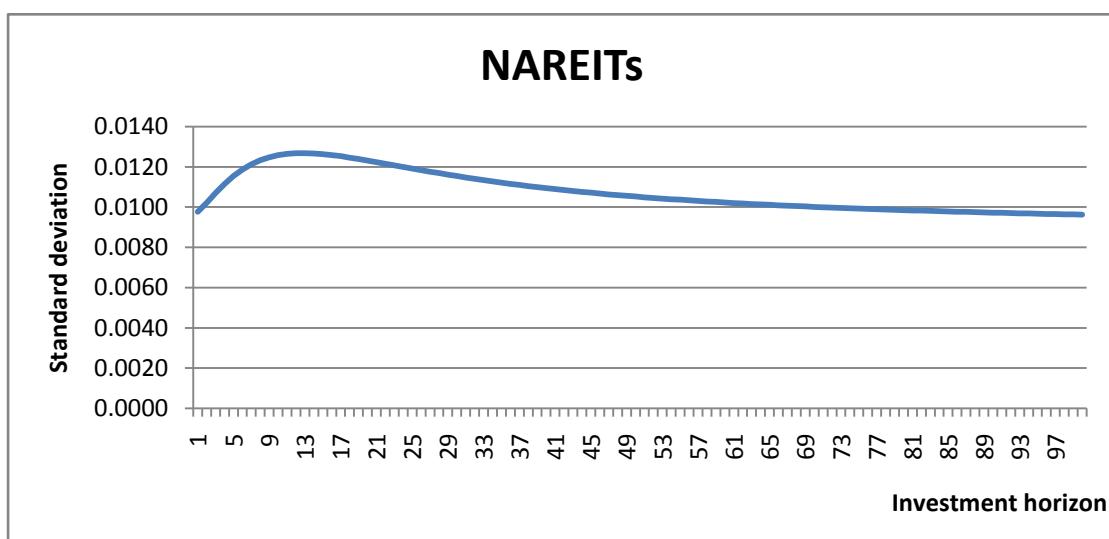


Chart.8

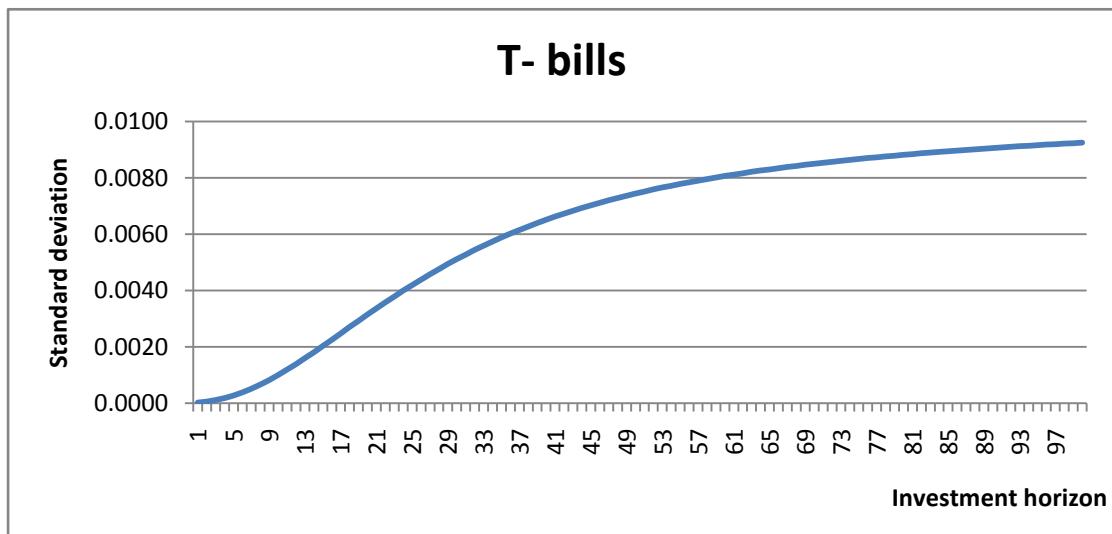


Chart.9

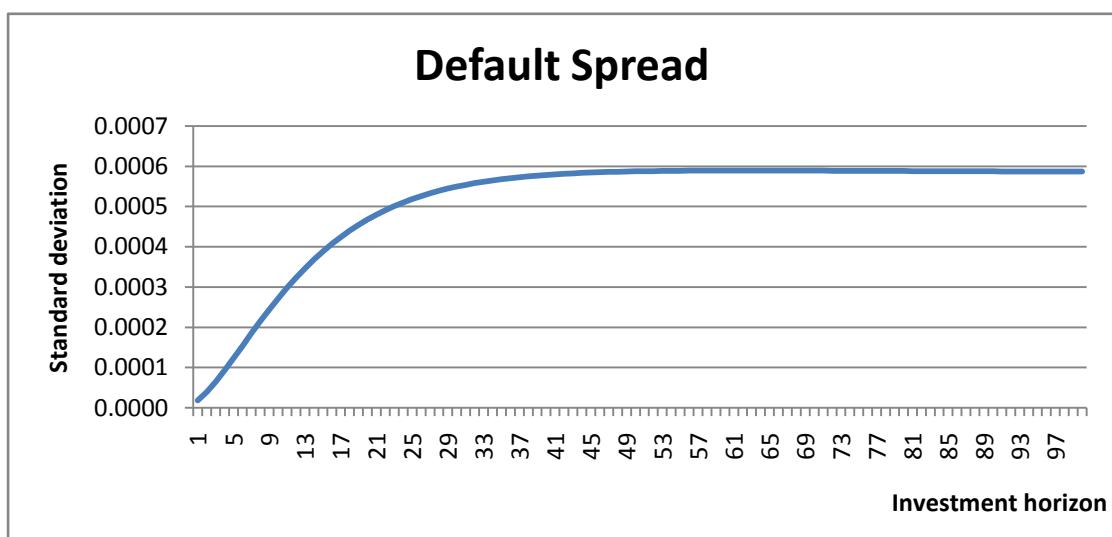


Chart.10

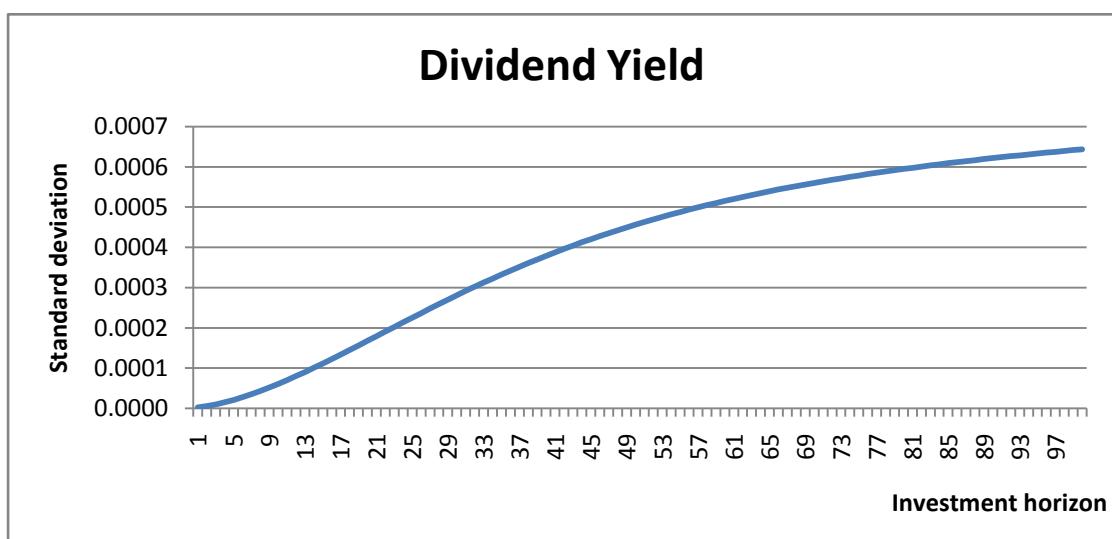


Chart.11

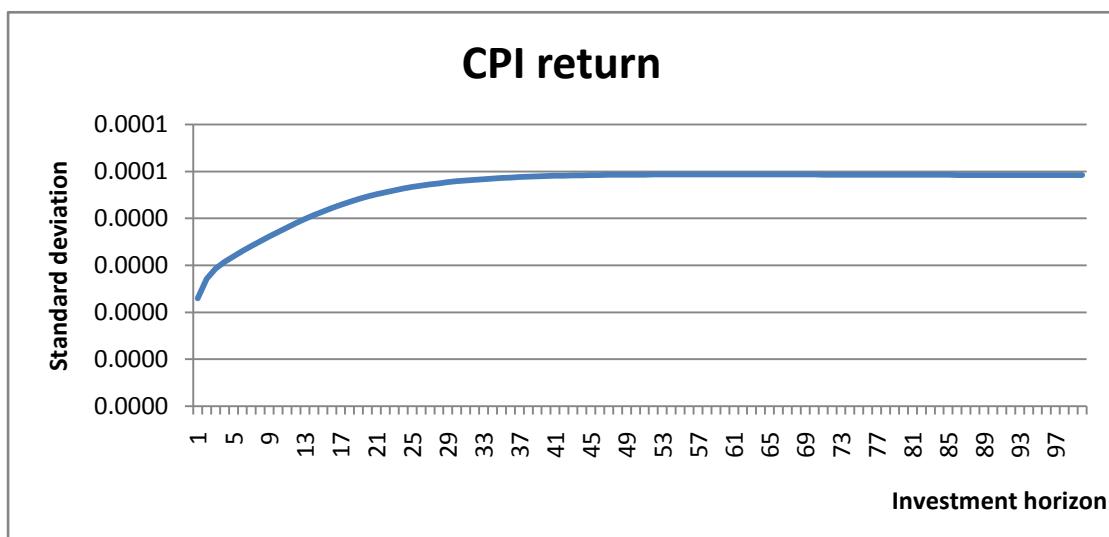
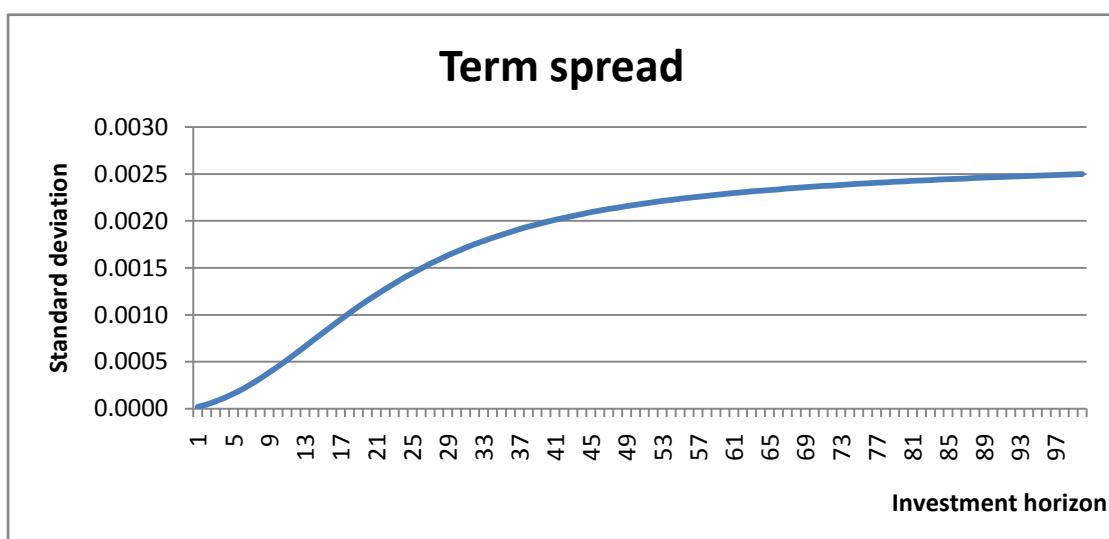


Chart.12



Risk diversification properties

In this paper part we compute the correlation coefficients between different asset classes in order to find out their diversification qualities in different investment horizons as far as the portfolio risk.

Correlation between equity and nominal bonds is negative and low across the investment horizon indicating that bonds could be used for risk hedging in a portfolio with stocks. Correlation coefficient is up to -15% for a short term investor of 4 quarters, it increases then to -35% after 7 years and falls under -30% after 17 years. Equity is highly correlated with real estate in all investment horizons. Correlation is about 70% for the first four quarters, it decreases at 65% until the first 5 years and it reaches the correlation level of 40% in the end of the 25-year investment horizon. Real estate indices are mainly based on listed stocks and as a result of that we don't find risk diversification properties between these two asset classes. For a mid-term investor which is interested in an investment horizon from 1 to 5 years, NAREITs correlation both with commodities and hedge funds is between 50% and 60%. This findings combination proves that listed real estate risk diversification qualities are captured by other assets.

T-bills could be an efficient risk diversification tool in a portfolio with stocks and bonds. They are positively correlated with stocks but negatively correlated with 10-year nominal bonds due to their duration mismatch. In a short-run investment horizon until 1 year, t-bills correlation with stocks and bonds is 35% and nearly -55% respectively. Both correlation figures are slightly increased after 3 years but then start decreasing to zero across the investment horizon. We conclude that t-bills risk diversification properties are being stronger for a long-term investor like an ALM one.

Hedge funds correlation with equity is high and almost at the level of 70% both for a short and the mid-term investment horizon. From 3 years and ahead, correlation is gradually decreasing and drops under the level of 20% after 21 years. This finding is explained by the high exposure of hedge funds to stocks both in the short and the mid-run. In the long-run hedge funds reduce their exposure to equity and as a consequence of that correlation between them falls. Hedge funds are not as much exposed to bonds as to stocks and the negative correlation coefficient between hedge funds and nominal

bonds is lower across the different investment horizons. It approaches -60% only at 4 years horizon but it slightly decreases after. Although hedge funds supplement the t-bills low short-term risk diversification qualities against equity and nominal bonds, the correlation between them is over 60% after 2 years, and approaches 90% in the long-term.

Although their performance is similar to the respective of hedge funds, commodities are better hedging tool in terms of portfolio risk diversification. Their correlation coefficient both with equity and nominal bonds is low across all investment horizons despite its opposite direction. Moreover their correlation with t-bills in middle and long investment horizons is high but not over 60% indicating that they could be both included in the investor's portfolio. Conclusively commodities have the best risk diversification properties among the assets. Graphs 13-27 separately represent the cross-assets correlations.

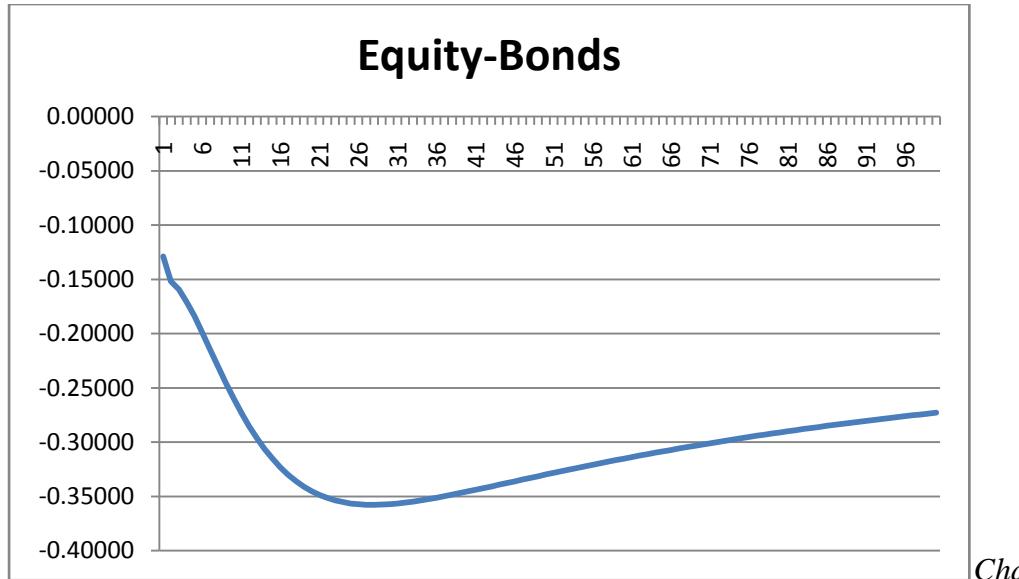


Chart.13

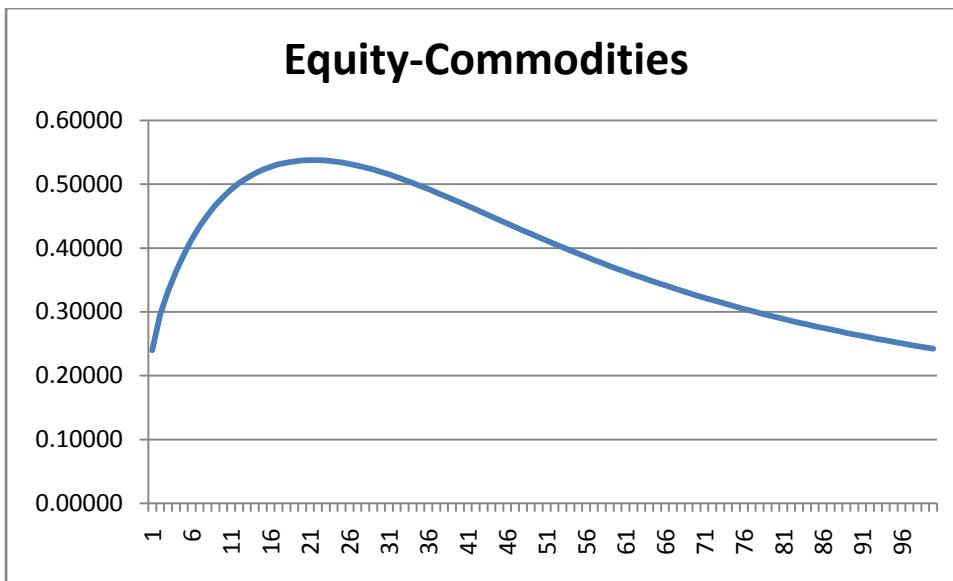


Chart.14

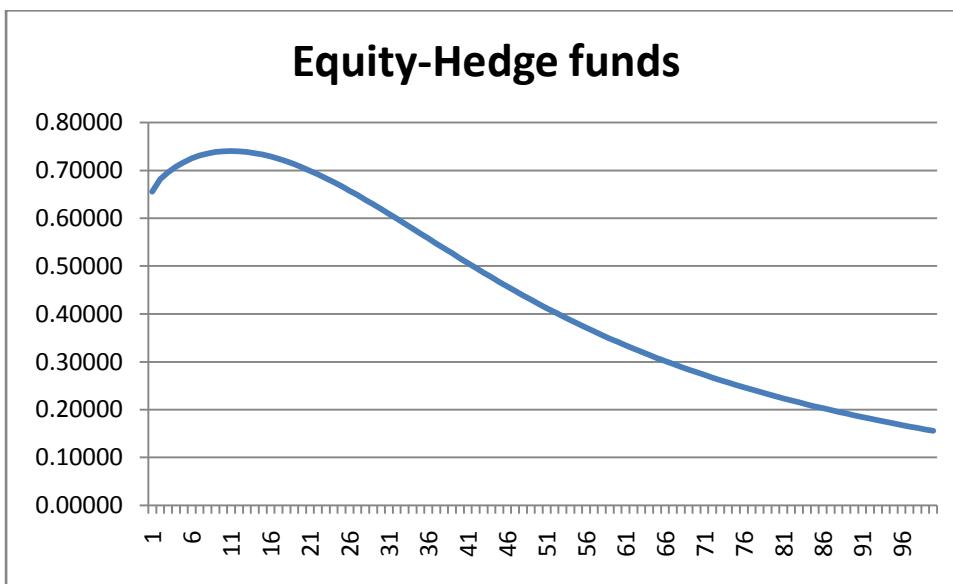


Chart.15

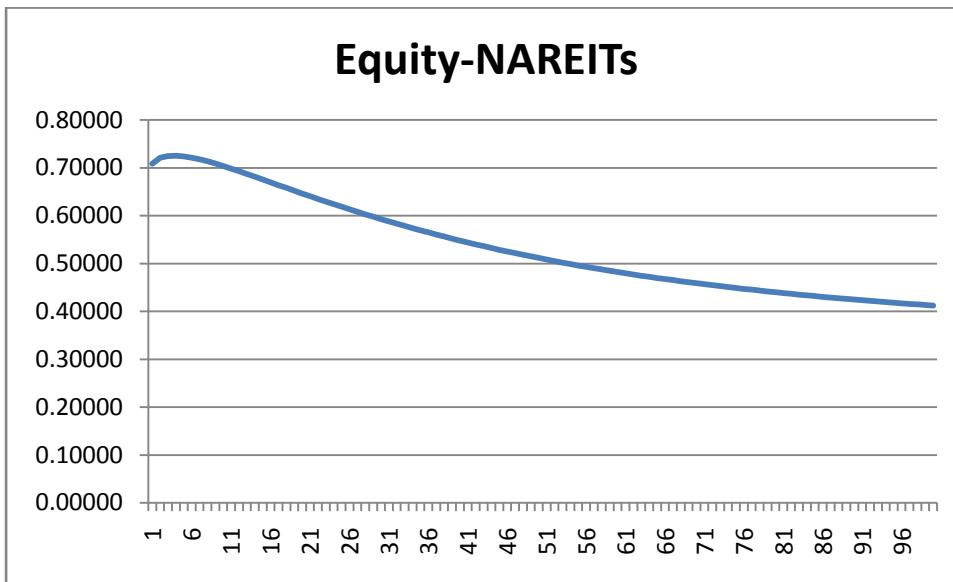


Chart.16

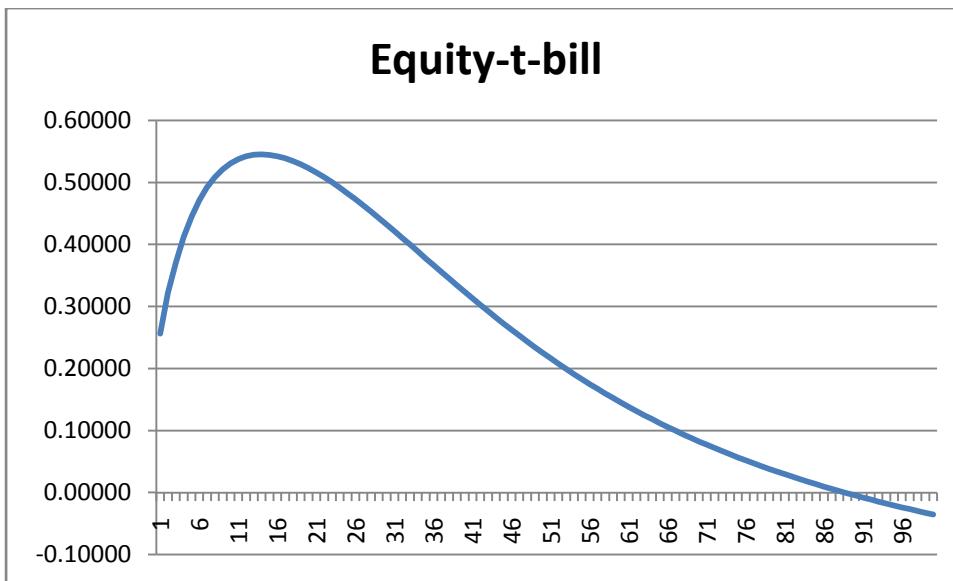


Chart.17

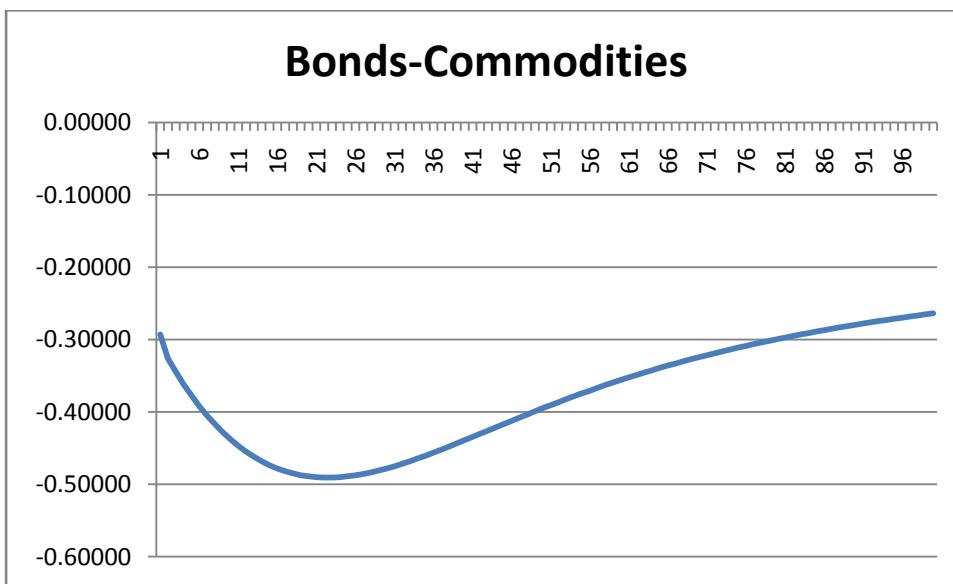


Chart.18

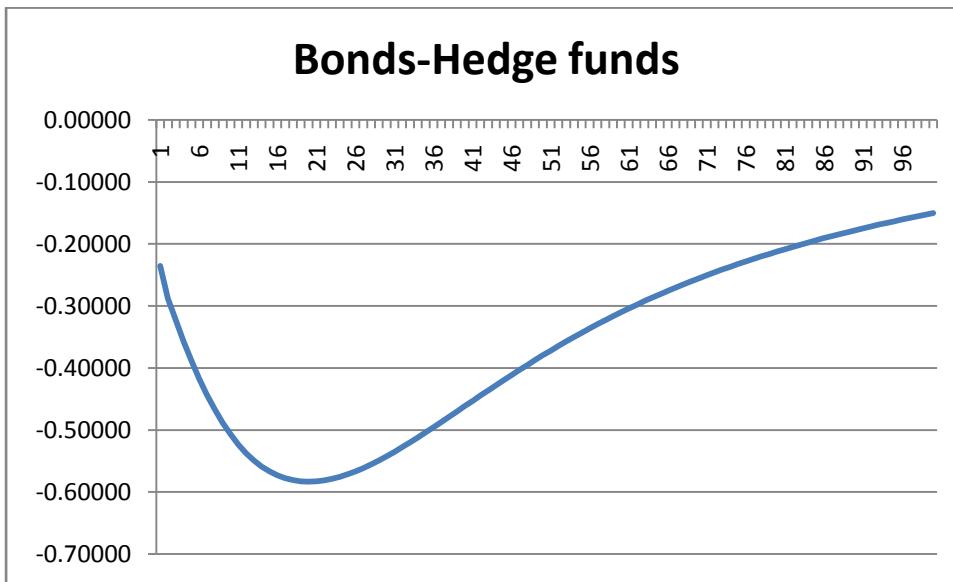


Chart.19

Bonds-NAREITs

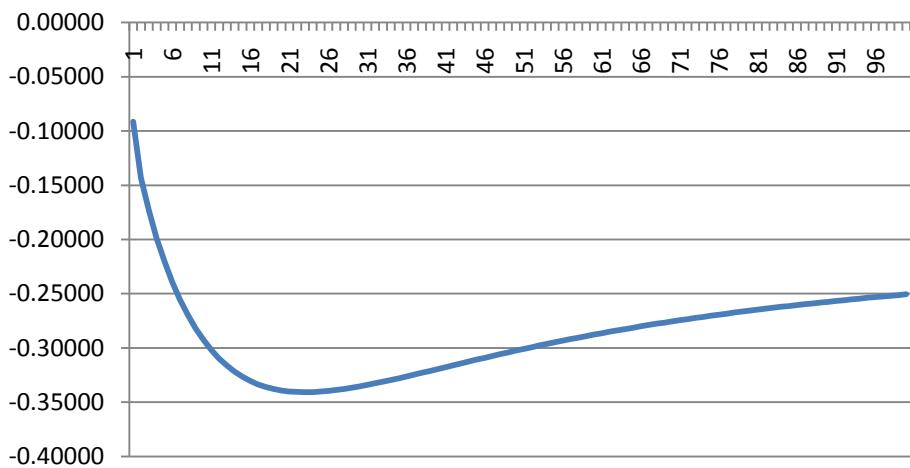


Chart.20

Bonds-t-bills

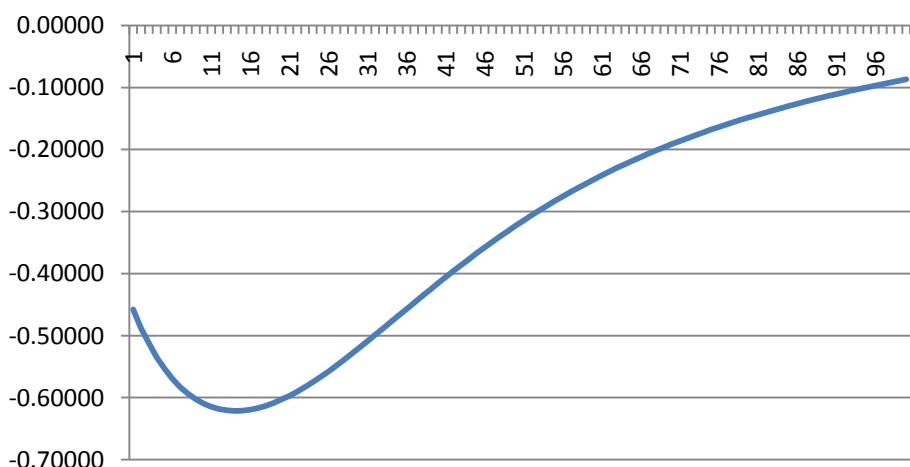


Chart.21

Commodities-Hedge funds

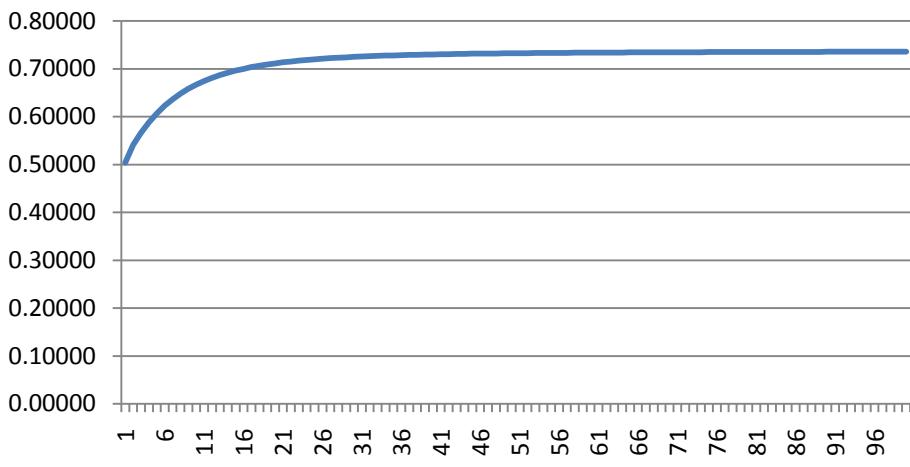


Chart.22

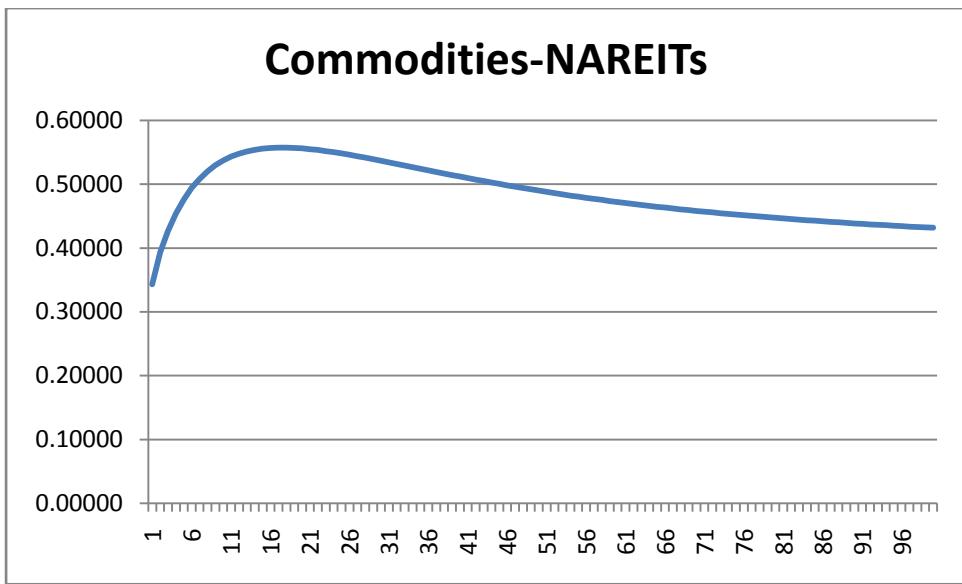


Chart.23

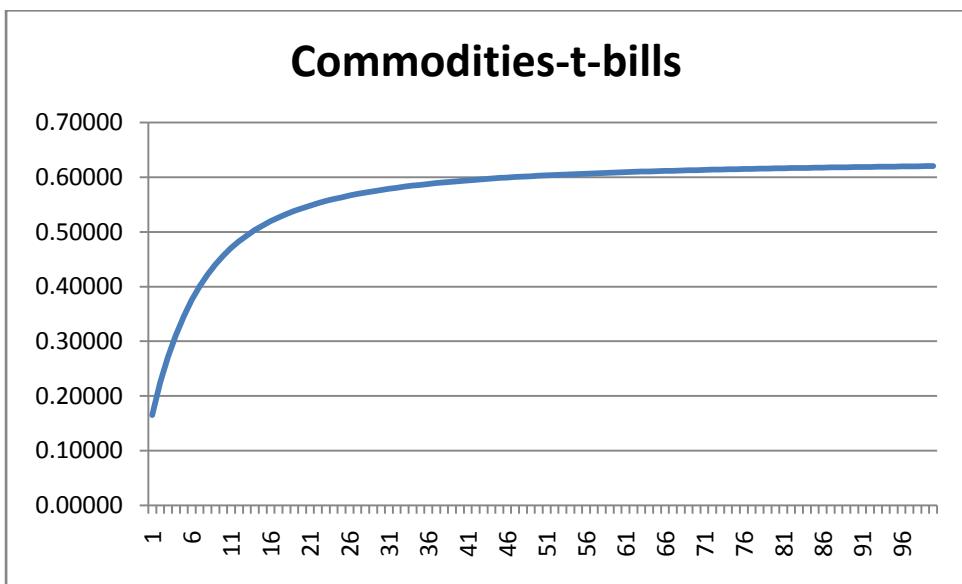


Chart.24

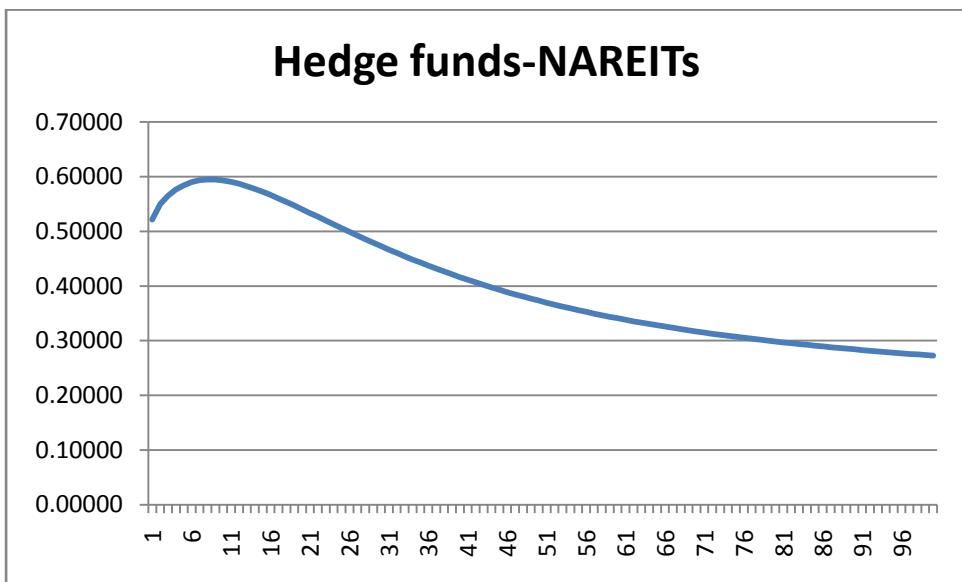


Chart.25

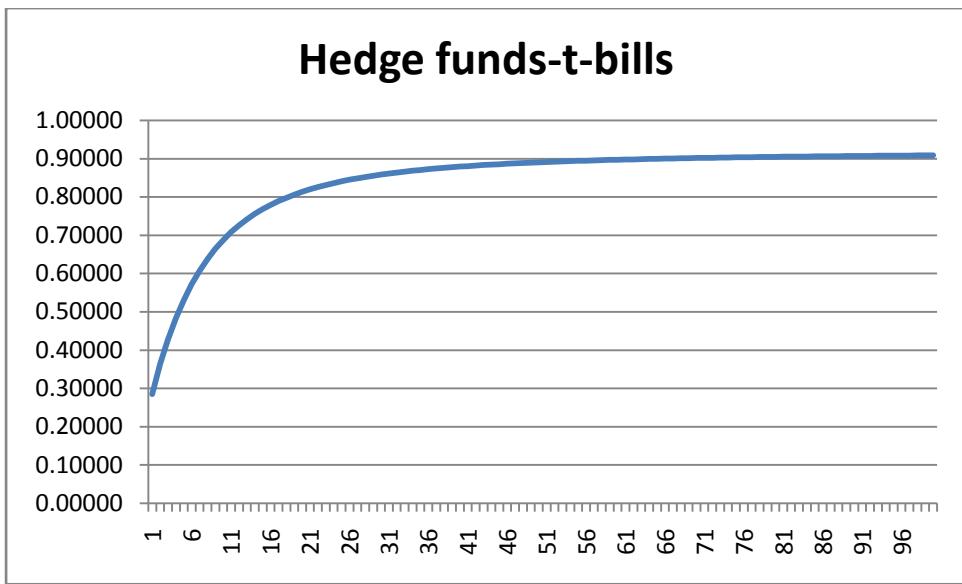


Chart.26

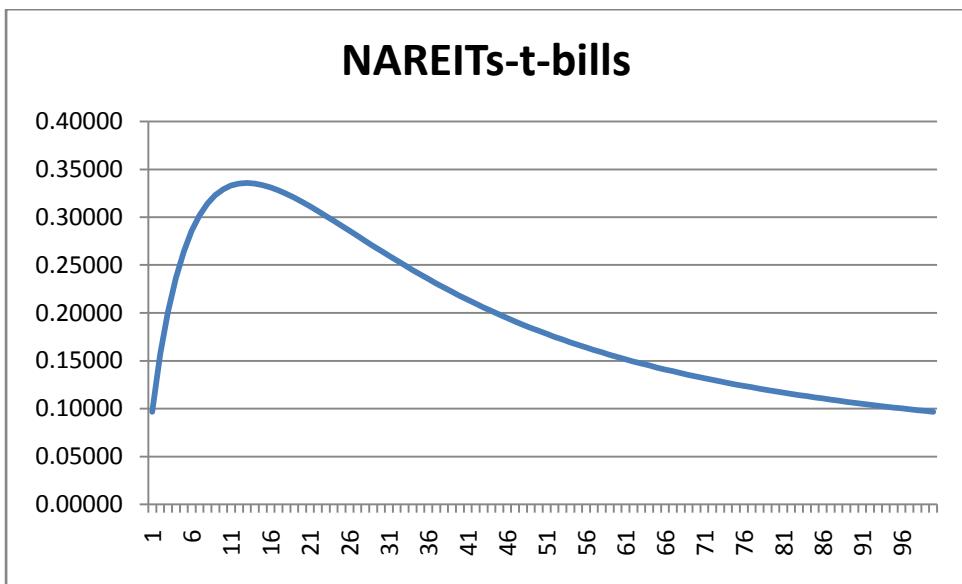


Chart.27

Wage inflation and CPI hedging properties

In this paper section we research the hedging qualities of assets against wage inflation and price inflation through computing the correlation coefficient between assets and liabilities across different investment horizons. All assets correlations both with price and wage inflation are lower in the short term and tend to increase in the long term except of nominal bonds which have the contrary performance. Commodities seem to be the only efficient hedging tool against price inflation for a short horizon investor while the same along with hedge funds are the two hedging solutions for a long horizon investor. All assets except of nominal bonds have a slight but negative wage inflation hedge potential for investment horizon until 1 year. We find that there is no asset to efficiently hedge wage inflation in the short term while only hedge funds have good wage inflation hedging qualities in the long term. All

Short-term correlation between nominal bonds and price inflation is negative because of the adverse relationship between CPI and real economic growth. An increase in price inflation leads to bond returns fall in contrast with wage inflation whose increase indicates an improving economic environment in the short-term. Although both the 2 figures decrease until 5 years investment horizon, they are increasing in the long-term because investing in long-term bonds is directly related to accumulated price and wage inflation risk.

T-bills correlation with CPI is 20% in the short-run and increases up to 50% in the long run. We would expect higher correlation degree between them because t-bills rolling over every 3 months should capture all the price inflation changes. Their hedging qualities against wage inflation are negative and poor in the short term through a correlation coefficient of -15% which increases up to 30% in the long term.

Equity correlation with CPI ranges from 20% in the short-run to 30% in the long-run and the respective figure against wage inflation ranges from -10% to 10% across the investment horizon. Changes both in price and wage inflation could be regarded as indicators of changes in real economic activity. Actually equity seems almost unaffected by these changes across investment horizons because the one-way impact on the discount rates is being offset by the adverse impact on the future dividends, leading stock returns to remain nearly stable. Real estate has the same hedging performance with equity both against price and wage inflation. The only difference is

that the correlation coefficients range in a slightly higher level. This fact is confident to previous findings of this paper and shows that listed real estate does not seem as a different asset class compared to equity.

Commodities turn out to be the best and most stable price inflation hedge at all investment horizons through a correlation coefficient of 80%. The respective figure against wage inflation is close to 0% for 1 year investment horizon, it increases at 40% until 5 years and remains stable at this level in the long-term. Our findings against CPI are confident to previous researches such as “[Briere and Signori](#)”, and [Hoevenaars 2009](#) which prove that commodities addition leads to higher real returns in an inflation affected portfolio. Our findings about commodities hedging properties against wage inflation are not as good as the respective against price inflation. The correlation degree of 40% between them is not enough to convince a long-term ALM investor for the commodities wage inflation hedging quality.

Hedge funds correlation with price inflation is 50% for the first four quarters and increases to 60% in the long term. This asset class correlation with wage inflation is little below 0% for investment horizon until 1 year, increases at 50% after 4 years and finally rises to 65% in the long term. On the one hand hedge funds hedging qualities against price inflation are good across the investment horizon but worse than the commodities respective. On the other hand although hedge funds are poor in the short term, they have the best wage inflation hedging properties in the long term. The ALM “Buy and Hold” investor, who is mainly interested in long term investment horizon, should conclusively include hedge funds in the wage inflation hedging portfolio. Graphs 28-35 represent the assets hedging qualities against the two liabilities risk measures.

Chart.28

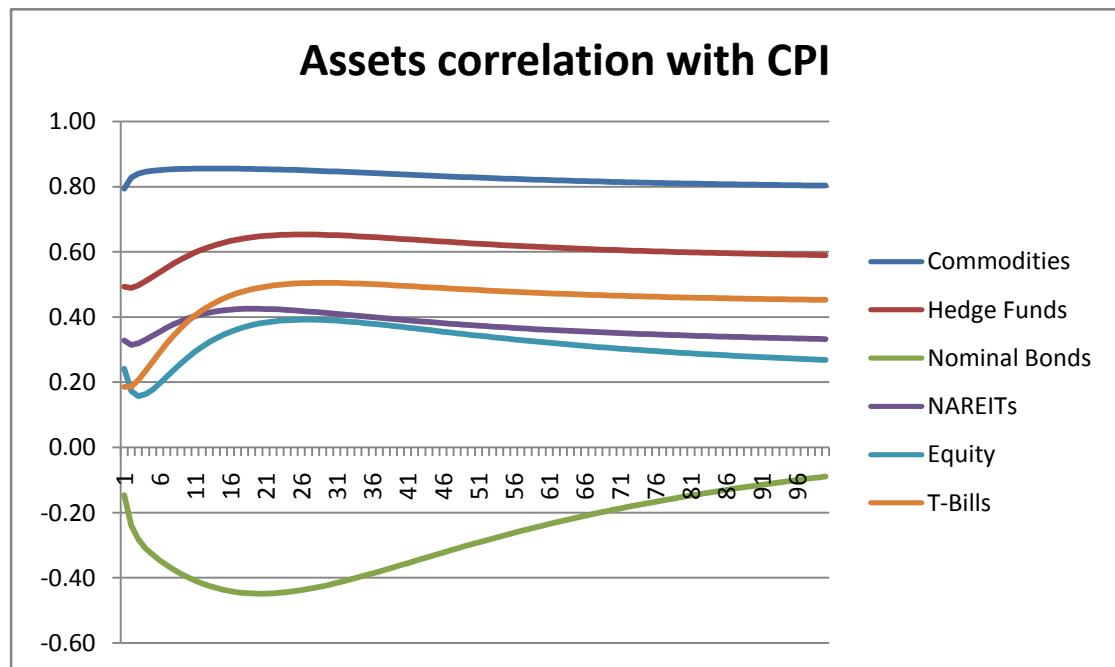


Chart.29

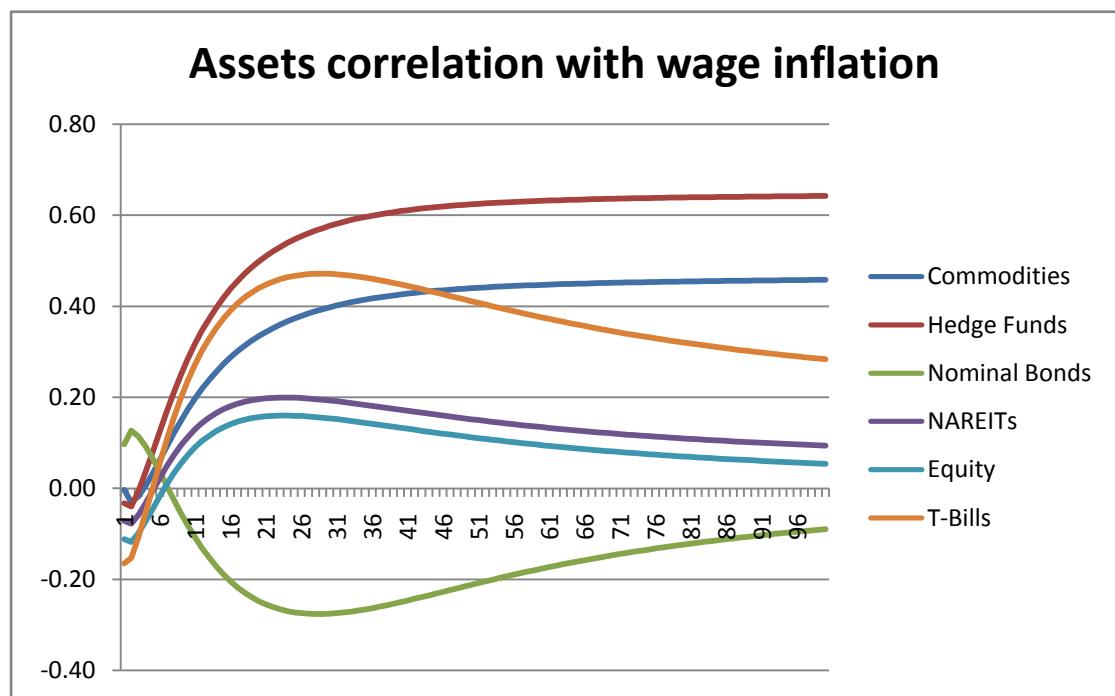


Chart.30

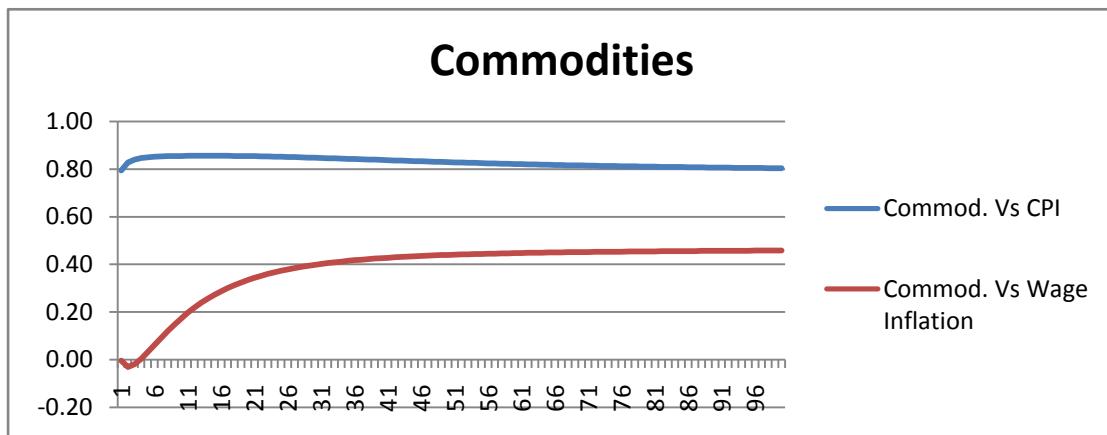


Chart.31

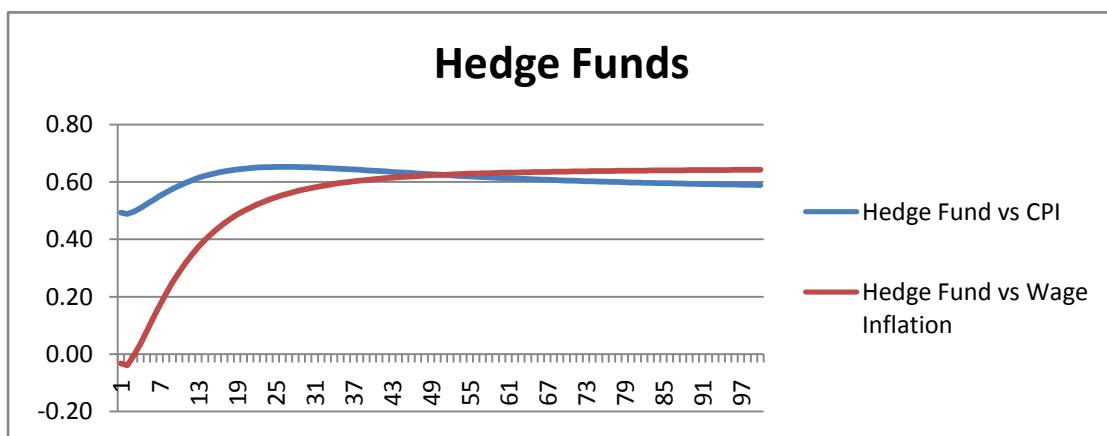


Chart.32

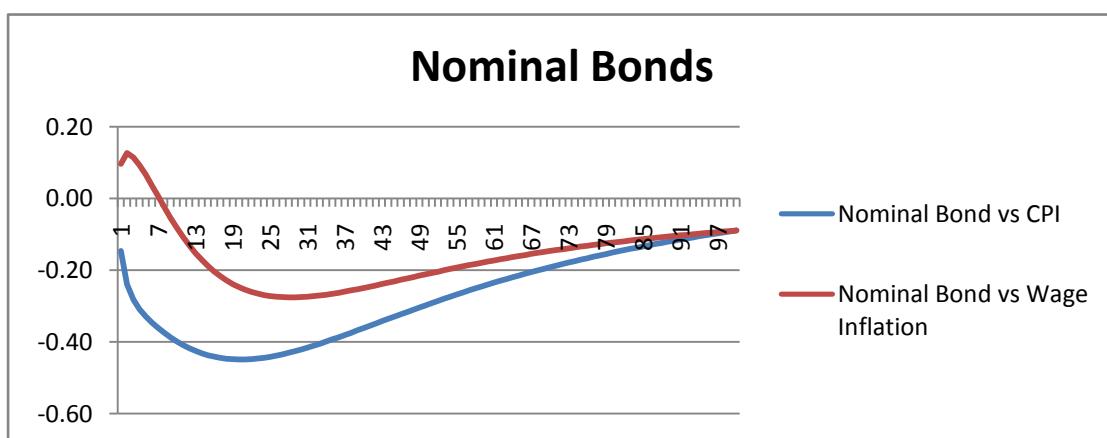


Chart.33

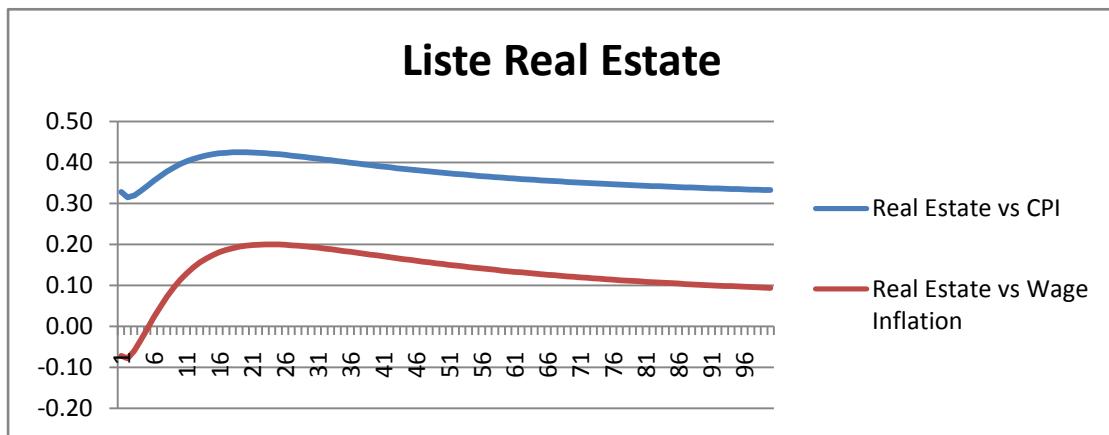


Chart.34

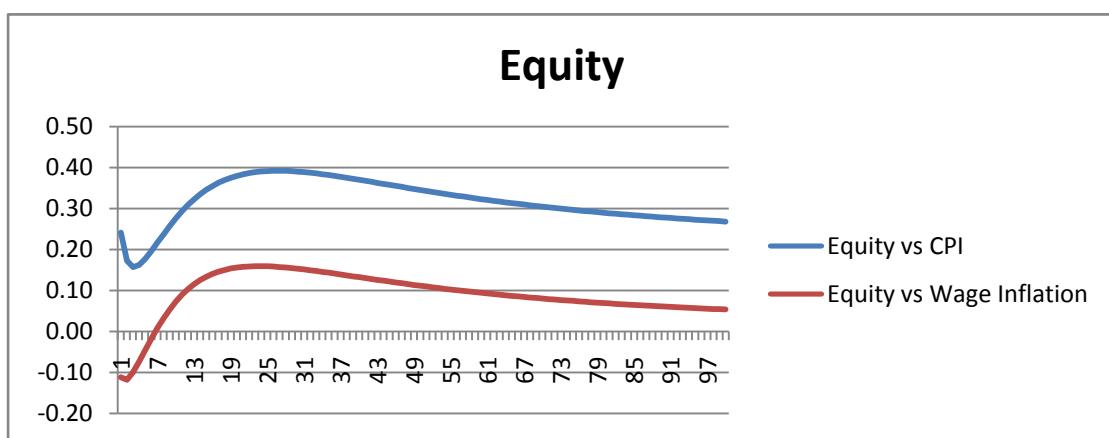
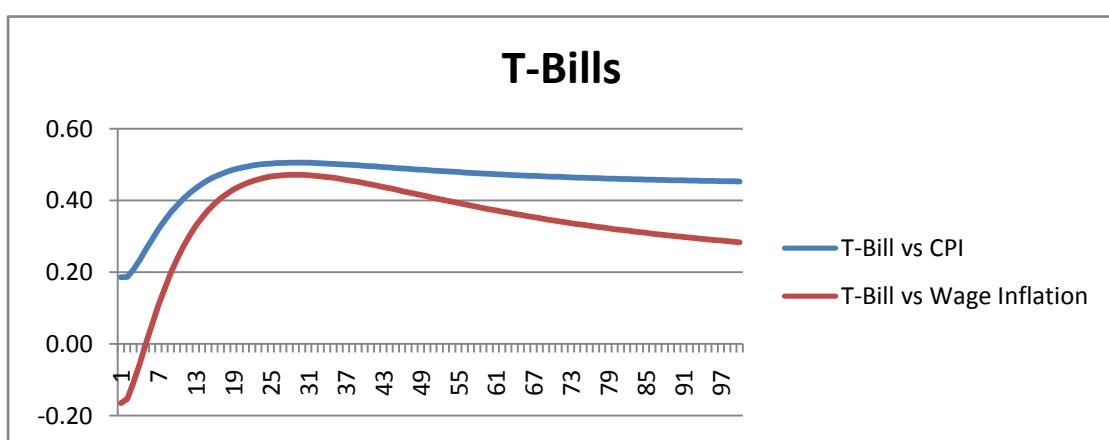


Chart.35



The optimal Strategic Asset Allocation

Theoretical background

Pension funds major liabilities are directly related to the pension payment. These liabilities vary across time and the ideal asset allocation process could not be static. A pure dynamic asset allocation is not proposed for this investor type too. Pension Funds are Asset–Liabilities Management “Buy and Hold” investors. Based on the investment horizon and the risk aversion degree they wish to take up, they define a specific asset allocation. They try to keep it stable across time through tactical rebalancing when the market value of an asset changes. The market value of an asset to the market value of the total portfolio should always be equal to the weight extracted of the initial asset allocation process.

The ALM “Buy and Hold” investor total portfolio basically consists of three other sub-portfolios. The sub-portfolio of cash based assets (t-bills), the Liability Hedging Portfolio (LHP) which includes this asset mix that hedges the liability risk and the Performance Seeking Portfolio (PSP) which incorporates the asset mix that produces real returns. The investor has to take into account the term structure of both assets and liabilities and based on his risk aversion level to construct these three sub-portfolios. This process is going to provide the final asset mix which changes across the investment horizon. This asset allocation maximizes the Power Utility Function of the “ALM Buy and Hold” investor.

$$U_t = \max E\left(\frac{C^{1-\gamma}}{1-\gamma}\right)$$

This utility function is called Constant Relative Risk Aversion (CRRA). $C = \frac{W}{L}$, where W is the portfolio wealth and L is the portfolio total liabilities. We should make clear at this point that in this paper we don't incorporate all the liabilities risks but we focus only on the inflation change side. As a result of that, adjusted to our paper research goal we regard L as the price inflation or wage inflation respectively. The “ γ ” parameter is often referred to as the coefficient of relative risk aversion. If two investors have different CRRA utility functions, the one with the higher value of “ γ ” is deemed to be the more risk averse.

The Asset mix scenarios

In this paper section we estimate different portfolio asset allocations for an investor who wishes to hedge against price inflation and an investor who wishes to hedge against wage inflation. The asset mix varies both across investment horizon and risk aversion degree. In tables 6 and 7 we report the asset allocations results for a price and wage inflation hedging portfolio respectively. We separate our findings in short (1 year), middle (5 years) and long (25 years) investment horizon as well as in risk like ($\gamma=2$), risk neutral ($\gamma=5$) and risk averse ($\gamma=10$) investor.

We find that the risk-like investor ($\gamma=2$) should include in the price inflation hedging portfolio mainly t-bills, equity and some commodities for investment horizon until 1 year. In a mid-term horizon he should mainly invest in nominal bonds, replace equity with listed real estate in a slightly increased proportion and reduce the commodities weight. In the long-term he should reduce more the commodities weight and increase the nominal bonds one investing also in equity but in a lower proportion than bonds.

In the short-run, the risk neutral investor ($\gamma=5$) should keep in the portfolio t-bills, equity and commodities but in lower proportions compared to the respective risk-like one, and firstly add some hedge funds and after nominal bonds. For a middle term investment horizon he should leave t-bills and mainly invest in nominal bonds, replace equity with listed real estate in a slightly increased proportion, reduce the commodities weight and increase the hedge funds one. In the long-term nominal bonds weight should be increased simultaneously reducing commodities and hedge funds. Investment in equity through the half proportion of nominal bonds should complete the inflation hedging portfolio asset allocation.

The risk averse investor ($\gamma=10$) in a short horizon keeps t-bills as the major asset of the portfolio though reducing its weight compared to the risk neutral one. He invests in listed real estate and commodities through remarkably lower proportions and also includes some hedge funds and less nominal bonds. In the mid-term, he mainly invests in nominal bonds, slightly increasing the NAREITs weight while he reduces commodities. He increases the hedge funds proportion and keeps a low weight of t-bills. In the long investment horizon of 25 years, the investor should leave t-bills and increase the nominal bonds weight. He imperceptibly reduces commodities and hedge

funds while he should replace listed real estate with equity increasing the respective proportion.

We remark that t-bills are important for the short term investor as their rolling over every 3 months incorporates all the risk outstanding. Moreover the risk-averse investor could include them in the middle-term portfolio due to their low risk properties. Nominal bonds presence in the portfolio is being very crucial both for long and middle term investment horizons, especially when the risk aversion level falls. Listed real estate have not been proved to be remarkably different than equity and as a result of that we include in the portfolio only the one which results more in the investor's utility function maximization. We observe that NAREITs seem better than equity always in the mid-term. Equity or listed real estate is included in the portfolio at all investment horizons and especially in the long term one. Commodities are part of the total portfolio in any case because they have the best price inflation hedging qualities. They are much preferred in short-term horizons and from the risk-like investor who doesn't care so much about risk diversification properties. Hedge funds don't seem so attractive because their CPI hedging properties are captured by commodities. They are preferred by the risk neutral and the risk-averse investor, especially in the middle term, replacing in this way the lower commodities properties.

Our findings for the wage inflation hedging portfolio asset allocations are almost the same with the price inflation one. The reason is that assets risk term structure and risk diversification properties contribute in an important way to the portfolio asset allocation. Furthermore, the assets hedging properties both against price and wage inflation are not remarkably different in the mid and the long-term.

Table.6

Price inflation hedging portfolio asset allocation									
Parameter "γ"	γ=2			γ=5			γ=10		
Horizon	1 year	5 years	25 years	1 year	5 years	25 years	1 year	5 years	25 years
<i>Equity</i>	190%	106%	311%	71%	41%	129%	32%	19%	69%
<i>Nominal bonds</i>	-480%	389%	496%	-177%	196%	248%	-76%	131%	165%
<i>Commodities</i>	64%	35%	20%	27%	16%	10%	15%	9%	7%
<i>Hedge funds</i>	-250%	-184%	-203%	-99%	-72%	-81%	-49%	-35%	-40%
<i>NAREITs</i>	184%	201%	211%	75%	81%	85%	38%	41%	42%
<i>T-bills</i>	393%	-446%	-736%	203%	-161%	-291%	140%	-66%	-143%
Total Portfolio	100%								

Table.7

Wage inflation hedging portfolio asset allocation									
Parameter "γ"	γ=2			γ=5			γ=10		
Horizon	1 year	5 years	25 years	1 year	5 years	25 years	1 year	5 years	25 years
<i>Equity</i>	189%	106%	312%	70%	42%	131%	31%	20%	70%
<i>Nominal bonds</i>	-480%	388%	493%	-177%	193%	243%	-76%	128%	160%
<i>Commodities</i>	62%	33%	19%	25%	13%	8%	12%	7%	4%
<i>Hedge funds</i>	-250%	-185%	-203%	-99%	-73%	-81%	-49%	-35%	-40%
<i>NAREITs</i>	184%	201%	212%	75%	81%	85%	39%	41%	43%
<i>T-bills</i>	395%	-444%	-733%	206%	-157%	-286%	143%	-61%	-137%
Total Portfolio	100%								

Conclusion

The optimal strategic asset allocation for an investor like a Pension Fund is a complicated process. This “Buy and Hold” investor acts in the context of Asset-Liabilities Management and he should take into account parameters such as the liabilities risk, the risk term structure of the assets he includes in the portfolio as well as their risk diversification properties, the hedging properties of these assets against the liabilities risks and finally the risk level he wishes to undertake. Based on these dimensions he could ideally construct this portfolio asset mix which maximizes his utility. This paper has not incorporated the total liabilities risks which an investor is exposed to. We have focused on the inflation fluctuation side of total risk which has been measured through the price inflation “CPI” variable until today. We have tried to propose the wage inflation variable as the optimal measure of inflation fluctuation risk which should replace or supplement price inflation in the Asset-Liabilities Management process from investors like Pension Funds.

To reach this finding we have firstly checked the historical relationship between price and wage inflation and we conclude that these two liability risk variables have a parallel medium correlated movement with a little lag in the wage inflation one. This indicates that there is a type of causality from wages to prices.

After that, through a vector autoregressive model we have tested the risk term structure, the risk diversification properties and the hedging properties of assets both against wage and price inflation at different investment horizons. We find that although commodities are the most risky assets, they have the best hedging qualities against price inflation across investment horizon. The respective asset hedging qualities against wage inflation are just moderate after the mid-term. Although hedge funds are highly exposed to equity and nominal bonds early in the middle term, they seem to be equally good both against price and wage inflation hedging after 3 and 9 years horizon respectively. Being consistent with the previous relative literature, we conclude that alternative assets add value to the liabilities risk hedging process while traditional assets offer low risk and good risk diversification in the investor’s portfolio.

Finally we estimate the optimal asset allocation both for the wage and the price inflation hedging portfolio. Asset allocation changes both across different investment

horizon and different investor's risk aversion degree. Our findings against the two liability risk measures are very similar. We derive that t-bills are always part of the short term investor's portfolio because they frequently roll over incorporating all the risk outstanding. Nominal bonds should also be preferred for middle and long term investment horizons especially by a lower risk aversion level investor. Equity or listed real estate (because NAREITs have not been proved to be remarkably different than equity) is included in the portfolio at all investment horizons but more in the long term one. Commodities should be included through a low proportion in the portfolio, especially in short-term horizons by risk-like investors. Hedge funds don't seem so attractive and they are preferred only by the risk neutral and the risk-averse investor when the commodities qualities are not good.

If the asset allocation results were remarkably different between price and wage inflation we should test then if our proposal is effective. We could be based on the "wage inflation" asset allocation and estimate the investor's portfolio return in a "price inflation" risk environment. This portfolio return compared to the respective extracted according to the "price inflation asset allocation, could provide us the welfare implication to the investor's portfolio. A positive welfare implication would indicate that wage inflation is an optimal measure of part of the liabilities risk compared to the price inflation.

Next researches could also incorporate interest rate risk along with wage inflation in order to capture more completely the liabilities risk outstanding for an ALM investor like a pension fund. In this way we hope to derive a different asset allocation if the investor wishes to hedge its portfolio both against interest rate and wage inflation risk.

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Appendix

1. Assets Volatility

Horizon in Quarters	Standard Deviations										
	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	Term Spread	Default Spread	Dividend Yield	CPI return	T-bills	
1	0.00498	0.00113	0.01360	0.00069	0.00976	0.00002	0.00002	0.00000	0.00002	0.00002	
2	0.00493	0.00105	0.01632	0.00071	0.01021	0.00005	0.00004	0.00001	0.00003	0.00006	
3	0.00500	0.00097	0.01771	0.00074	0.01070	0.00008	0.00006	0.00001	0.00003	0.00011	
4	0.00511	0.00090	0.01859	0.00078	0.01115	0.00012	0.00009	0.00002	0.00003	0.00018	
5	0.00524	0.00083	0.01923	0.00083	0.01154	0.00016	0.00012	0.00002	0.00003	0.00027	
6	0.00538	0.00077	0.01975	0.00088	0.01187	0.00021	0.00015	0.00003	0.00003	0.00038	
7	0.00551	0.00072	0.02019	0.00093	0.01212	0.00026	0.00018	0.00004	0.00003	0.00051	
8	0.00564	0.00068	0.02057	0.00098	0.01232	0.00032	0.00021	0.00004	0.00004	0.00066	
9	0.00575	0.00064	0.02093	0.00104	0.01247	0.00038	0.00024	0.00005	0.00004	0.00082	
10	0.00585	0.00061	0.02125	0.00109	0.01257	0.00045	0.00027	0.00006	0.00004	0.00100	
11	0.00593	0.00058	0.02154	0.00115	0.01264	0.00052	0.00030	0.00007	0.00004	0.00119	
12	0.00599	0.00055	0.02181	0.00121	0.01267	0.00059	0.00032	0.00008	0.00004	0.00139	
13	0.00603	0.00053	0.02207	0.00126	0.01268	0.00066	0.00035	0.00009	0.00004	0.00160	
14	0.00605	0.00050	0.02230	0.00132	0.01266	0.00074	0.00037	0.00010	0.00004	0.00181	
15	0.00606	0.00048	0.02252	0.00137	0.01263	0.00081	0.00039	0.00011	0.00004	0.00203	
16	0.00605	0.00046	0.02273	0.00143	0.01258	0.00088	0.00041	0.00012	0.00004	0.00225	
17	0.00603	0.00044	0.02292	0.00148	0.01253	0.00095	0.00042	0.00013	0.00004	0.00248	
18	0.00600	0.00043	0.02310	0.00153	0.01246	0.00102	0.00044	0.00014	0.00004	0.00270	
19	0.00596	0.00041	0.02326	0.00158	0.01239	0.00109	0.00045	0.00016	0.00004	0.00292	
20	0.00591	0.00039	0.02342	0.00163	0.01232	0.00115	0.00047	0.00017	0.00004	0.00315	
21	0.00586	0.00038	0.02356	0.00168	0.01224	0.00121	0.00048	0.00018	0.00005	0.00336	
22	0.00580	0.00037	0.02370	0.00172	0.01216	0.00128	0.00049	0.00019	0.00005	0.00358	
23	0.00573	0.00035	0.02382	0.00177	0.01208	0.00133	0.00050	0.00020	0.00005	0.00379	
24	0.00567	0.00034	0.02394	0.00181	0.01200	0.00139	0.00051	0.00021	0.00005	0.00400	
25	0.00560	0.00033	0.02405	0.00185	0.01192	0.00144	0.00052	0.00023	0.00005	0.00420	
26	0.00554	0.00032	0.02415	0.00189	0.01184	0.00149	0.00053	0.00024	0.00005	0.00439	
27	0.00547	0.00031	0.02425	0.00192	0.01176	0.00154	0.00053	0.00025	0.00005	0.00458	
28	0.00540	0.00030	0.02434	0.00196	0.01169	0.00159	0.00054	0.00026	0.00005	0.00476	
29	0.00534	0.00029	0.02443	0.00199	0.01161	0.00163	0.00054	0.00027	0.00005	0.00494	
30	0.00527	0.00028	0.02451	0.00203	0.01154	0.00167	0.00055	0.00028	0.00005	0.00511	
31	0.00521	0.00028	0.02458	0.00206	0.01147	0.00171	0.00055	0.00029	0.00005	0.00528	
32	0.00515	0.00027	0.02465	0.00209	0.01140	0.00175	0.00056	0.00030	0.00005	0.00544	
33	0.00509	0.00026	0.02471	0.00212	0.01134	0.00179	0.00056	0.00031	0.00005	0.00559	
34	0.00503	0.00025	0.02478	0.00214	0.01127	0.00182	0.00056	0.00032	0.00005	0.00574	
35	0.00498	0.00025	0.02483	0.00217	0.01121	0.00185	0.00057	0.00033	0.00005	0.00588	
36	0.00493	0.00024	0.02489	0.00219	0.01115	0.00188	0.00057	0.00034	0.00005	0.00602	
37	0.00488	0.00024	0.02494	0.00222	0.01110	0.00191	0.00057	0.00035	0.00005	0.00615	
38	0.00483	0.00023	0.02499	0.00224	0.01104	0.00194	0.00057	0.00036	0.00005	0.00628	

Horizon in Quarters	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	Term Spread	Default Spread	Dividend Yield	CPI return	T-bills
39	0.00479	0.00023	0.02503	0.00226	0.01099	0.00196	0.00058	0.00037	0.00005	0.00640
40	0.00474	0.00022	0.02508	0.00228	0.01094	0.00199	0.00058	0.00038	0.00005	0.00651
41	0.00470	0.00022	0.02512	0.00230	0.01089	0.00201	0.00058	0.00039	0.00005	0.00662
42	0.00466	0.00021	0.02515	0.00232	0.01084	0.00203	0.00058	0.00040	0.00005	0.00673
43	0.00462	0.00021	0.02519	0.00234	0.01080	0.00205	0.00058	0.00040	0.00005	0.00683
44	0.00459	0.00021	0.02523	0.00236	0.01075	0.00207	0.00058	0.00041	0.00005	0.00693
45	0.00455	0.00020	0.02526	0.00237	0.01071	0.00209	0.00058	0.00042	0.00005	0.00702
46	0.00452	0.00020	0.02529	0.00239	0.01067	0.00211	0.00059	0.00043	0.00005	0.00712
47	0.00449	0.00020	0.02532	0.00240	0.01063	0.00213	0.00059	0.00044	0.00005	0.00720
48	0.00446	0.00019	0.02535	0.00242	0.01059	0.00214	0.00059	0.00044	0.00005	0.00729
49	0.00443	0.00019	0.02537	0.00243	0.01056	0.00216	0.00059	0.00045	0.00005	0.00737
50	0.00441	0.00019	0.02540	0.00244	0.01052	0.00217	0.00059	0.00046	0.00005	0.00744
51	0.00438	0.00019	0.02542	0.00246	0.01049	0.00219	0.00059	0.00046	0.00005	0.00752
52	0.00436	0.00018	0.02545	0.00247	0.01045	0.00220	0.00059	0.00047	0.00005	0.00759
53	0.00433	0.00018	0.02547	0.00248	0.01042	0.00221	0.00059	0.00048	0.00005	0.00766
54	0.00431	0.00018	0.02549	0.00249	0.01039	0.00222	0.00059	0.00048	0.00005	0.00772
55	0.00429	0.00018	0.02551	0.00250	0.01036	0.00224	0.00059	0.00049	0.00005	0.00778
56	0.00427	0.00018	0.02553	0.00251	0.01033	0.00225	0.00059	0.00049	0.00005	0.00784
57	0.00425	0.00017	0.02555	0.00252	0.01030	0.00226	0.00059	0.00050	0.00005	0.00790
58	0.00423	0.00017	0.02557	0.00253	0.01028	0.00227	0.00059	0.00050	0.00005	0.00796
59	0.00421	0.00017	0.02558	0.00254	0.01025	0.00228	0.00059	0.00051	0.00005	0.00801
60	0.00419	0.00017	0.02560	0.00255	0.01022	0.00229	0.00059	0.00052	0.00005	0.00807
61	0.00417	0.00017	0.02562	0.00256	0.01020	0.00230	0.00059	0.00052	0.00005	0.00812
62	0.00416	0.00017	0.02563	0.00257	0.01018	0.00230	0.00059	0.00053	0.00005	0.00816
63	0.00414	0.00016	0.02565	0.00257	0.01015	0.00231	0.00059	0.00053	0.00005	0.00821
64	0.00412	0.00016	0.02566	0.00258	0.01013	0.00232	0.00059	0.00053	0.00005	0.00826
65	0.00411	0.00016	0.02567	0.00259	0.01011	0.00233	0.00059	0.00054	0.00005	0.00830
66	0.00409	0.00016	0.02569	0.00260	0.01009	0.00234	0.00059	0.00054	0.00005	0.00834
67	0.00408	0.00016	0.02570	0.00260	0.01007	0.00234	0.00059	0.00055	0.00005	0.00838
68	0.00407	0.00016	0.02571	0.00261	0.01005	0.00235	0.00059	0.00055	0.00005	0.00842
69	0.00405	0.00016	0.02572	0.00261	0.01003	0.00236	0.00059	0.00056	0.00005	0.00846
70	0.00404	0.00015	0.02574	0.00262	0.01001	0.00236	0.00059	0.00056	0.00005	0.00850
71	0.00403	0.00015	0.02575	0.00263	0.00999	0.00237	0.00059	0.00056	0.00005	0.00854
72	0.00401	0.00015	0.02576	0.00263	0.00997	0.00238	0.00059	0.00057	0.00005	0.00857
73	0.00400	0.00015	0.02577	0.00264	0.00995	0.00238	0.00059	0.00057	0.00005	0.00861
74	0.00399	0.00015	0.02578	0.00264	0.00994	0.00239	0.00059	0.00057	0.00005	0.00864
75	0.00398	0.00015	0.02579	0.00265	0.00992	0.00239	0.00059	0.00058	0.00005	0.00867
76	0.00397	0.00015	0.02580	0.00265	0.00991	0.00240	0.00059	0.00058	0.00005	0.00870
77	0.00396	0.00015	0.02581	0.00266	0.00989	0.00241	0.00059	0.00059	0.00005	0.00873
78	0.00395	0.00015	0.02582	0.00266	0.00987	0.00241	0.00059	0.00059	0.00005	0.00876
79	0.00394	0.00015	0.02583	0.00267	0.00986	0.00242	0.00059	0.00059	0.00005	0.00879
80	0.00393	0.00014	0.02584	0.00267	0.00985	0.00242	0.00059	0.00059	0.00005	0.00882
81	0.00392	0.00014	0.02584	0.00268	0.00983	0.00243	0.00059	0.00060	0.00005	0.00884

Horizon in Quarters	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	Term Spread	Default Spread	Dividend Yield	CPI return	T-bills
82	0.00391	0.00014	0.02585	0.00268	0.00982	0.00243	0.00059	0.00060	0.00005	0.00887
83	0.00390	0.00014	0.02586	0.00269	0.00980	0.00243	0.00059	0.00060	0.00005	0.00890
84	0.00389	0.00014	0.02587	0.00269	0.00979	0.00244	0.00059	0.00061	0.00005	0.00892
85	0.00388	0.00014	0.02588	0.00269	0.00978	0.00244	0.00059	0.00061	0.00005	0.00895
86	0.00387	0.00014	0.02588	0.00270	0.00977	0.00245	0.00059	0.00061	0.00005	0.00897
87	0.00386	0.00014	0.02589	0.00270	0.00975	0.00245	0.00059	0.00061	0.00005	0.00899
88	0.00386	0.00014	0.02590	0.00271	0.00974	0.00246	0.00059	0.00062	0.00005	0.00902
89	0.00385	0.00014	0.02591	0.00271	0.00973	0.00246	0.00059	0.00062	0.00005	0.00904
90	0.00384	0.00014	0.02591	0.00271	0.00972	0.00246	0.00059	0.00062	0.00005	0.00906
91	0.00383	0.00014	0.02592	0.00272	0.00971	0.00247	0.00059	0.00062	0.00005	0.00908
92	0.00382	0.00014	0.02593	0.00272	0.00970	0.00247	0.00059	0.00063	0.00005	0.00910
93	0.00382	0.00014	0.02593	0.00272	0.00969	0.00247	0.00059	0.00063	0.00005	0.00912
94	0.00381	0.00013	0.02594	0.00273	0.00968	0.00248	0.00059	0.00063	0.00005	0.00914
95	0.00380	0.00013	0.02595	0.00273	0.00967	0.00248	0.00059	0.00063	0.00005	0.00916
96	0.00380	0.00013	0.02595	0.00273	0.00966	0.00249	0.00059	0.00064	0.00005	0.00918
97	0.00379	0.00013	0.02596	0.00273	0.00965	0.00249	0.00059	0.00064	0.00005	0.00920
98	0.00378	0.00013	0.02596	0.00274	0.00964	0.00249	0.00059	0.00064	0.00005	0.00922
99	0.00378	0.00013	0.02597	0.00274	0.00963	0.00250	0.00059	0.00064	0.00005	0.00923
100	0.00377	0.00013	0.02598	0.00274	0.00962	0.00250	0.00059	0.00064	0.00005	0.00925

2. Cross-asset correlations

Cross-asset Correlations part.1								
Horizon in Quarters	Equity- Bonds	Equity- Commodities	Equity- Hedge funds	Equity- NAREITs	Equity- T-bills	Bonds- Commodities	Bonds- Hedge funds	Bonds- NAREITs
1	-0.129	0.240	0.655	0.708	0.256	-0.293	-0.235	-0.091
2	-0.152	0.296	0.681	0.721	0.322	-0.326	-0.288	-0.143
3	-0.159	0.331	0.695	0.724	0.371	-0.345	-0.323	-0.173
4	-0.171	0.363	0.707	0.725	0.412	-0.362	-0.357	-0.199
5	-0.184	0.390	0.717	0.724	0.445	-0.378	-0.388	-0.220
6	-0.199	0.413	0.724	0.721	0.471	-0.392	-0.417	-0.239
7	-0.215	0.434	0.730	0.718	0.492	-0.405	-0.444	-0.255
8	-0.230	0.452	0.735	0.713	0.508	-0.417	-0.467	-0.270
9	-0.245	0.467	0.738	0.709	0.521	-0.428	-0.488	-0.282
10	-0.259	0.480	0.739	0.704	0.531	-0.438	-0.507	-0.293
11	-0.273	0.492	0.740	0.698	0.537	-0.447	-0.523	-0.302
12	-0.285	0.501	0.740	0.693	0.542	-0.455	-0.537	-0.310
13	-0.296	0.510	0.738	0.687	0.544	-0.462	-0.549	-0.316
14	-0.306	0.517	0.736	0.681	0.545	-0.468	-0.559	-0.322
15	-0.315	0.523	0.732	0.675	0.544	-0.474	-0.567	-0.327
16	-0.323	0.527	0.728	0.669	0.542	-0.478	-0.573	-0.330

Horizon in Quarters	Equity- Bonds	Equity- Commodities	Equity- Hedge funds	Equity- NAREITs	Equity- T-bills	Bonds- Commodities	Bonds- Hedge funds	Bonds- NAREITs
17	-0.330	0.531	0.724	0.664	0.539	-0.482	-0.578	-0.333
18	-0.336	0.534	0.718	0.658	0.534	-0.485	-0.581	-0.336
19	-0.341	0.536	0.712	0.652	0.529	-0.487	-0.583	-0.338
20	-0.345	0.537	0.706	0.646	0.523	-0.489	-0.583	-0.339
21	-0.348	0.538	0.699	0.640	0.516	-0.490	-0.583	-0.340
22	-0.351	0.538	0.691	0.635	0.508	-0.491	-0.581	-0.340
23	-0.353	0.537	0.683	0.629	0.500	-0.491	-0.579	-0.341
24	-0.355	0.536	0.675	0.624	0.492	-0.490	-0.575	-0.341
25	-0.356	0.534	0.666	0.618	0.482	-0.489	-0.571	-0.340
26	-0.357	0.532	0.657	0.613	0.473	-0.488	-0.567	-0.340
27	-0.357	0.529	0.648	0.608	0.463	-0.486	-0.561	-0.339
28	-0.358	0.526	0.639	0.603	0.453	-0.483	-0.555	-0.338
29	-0.357	0.523	0.629	0.598	0.443	-0.481	-0.549	-0.337
30	-0.357	0.519	0.619	0.593	0.432	-0.478	-0.542	-0.335
31	-0.356	0.515	0.609	0.588	0.421	-0.475	-0.535	-0.334
32	-0.356	0.511	0.599	0.583	0.411	-0.472	-0.528	-0.333
33	-0.355	0.507	0.588	0.578	0.400	-0.468	-0.520	-0.331
34	-0.353	0.502	0.578	0.574	0.389	-0.464	-0.512	-0.329
35	-0.352	0.497	0.568	0.569	0.378	-0.460	-0.504	-0.328
36	-0.351	0.492	0.557	0.565	0.367	-0.456	-0.495	-0.326
37	-0.350	0.487	0.547	0.560	0.356	-0.452	-0.487	-0.324
38	-0.348	0.482	0.537	0.556	0.345	-0.448	-0.479	-0.323
39	-0.347	0.477	0.526	0.552	0.334	-0.443	-0.470	-0.321
40	-0.345	0.471	0.516	0.548	0.324	-0.439	-0.462	-0.319
41	-0.344	0.466	0.506	0.544	0.313	-0.435	-0.453	-0.318
42	-0.342	0.460	0.496	0.540	0.303	-0.430	-0.445	-0.316
43	-0.341	0.455	0.486	0.536	0.292	-0.426	-0.436	-0.314
44	-0.339	0.450	0.476	0.532	0.282	-0.421	-0.428	-0.312
45	-0.338	0.444	0.467	0.528	0.272	-0.417	-0.419	-0.311
46	-0.336	0.439	0.457	0.525	0.263	-0.412	-0.411	-0.309
47	-0.334	0.433	0.448	0.521	0.253	-0.408	-0.403	-0.307
48	-0.333	0.428	0.438	0.518	0.244	-0.403	-0.395	-0.306
49	-0.331	0.422	0.429	0.514	0.234	-0.399	-0.387	-0.304
50	-0.330	0.417	0.421	0.511	0.225	-0.395	-0.380	-0.302
51	-0.328	0.412	0.412	0.508	0.217	-0.391	-0.372	-0.301
52	-0.327	0.406	0.403	0.505	0.208	-0.386	-0.365	-0.299
53	-0.325	0.401	0.395	0.501	0.199	-0.382	-0.357	-0.298
54	-0.324	0.396	0.387	0.498	0.191	-0.378	-0.350	-0.296
55	-0.322	0.391	0.379	0.495	0.183	-0.374	-0.343	-0.295
56	-0.321	0.386	0.371	0.493	0.175	-0.371	-0.336	-0.293
57	-0.319	0.381	0.363	0.490	0.167	-0.367	-0.329	-0.292
58	-0.318	0.377	0.356	0.487	0.160	-0.363	-0.323	-0.290
59	-0.316	0.372	0.348	0.484	0.153	-0.359	-0.317	-0.289

Horizon in Quarters	Equity- Bonds	Equity- Commodities	Equity- Hedge funds	Equity- NAREITs	Equity- T-bills	Bonds- Commodities	Bonds- Hedge funds	Bonds- NAREITs
60	-0.315	0.367	0.341	0.482	0.145	-0.356	-0.310	-0.288
61	-0.314	0.363	0.334	0.479	0.138	-0.352	-0.304	-0.286
62	-0.312	0.358	0.327	0.477	0.132	-0.349	-0.298	-0.285
63	-0.311	0.354	0.320	0.474	0.125	-0.346	-0.292	-0.284
64	-0.310	0.350	0.314	0.472	0.118	-0.342	-0.287	-0.282
65	-0.308	0.346	0.307	0.469	0.112	-0.339	-0.281	-0.281
66	-0.307	0.341	0.301	0.467	0.106	-0.336	-0.276	-0.280
67	-0.306	0.337	0.295	0.465	0.100	-0.333	-0.270	-0.279
68	-0.305	0.333	0.289	0.462	0.094	-0.330	-0.265	-0.278
69	-0.303	0.330	0.283	0.460	0.088	-0.327	-0.260	-0.277
70	-0.302	0.326	0.278	0.458	0.083	-0.324	-0.255	-0.275
71	-0.301	0.322	0.272	0.456	0.077	-0.322	-0.250	-0.274
72	-0.300	0.318	0.267	0.454	0.072	-0.319	-0.246	-0.273
73	-0.299	0.315	0.261	0.452	0.067	-0.316	-0.241	-0.272
74	-0.297	0.311	0.256	0.450	0.062	-0.314	-0.237	-0.271
75	-0.296	0.308	0.251	0.448	0.057	-0.311	-0.232	-0.270
76	-0.295	0.305	0.246	0.446	0.052	-0.309	-0.228	-0.269
77	-0.294	0.301	0.241	0.445	0.047	-0.306	-0.224	-0.268
78	-0.293	0.298	0.237	0.443	0.043	-0.304	-0.220	-0.267
79	-0.292	0.295	0.232	0.441	0.038	-0.302	-0.216	-0.266
80	-0.291	0.292	0.228	0.439	0.034	-0.299	-0.212	-0.266
81	-0.290	0.289	0.223	0.438	0.030	-0.297	-0.208	-0.265
82	-0.289	0.286	0.219	0.436	0.026	-0.295	-0.205	-0.264
83	-0.288	0.283	0.215	0.434	0.022	-0.293	-0.201	-0.263
84	-0.287	0.280	0.210	0.433	0.018	-0.291	-0.197	-0.262
85	-0.286	0.278	0.206	0.431	0.014	-0.289	-0.194	-0.261
86	-0.285	0.275	0.203	0.430	0.010	-0.287	-0.191	-0.260
87	-0.284	0.272	0.199	0.428	0.006	-0.285	-0.187	-0.260
88	-0.283	0.270	0.195	0.427	0.003	-0.283	-0.184	-0.259
89	-0.282	0.267	0.191	0.426	-0.001	-0.282	-0.181	-0.258
90	-0.281	0.265	0.188	0.424	-0.004	-0.280	-0.178	-0.257
91	-0.280	0.262	0.184	0.423	-0.008	-0.278	-0.175	-0.257
92	-0.279	0.260	0.181	0.421	-0.011	-0.276	-0.172	-0.256
93	-0.279	0.257	0.177	0.420	-0.014	-0.275	-0.169	-0.255
94	-0.278	0.255	0.174	0.419	-0.017	-0.273	-0.166	-0.254
95	-0.277	0.253	0.171	0.417	-0.020	-0.271	-0.163	-0.254
96	-0.276	0.251	0.167	0.416	-0.024	-0.270	-0.161	-0.253
97	-0.275	0.249	0.164	0.415	-0.026	-0.268	-0.158	-0.252
98	-0.274	0.246	0.161	0.414	-0.029	-0.267	-0.155	-0.252
99	-0.274	0.244	0.158	0.413	-0.032	-0.265	-0.153	-0.251
100	-0.273	0.242	0.155	0.411	-0.035	-0.264	-0.150	-0.251

Cross-asset Correlations part 2.							
Horizon in Quarters	Bonds- T-bills	Commodities- Hedge funds	Commodities- NAREITs	Commodities- T-bills	Hedge funds- NAREITs	Hedge funds- T-bills	NAREITs- T-bills
1	-0.458	0.503	0.343	0.165	0.521	0.284	0.097
2	-0.488	0.541	0.393	0.225	0.549	0.364	0.157
3	-0.512	0.566	0.426	0.271	0.564	0.427	0.201
4	-0.534	0.588	0.454	0.311	0.576	0.483	0.236
5	-0.553	0.606	0.476	0.346	0.584	0.530	0.264
6	-0.569	0.622	0.494	0.375	0.590	0.571	0.285
7	-0.583	0.636	0.508	0.400	0.593	0.607	0.302
8	-0.594	0.648	0.520	0.422	0.594	0.637	0.314
9	-0.602	0.658	0.529	0.440	0.594	0.664	0.323
10	-0.609	0.666	0.537	0.456	0.593	0.687	0.329
11	-0.615	0.674	0.543	0.470	0.590	0.708	0.333
12	-0.618	0.681	0.548	0.483	0.587	0.726	0.335
13	-0.621	0.686	0.551	0.493	0.582	0.742	0.336
14	-0.621	0.691	0.554	0.503	0.577	0.756	0.335
15	-0.621	0.696	0.556	0.512	0.572	0.768	0.333
16	-0.619	0.700	0.557	0.519	0.566	0.779	0.331
17	-0.617	0.703	0.557	0.526	0.560	0.789	0.328
18	-0.613	0.706	0.557	0.533	0.553	0.798	0.324
19	-0.608	0.708	0.557	0.538	0.547	0.806	0.320
20	-0.603	0.711	0.556	0.543	0.540	0.813	0.316
21	-0.597	0.713	0.555	0.548	0.533	0.820	0.311
22	-0.590	0.715	0.553	0.552	0.526	0.826	0.306
23	-0.583	0.716	0.552	0.556	0.519	0.831	0.301
24	-0.575	0.718	0.550	0.560	0.512	0.836	0.296
25	-0.566	0.719	0.548	0.563	0.506	0.841	0.291
26	-0.558	0.720	0.546	0.566	0.499	0.845	0.286
27	-0.548	0.722	0.544	0.569	0.492	0.849	0.280
28	-0.539	0.723	0.541	0.572	0.485	0.852	0.275
29	-0.529	0.723	0.539	0.574	0.479	0.856	0.270
30	-0.519	0.724	0.537	0.577	0.473	0.859	0.265
31	-0.509	0.725	0.534	0.579	0.466	0.861	0.260
32	-0.499	0.726	0.532	0.581	0.460	0.864	0.255
33	-0.488	0.726	0.529	0.583	0.454	0.866	0.250
34	-0.478	0.727	0.527	0.584	0.448	0.869	0.245
35	-0.468	0.727	0.524	0.586	0.443	0.871	0.240
36	-0.457	0.728	0.522	0.588	0.437	0.873	0.235
37	-0.447	0.728	0.519	0.589	0.432	0.875	0.231
38	-0.436	0.729	0.517	0.591	0.426	0.876	0.226
39	-0.426	0.729	0.514	0.592	0.421	0.878	0.222
40	-0.416	0.730	0.512	0.593	0.416	0.879	0.218
41	-0.406	0.730	0.509	0.594	0.411	0.881	0.214
42	-0.396	0.730	0.507	0.595	0.406	0.882	0.210

Horizon in Quarters	Bonds- T-bills	Commodities- Hedge funds	Commodities- NAREITs	Commodities- T-bills	Hedge funds- NAREITs	Hedge funds- T-bills	NAREITs- T-bills
43	-0.386	0.730	0.505	0.596	0.402	0.883	0.206
44	-0.377	0.731	0.503	0.597	0.397	0.885	0.202
45	-0.367	0.731	0.500	0.598	0.393	0.886	0.198
46	-0.358	0.731	0.498	0.599	0.389	0.887	0.195
47	-0.349	0.731	0.496	0.600	0.385	0.888	0.191
48	-0.340	0.732	0.494	0.601	0.381	0.889	0.188
49	-0.331	0.732	0.492	0.602	0.377	0.890	0.184
50	-0.323	0.732	0.490	0.603	0.373	0.891	0.181
51	-0.314	0.732	0.488	0.603	0.369	0.891	0.178
52	-0.306	0.732	0.486	0.604	0.366	0.892	0.175
53	-0.298	0.732	0.484	0.605	0.362	0.893	0.172
54	-0.290	0.733	0.482	0.605	0.359	0.894	0.169
55	-0.283	0.733	0.480	0.606	0.356	0.894	0.166
56	-0.276	0.733	0.479	0.607	0.352	0.895	0.164
57	-0.268	0.733	0.477	0.607	0.349	0.896	0.161
58	-0.261	0.733	0.475	0.608	0.346	0.896	0.159
59	-0.255	0.733	0.474	0.608	0.344	0.897	0.156
60	-0.248	0.733	0.472	0.609	0.341	0.897	0.154
61	-0.242	0.733	0.470	0.609	0.338	0.898	0.151
62	-0.235	0.733	0.469	0.610	0.335	0.898	0.149
63	-0.229	0.733	0.467	0.610	0.333	0.899	0.147
64	-0.223	0.734	0.466	0.611	0.330	0.899	0.145
65	-0.218	0.734	0.465	0.611	0.328	0.900	0.143
66	-0.212	0.734	0.463	0.611	0.325	0.900	0.141
67	-0.207	0.734	0.462	0.612	0.323	0.901	0.139
68	-0.201	0.734	0.461	0.612	0.321	0.901	0.137
69	-0.196	0.734	0.459	0.613	0.319	0.901	0.135
70	-0.191	0.734	0.458	0.613	0.317	0.902	0.133
71	-0.186	0.734	0.457	0.613	0.315	0.902	0.132
72	-0.181	0.734	0.456	0.614	0.313	0.903	0.130
73	-0.177	0.734	0.455	0.614	0.311	0.903	0.128
74	-0.172	0.734	0.453	0.614	0.309	0.903	0.127
75	-0.168	0.734	0.452	0.615	0.307	0.903	0.125
76	-0.164	0.734	0.451	0.615	0.305	0.904	0.124
77	-0.159	0.734	0.450	0.615	0.303	0.904	0.122
78	-0.155	0.734	0.449	0.616	0.302	0.904	0.121
79	-0.151	0.735	0.448	0.616	0.300	0.905	0.119
80	-0.148	0.735	0.447	0.616	0.298	0.905	0.118
81	-0.144	0.735	0.446	0.616	0.297	0.905	0.117
82	-0.140	0.735	0.445	0.617	0.295	0.905	0.115
83	-0.136	0.735	0.444	0.617	0.294	0.906	0.114
84	-0.133	0.735	0.444	0.617	0.292	0.906	0.113
85	-0.130	0.735	0.443	0.617	0.291	0.906	0.112

Horizon in Quarters	Bonds-T-bills	Commodities-Hedge funds	Commodities-NAREITs	Commodities-T-bills	Hedge funds-NAREITs	Hedge funds-T-bills	NAREITs-T-bills
86	-0.126	0.735	0.442	0.618	0.289	0.906	0.111
87	-0.123	0.735	0.441	0.618	0.288	0.907	0.109
88	-0.120	0.735	0.440	0.618	0.287	0.907	0.108
89	-0.117	0.735	0.439	0.618	0.285	0.907	0.107
90	-0.114	0.735	0.439	0.618	0.284	0.907	0.106
91	-0.111	0.735	0.438	0.619	0.283	0.907	0.105
92	-0.108	0.735	0.437	0.619	0.281	0.908	0.104
93	-0.105	0.735	0.436	0.619	0.280	0.908	0.103
94	-0.102	0.735	0.436	0.619	0.279	0.908	0.102
95	-0.099	0.735	0.435	0.619	0.278	0.908	0.101
96	-0.097	0.735	0.434	0.620	0.277	0.908	0.100
97	-0.094	0.735	0.434	0.620	0.276	0.908	0.099
98	-0.092	0.735	0.433	0.620	0.275	0.909	0.098
99	-0.089	0.735	0.432	0.620	0.274	0.909	0.098
100	-0.087	0.735	0.432	0.620	0.272	0.909	0.097

3. Assets hedging capacity

Assets correlation with price inflation						
Horizon in Quarters	Commodities	Hedge Funds	Nominal Bonds	NAREITs	Equity	T-Bills
1	0,79	0,49	-0,15	0,33	0,24	0,19
2	0,83	0,49	-0,24	0,31	0,17	0,19
3	0,84	0,50	-0,28	0,32	0,16	0,21
4	0,85	0,51	-0,31	0,33	0,16	0,23
5	0,85	0,52	-0,33	0,34	0,18	0,26
6	0,85	0,54	-0,35	0,36	0,20	0,29
7	0,85	0,55	-0,36	0,37	0,22	0,32
8	0,85	0,56	-0,38	0,38	0,24	0,34
9	0,85	0,58	-0,39	0,39	0,26	0,37
10	0,85	0,59	-0,40	0,40	0,28	0,39
11	0,86	0,60	-0,41	0,40	0,29	0,40
12	0,86	0,61	-0,42	0,41	0,31	0,42
13	0,86	0,61	-0,42	0,41	0,32	0,43
14	0,86	0,62	-0,43	0,42	0,34	0,45
15	0,86	0,63	-0,44	0,42	0,35	0,46
16	0,86	0,63	-0,44	0,42	0,35	0,47
17	0,86	0,64	-0,44	0,42	0,36	0,47
18	0,85	0,64	-0,45	0,42	0,37	0,48
19	0,85	0,64	-0,45	0,43	0,38	0,48
20	0,85	0,65	-0,45	0,43	0,38	0,49
21	0,85	0,65	-0,45	0,42	0,38	0,49

Horizon in Quarters	Commodities	Hedge Funds	Nominal Bonds	NAREITs	Equity	T-Bills
22	0,85	0,65	-0,45	0,42	0,39	0,50
23	0,85	0,65	-0,45	0,42	0,39	0,50
24	0,85	0,65	-0,44	0,42	0,39	0,50
25	0,85	0,65	-0,44	0,42	0,39	0,50
26	0,85	0,65	-0,44	0,42	0,39	0,50
27	0,85	0,65	-0,43	0,42	0,39	0,50
28	0,85	0,65	-0,43	0,41	0,39	0,50
29	0,85	0,65	-0,43	0,41	0,39	0,50
30	0,85	0,65	-0,42	0,41	0,39	0,50
31	0,85	0,65	-0,42	0,41	0,39	0,50
32	0,85	0,65	-0,41	0,41	0,39	0,50
33	0,84	0,65	-0,40	0,41	0,39	0,50
34	0,84	0,65	-0,40	0,40	0,38	0,50
35	0,84	0,65	-0,39	0,40	0,38	0,50
36	0,84	0,64	-0,39	0,40	0,38	0,50
37	0,84	0,64	-0,38	0,40	0,38	0,50
38	0,84	0,64	-0,37	0,40	0,38	0,50
39	0,84	0,64	-0,37	0,39	0,37	0,50
40	0,84	0,64	-0,36	0,39	0,37	0,50
41	0,84	0,64	-0,36	0,39	0,37	0,49
42	0,84	0,64	-0,35	0,39	0,37	0,49
43	0,83	0,64	-0,34	0,39	0,36	0,49
44	0,83	0,63	-0,34	0,38	0,36	0,49
45	0,83	0,63	-0,33	0,38	0,36	0,49
46	0,83	0,63	-0,32	0,38	0,36	0,49
47	0,83	0,63	-0,32	0,38	0,35	0,49
48	0,83	0,63	-0,31	0,38	0,35	0,49
49	0,83	0,63	-0,30	0,38	0,35	0,49
50	0,83	0,63	-0,30	0,37	0,35	0,48
51	0,83	0,62	-0,29	0,37	0,34	0,48
52	0,83	0,62	-0,29	0,37	0,34	0,48
53	0,83	0,62	-0,28	0,37	0,34	0,48
54	0,83	0,62	-0,27	0,37	0,34	0,48
55	0,82	0,62	-0,27	0,37	0,33	0,48
56	0,82	0,62	-0,26	0,37	0,33	0,48
57	0,82	0,62	-0,26	0,37	0,33	0,48
58	0,82	0,62	-0,25	0,36	0,33	0,48
59	0,82	0,62	-0,25	0,36	0,33	0,47
60	0,82	0,61	-0,24	0,36	0,32	0,47
61	0,82	0,61	-0,24	0,36	0,32	0,47
62	0,82	0,61	-0,23	0,36	0,32	0,47
63	0,82	0,61	-0,22	0,36	0,32	0,47
64	0,82	0,61	-0,22	0,36	0,32	0,47
65	0,82	0,61	-0,21	0,36	0,31	0,47

Horizon in Quarters	Commodities	Hedge Funds	Nominal Bonds	NAREITs	Equity	T-Bills
66	0,82	0,61	-0,21	0,36	0,31	0,47
67	0,82	0,61	-0,21	0,35	0,31	0,47
68	0,82	0,61	-0,20	0,35	0,31	0,47
69	0,82	0,61	-0,20	0,35	0,31	0,47
70	0,81	0,61	-0,19	0,35	0,30	0,47
71	0,81	0,60	-0,19	0,35	0,30	0,47
72	0,81	0,60	-0,18	0,35	0,30	0,46
73	0,81	0,60	-0,18	0,35	0,30	0,46
74	0,81	0,60	-0,17	0,35	0,30	0,46
75	0,81	0,60	-0,17	0,35	0,30	0,46
76	0,81	0,60	-0,17	0,35	0,30	0,46
77	0,81	0,60	-0,16	0,35	0,29	0,46
78	0,81	0,60	-0,16	0,35	0,29	0,46
79	0,81	0,60	-0,16	0,34	0,29	0,46
80	0,81	0,60	-0,15	0,34	0,29	0,46
81	0,81	0,60	-0,15	0,34	0,29	0,46
82	0,81	0,60	-0,14	0,34	0,29	0,46
83	0,81	0,60	-0,14	0,34	0,29	0,46
84	0,81	0,60	-0,14	0,34	0,28	0,46
85	0,81	0,60	-0,13	0,34	0,28	0,46
86	0,81	0,60	-0,13	0,34	0,28	0,46
87	0,81	0,59	-0,13	0,34	0,28	0,46
88	0,81	0,59	-0,12	0,34	0,28	0,46
89	0,81	0,59	-0,12	0,34	0,28	0,46
90	0,81	0,59	-0,12	0,34	0,28	0,46
91	0,81	0,59	-0,11	0,34	0,28	0,46
92	0,81	0,59	-0,11	0,34	0,28	0,45
93	0,81	0,59	-0,11	0,34	0,27	0,45
94	0,80	0,59	-0,11	0,34	0,27	0,45
95	0,80	0,59	-0,10	0,33	0,27	0,45
96	0,80	0,59	-0,10	0,33	0,27	0,45
97	0,80	0,59	-0,10	0,33	0,27	0,45
98	0,80	0,59	-0,09	0,33	0,27	0,45
99	0,80	0,59	-0,09	0,33	0,27	0,45
100	0,80	0,59	-0,09	0,33	0,27	0,45

Assets correlation with wage inflation						
Horizon in Quarters	Commodities	Hedge Funds	Nominal Bonds	NAREITs	Equity	T-Bills
1	0,00	-0,03	0,10	-0,07	-0,11	-0,16
2	-0,03	-0,04	0,13	-0,08	-0,12	-0,15
3	-0,02	-0,01	0,11	-0,06	-0,10	-0,11
4	0,00	0,03	0,09	-0,03	-0,07	-0,05
5	0,03	0,08	0,07	-0,01	-0,05	0,00
6	0,06	0,13	0,04	0,02	-0,02	0,06
7	0,09	0,17	0,01	0,05	0,01	0,11
8	0,12	0,21	-0,03	0,07	0,03	0,16
9	0,15	0,25	-0,05	0,09	0,05	0,20
10	0,17	0,29	-0,08	0,11	0,07	0,24
11	0,20	0,32	-0,11	0,13	0,09	0,27
12	0,22	0,35	-0,13	0,14	0,10	0,30
13	0,24	0,37	-0,15	0,16	0,12	0,33
14	0,26	0,40	-0,17	0,17	0,13	0,35
15	0,27	0,42	-0,19	0,17	0,13	0,37
16	0,29	0,44	-0,20	0,18	0,14	0,39
17	0,30	0,46	-0,22	0,19	0,15	0,41
18	0,31	0,47	-0,23	0,19	0,15	0,42
19	0,32	0,49	-0,24	0,19	0,15	0,43
20	0,33	0,50	-0,25	0,20	0,16	0,44
21	0,34	0,51	-0,25	0,20	0,16	0,45
22	0,35	0,52	-0,26	0,20	0,16	0,45
23	0,36	0,53	-0,27	0,20	0,16	0,46
24	0,37	0,54	-0,27	0,20	0,16	0,46
25	0,37	0,55	-0,27	0,20	0,16	0,47
26	0,38	0,55	-0,27	0,20	0,16	0,47
27	0,38	0,56	-0,28	0,20	0,16	0,47
28	0,39	0,57	-0,28	0,20	0,16	0,47
29	0,39	0,57	-0,28	0,19	0,15	0,47
30	0,40	0,58	-0,28	0,19	0,15	0,47
31	0,40	0,58	-0,27	0,19	0,15	0,47
32	0,41	0,59	-0,27	0,19	0,15	0,47
33	0,41	0,59	-0,27	0,19	0,15	0,47
34	0,41	0,59	-0,27	0,19	0,15	0,47
35	0,41	0,60	-0,27	0,18	0,14	0,46
36	0,42	0,60	-0,26	0,18	0,14	0,46
37	0,42	0,60	-0,26	0,18	0,14	0,46
38	0,42	0,60	-0,26	0,18	0,14	0,45
39	0,42	0,61	-0,25	0,17	0,13	0,45
40	0,43	0,61	-0,25	0,17	0,13	0,45
41	0,43	0,61	-0,25	0,17	0,13	0,44
42	0,43	0,61	-0,24	0,17	0,13	0,44
43	0,43	0,61	-0,24	0,17	0,13	0,44

Horizon in Quarters	Commodities	Hedge Funds	Nominal Bonds	NAREITs	Equity	T-Bills
44	0,43	0,62	-0,23	0,16	0,12	0,43
45	0,43	0,62	-0,23	0,16	0,12	0,43
46	0,44	0,62	-0,23	0,16	0,12	0,43
47	0,44	0,62	-0,22	0,16	0,12	0,42
48	0,44	0,62	-0,22	0,16	0,12	0,42
49	0,44	0,62	-0,22	0,15	0,11	0,42
50	0,44	0,62	-0,21	0,15	0,11	0,41
51	0,44	0,63	-0,21	0,15	0,11	0,41
52	0,44	0,63	-0,20	0,15	0,11	0,40
53	0,44	0,63	-0,20	0,15	0,11	0,40
54	0,44	0,63	-0,20	0,14	0,10	0,40
55	0,44	0,63	-0,19	0,14	0,10	0,39
56	0,44	0,63	-0,19	0,14	0,10	0,39
57	0,45	0,63	-0,19	0,14	0,10	0,39
58	0,45	0,63	-0,18	0,14	0,10	0,38
59	0,45	0,63	-0,18	0,14	0,10	0,38
60	0,45	0,63	-0,18	0,13	0,09	0,38
61	0,45	0,63	-0,17	0,13	0,09	0,37
62	0,45	0,63	-0,17	0,13	0,09	0,37
63	0,45	0,63	-0,17	0,13	0,09	0,37
64	0,45	0,63	-0,16	0,13	0,09	0,36
65	0,45	0,63	-0,16	0,13	0,09	0,36
66	0,45	0,63	-0,16	0,13	0,09	0,36
67	0,45	0,64	-0,15	0,12	0,08	0,35
68	0,45	0,64	-0,15	0,12	0,08	0,35
69	0,45	0,64	-0,15	0,12	0,08	0,35
70	0,45	0,64	-0,15	0,12	0,08	0,35
71	0,45	0,64	-0,14	0,12	0,08	0,34
72	0,45	0,64	-0,14	0,12	0,08	0,34
73	0,45	0,64	-0,14	0,12	0,08	0,34
74	0,45	0,64	-0,14	0,12	0,08	0,33
75	0,45	0,64	-0,13	0,11	0,07	0,33
76	0,45	0,64	-0,13	0,11	0,07	0,33
77	0,45	0,64	-0,13	0,11	0,07	0,33
78	0,45	0,64	-0,13	0,11	0,07	0,32
79	0,45	0,64	-0,13	0,11	0,07	0,32
80	0,45	0,64	-0,12	0,11	0,07	0,32
81	0,45	0,64	-0,12	0,11	0,07	0,32
82	0,46	0,64	-0,12	0,11	0,07	0,32
83	0,46	0,64	-0,12	0,11	0,07	0,31
84	0,46	0,64	-0,12	0,11	0,07	0,31
85	0,46	0,64	-0,11	0,11	0,07	0,31
86	0,46	0,64	-0,11	0,10	0,06	0,31
87	0,46	0,64	-0,11	0,10	0,06	0,31

Horizon in Quarters	Commodities	Hedge Funds	Nominal Bonds	NAREITs	Equity	T-Bills
88	0,46	0,64	-0,11	0,10	0,06	0,30
89	0,46	0,64	-0,11	0,10	0,06	0,30
90	0,46	0,64	-0,10	0,10	0,06	0,30
91	0,46	0,64	-0,10	0,10	0,06	0,30
92	0,46	0,64	-0,10	0,10	0,06	0,30
93	0,46	0,64	-0,10	0,10	0,06	0,29
94	0,46	0,64	-0,10	0,10	0,06	0,29
95	0,46	0,64	-0,10	0,10	0,06	0,29
96	0,46	0,64	-0,10	0,10	0,06	0,29
97	0,46	0,64	-0,09	0,10	0,06	0,29
98	0,46	0,64	-0,09	0,10	0,06	0,29
99	0,46	0,64	-0,09	0,09	0,05	0,29
100	0,46	0,64	-0,09	0,09	0,05	0,28

4a. Price inflation asset allocation

Horizon	$\gamma=2$					
	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
1	2,7085	-7,5971	0,7393	-2,7133	1,7778	6,0848
2	2,5653	-6,9219	0,7326	-2,6849	1,7713	5,5376
3	2,2621	-5,9332	0,6923	-2,6070	1,7966	4,7892
4	1,8965	-4,7998	0,6378	-2,5045	1,8388	3,9311
5	1,5415	-3,6546	0,5828	-2,3971	1,8849	3,0424
6	1,2370	-2,5774	0,5342	-2,2964	1,9269	2,1757
7	0,9975	-1,6049	0,4943	-2,2078	1,9611	1,3598
8	0,8224	-0,7466	0,4629	-2,1327	1,9870	0,6071
9	0,7045	0,0016	0,4386	-2,0704	2,0052	-0,0796
10	0,6343	0,6504	0,4201	-2,0194	2,0172	-0,7026
11	0,6024	1,2118	0,4058	-1,9781	2,0243	-1,2663
12	0,6004	1,6979	0,3947	-1,9448	2,0278	-1,7759
13	0,6215	2,1193	0,3858	-1,9184	2,0286	-2,2368
14	0,6599	2,4854	0,3785	-1,8974	2,0277	-2,6540
15	0,7111	2,8042	0,3722	-1,8811	2,0256	-3,0321
16	0,7716	3,0825	0,3666	-1,8685	2,0229	-3,3752
17	0,8386	3,3260	0,3615	-1,8591	2,0198	-3,6869
18	0,9099	3,5395	0,3567	-1,8522	2,0166	-3,9705
19	0,9837	3,7272	0,3521	-1,8475	2,0135	-4,2290
20	1,0587	3,8923	0,3476	-1,8446	2,0107	-4,4648
21	1,1340	4,0380	0,3432	-1,8431	2,0080	-4,6802
22	1,2088	4,1666	0,3388	-1,8428	2,0057	-4,8771
23	1,2823	4,2804	0,3344	-1,8435	2,0038	-5,0575
24	1,3543	4,3812	0,3301	-1,8450	2,0022	-5,2228
25	1,4244	4,4705	0,3259	-1,8472	2,0010	-5,3745

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
26	1,4923	4,5497	0,3217	-1,8500	2,0001	-5,5139
27	1,5580	4,6201	0,3176	-1,8531	1,9995	-5,6420
28	1,6212	4,6826	0,3135	-1,8566	1,9993	-5,7600
29	1,6821	4,7382	0,3096	-1,8604	1,9993	-5,8686
30	1,7404	4,7876	0,3057	-1,8644	1,9996	-5,9689
31	1,7964	4,8315	0,3019	-1,8685	2,0001	-6,0614
32	1,8499	4,8705	0,2983	-1,8728	2,0008	-6,1468
33	1,9012	4,9053	0,2947	-1,8771	2,0018	-6,2259
34	1,9502	4,9361	0,2913	-1,8814	2,0029	-6,2991
35	1,9970	4,9634	0,2880	-1,8857	2,0042	-6,3668
36	2,0417	4,9877	0,2848	-1,8901	2,0056	-6,4297
37	2,0844	5,0092	0,2817	-1,8944	2,0071	-6,4880
38	2,1252	5,0282	0,2787	-1,8986	2,0088	-6,5422
39	2,1641	5,0449	0,2759	-1,9028	2,0105	-6,5926
40	2,2014	5,0596	0,2731	-1,9069	2,0123	-6,6395
41	2,2370	5,0724	0,2705	-1,9109	2,0142	-6,6832
42	2,2710	5,0837	0,2680	-1,9149	2,0161	-6,7239
43	2,3035	5,0934	0,2655	-1,9187	2,0181	-6,7618
44	2,3346	5,1018	0,2632	-1,9225	2,0202	-6,7973
45	2,3645	5,1090	0,2609	-1,9262	2,0222	-6,8304
46	2,3930	5,1150	0,2588	-1,9297	2,0243	-6,8614
47	2,4204	5,1201	0,2567	-1,9332	2,0264	-6,8903
48	2,4467	5,1242	0,2547	-1,9366	2,0285	-6,9175
49	2,4719	5,1275	0,2528	-1,9399	2,0306	-6,9429
50	2,4962	5,1301	0,2509	-1,9431	2,0327	-6,9668
51	2,5195	5,1320	0,2491	-1,9462	2,0349	-6,9892
52	2,5419	5,1332	0,2474	-1,9492	2,0370	-7,0102
53	2,5634	5,1339	0,2458	-1,9521	2,0391	-7,0300
54	2,5842	5,1341	0,2442	-1,9550	2,0412	-7,0486
55	2,6043	5,1337	0,2426	-1,9577	2,0432	-7,0662
56	2,6236	5,1330	0,2411	-1,9604	2,0453	-7,0827
57	2,6423	5,1319	0,2397	-1,9630	2,0474	-7,0983
58	2,6604	5,1304	0,2383	-1,9655	2,0494	-7,1129
59	2,6778	5,1286	0,2369	-1,9679	2,0514	-7,1268
60	2,6947	5,1265	0,2356	-1,9703	2,0534	-7,1399
61	2,7111	5,1241	0,2343	-1,9726	2,0554	-7,1523
62	2,7269	5,1215	0,2331	-1,9748	2,0573	-7,1640
63	2,7423	5,1187	0,2319	-1,9770	2,0593	-7,1751
64	2,7572	5,1156	0,2307	-1,9791	2,0612	-7,1856
65	2,7717	5,1124	0,2296	-1,9811	2,0630	-7,1956
66	2,7858	5,1090	0,2284	-1,9831	2,0649	-7,2050
67	2,7994	5,1055	0,2274	-1,9850	2,0667	-7,2140
68	2,8127	5,1018	0,2263	-1,9869	2,0686	-7,2225
69	2,8257	5,0980	0,2253	-1,9887	2,0703	-7,2306
70	2,8382	5,0941	0,2243	-1,9905	2,0721	-7,2383

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
71	2,8505	5,0901	0,2233	-1,9922	2,0738	-7,2456
72	2,8625	5,0860	0,2223	-1,9938	2,0756	-7,2525
73	2,8741	5,0819	0,2214	-1,9955	2,0772	-7,2592
74	2,8855	5,0776	0,2204	-1,9970	2,0789	-7,2655
75	2,8966	5,0733	0,2195	-1,9986	2,0806	-7,2715
76	2,9075	5,0690	0,2186	-2,0000	2,0822	-7,2772
77	2,9180	5,0646	0,2178	-2,0015	2,0838	-7,2827
78	2,9284	5,0602	0,2169	-2,0029	2,0854	-7,2879
79	2,9385	5,0557	0,2161	-2,0043	2,0869	-7,2929
80	2,9484	5,0513	0,2152	-2,0056	2,0884	-7,2977
81	2,9581	5,0467	0,2144	-2,0069	2,0900	-7,3023
82	2,9676	5,0422	0,2136	-2,0082	2,0914	-7,3066
83	2,9768	5,0377	0,2128	-2,0094	2,0929	-7,3108
84	2,9859	5,0331	0,2120	-2,0106	2,0944	-7,3148
85	2,9948	5,0286	0,2113	-2,0118	2,0958	-7,3186
86	3,0035	5,0240	0,2105	-2,0130	2,0972	-7,3223
87	3,0121	5,0195	0,2098	-2,0141	2,0986	-7,3258
88	3,0205	5,0149	0,2091	-2,0152	2,1000	-7,3292
89	3,0287	5,0104	0,2083	-2,0163	2,1013	-7,3324
90	3,0367	5,0058	0,2076	-2,0173	2,1026	-7,3355
91	3,0447	5,0013	0,2069	-2,0183	2,1039	-7,3385
92	3,0524	4,9968	0,2062	-2,0193	2,1052	-7,3414
93	3,0601	4,9923	0,2056	-2,0203	2,1065	-7,3441
94	3,0676	4,9878	0,2049	-2,0212	2,1078	-7,3468
95	3,0749	4,9833	0,2042	-2,0222	2,1090	-7,3493
96	3,0821	4,9788	0,2036	-2,0231	2,1102	-7,3517
97	3,0893	4,9744	0,2029	-2,0240	2,1115	-7,3541
98	3,0962	4,9700	0,2023	-2,0248	2,1126	-7,3563
99	3,1031	4,9656	0,2017	-2,0257	2,1138	-7,3585
100	3,1099	4,9612	0,2011	-2,0265	2,1150	-7,3606

$\gamma=5$						
Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
1	1,0680	-2,9904	0,3140	-1,0826	0,7167	2,9742
2	1,0007	-2,6874	0,3106	-1,0695	0,7164	2,7291
3	0,8694	-2,2566	0,2936	-1,0362	0,7286	2,4013
4	0,7146	-1,7686	0,2710	-0,9932	0,7470	2,0292
5	0,5663	-1,2783	0,2484	-0,9485	0,7665	1,6456
6	0,4405	-0,8183	0,2286	-0,9069	0,7838	1,2723
7	0,3427	-0,4035	0,2125	-0,8704	0,7977	0,9210
8	0,2724	-0,0373	0,1999	-0,8396	0,8078	0,5968
9	0,2263	0,2822	0,1903	-0,8141	0,8147	0,3006
10	0,2003	0,5596	0,1831	-0,7934	0,8189	0,0315

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
11	0,1903	0,8001	0,1776	-0,7767	0,8211	-0,2124
12	0,1929	1,0087	0,1733	-0,7633	0,8218	-0,4333
13	0,2050	1,1899	0,1700	-0,7527	0,8214	-0,6335
14	0,2242	1,3477	0,1673	-0,7445	0,8203	-0,8151
15	0,2488	1,4855	0,1650	-0,7380	0,8187	-0,9799
16	0,2771	1,6060	0,1629	-0,7332	0,8169	-1,1297
17	0,3079	1,7117	0,1611	-0,7296	0,8150	-1,2661
18	0,3405	1,8046	0,1593	-0,7271	0,8132	-1,3905
19	0,3739	1,8865	0,1575	-0,7254	0,8113	-1,5039
20	0,4078	1,9588	0,1558	-0,7245	0,8097	-1,6076
21	0,4416	2,0227	0,1542	-0,7241	0,8081	-1,7024
22	0,4751	2,0793	0,1525	-0,7243	0,8067	-1,7893
23	0,5079	2,1295	0,1508	-0,7248	0,8055	-1,8690
24	0,5400	2,1741	0,1491	-0,7257	0,8045	-1,9421
25	0,5711	2,2138	0,1475	-0,7268	0,8037	-2,0093
26	0,6013	2,2492	0,1458	-0,7282	0,8030	-2,0711
27	0,6303	2,2807	0,1442	-0,7297	0,8025	-2,1280
28	0,6583	2,3088	0,1426	-0,7313	0,8021	-2,1805
29	0,6852	2,3339	0,1411	-0,7331	0,8018	-2,2289
30	0,7109	2,3563	0,1395	-0,7349	0,8017	-2,2736
31	0,7355	2,3764	0,1380	-0,7368	0,8017	-2,3149
32	0,7590	2,3943	0,1366	-0,7387	0,8018	-2,3531
33	0,7815	2,4104	0,1352	-0,7407	0,8021	-2,3885
34	0,8030	2,4247	0,1338	-0,7426	0,8023	-2,4213
35	0,8235	2,4376	0,1325	-0,7446	0,8027	-2,4517
36	0,8430	2,4490	0,1313	-0,7465	0,8032	-2,4799
37	0,8616	2,4593	0,1300	-0,7484	0,8036	-2,5062
38	0,8794	2,4685	0,1289	-0,7503	0,8042	-2,5306
39	0,8963	2,4767	0,1278	-0,7521	0,8048	-2,5534
40	0,9125	2,4839	0,1267	-0,7540	0,8054	-2,5746
41	0,9279	2,4904	0,1256	-0,7557	0,8061	-2,5944
42	0,9426	2,4962	0,1246	-0,7575	0,8068	-2,6128
43	0,9567	2,5013	0,1237	-0,7592	0,8075	-2,6301
44	0,9701	2,5058	0,1228	-0,7609	0,8083	-2,6462
45	0,9830	2,5098	0,1219	-0,7625	0,8091	-2,6613
46	0,9953	2,5133	0,1211	-0,7640	0,8098	-2,6754
47	1,0070	2,5163	0,1203	-0,7656	0,8106	-2,6887
48	1,0183	2,5189	0,1195	-0,7671	0,8114	-2,7011
49	1,0291	2,5212	0,1188	-0,7685	0,8123	-2,7128
50	1,0395	2,5231	0,1180	-0,7699	0,8131	-2,7237
51	1,0494	2,5247	0,1174	-0,7713	0,8139	-2,7341
52	1,0589	2,5260	0,1167	-0,7726	0,8147	-2,7438
53	1,0681	2,5271	0,1161	-0,7739	0,8155	-2,7529
54	1,0769	2,5279	0,1155	-0,7751	0,8163	-2,7616

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
55	1,0854	2,5286	0,1149	-0,7763	0,8172	-2,7697
56	1,0936	2,5290	0,1143	-0,7775	0,8180	-2,7774
57	1,1015	2,5292	0,1138	-0,7786	0,8188	-2,7846
58	1,1091	2,5293	0,1132	-0,7797	0,8196	-2,7915
59	1,1165	2,5292	0,1127	-0,7808	0,8204	-2,7980
60	1,1236	2,5290	0,1123	-0,7818	0,8211	-2,8042
61	1,1304	2,5287	0,1118	-0,7829	0,8219	-2,8100
62	1,1371	2,5283	0,1113	-0,7838	0,8227	-2,8155
63	1,1435	2,5277	0,1109	-0,7848	0,8235	-2,8208
64	1,1497	2,5271	0,1104	-0,7857	0,8242	-2,8257
65	1,1558	2,5263	0,1100	-0,7866	0,8250	-2,8305
66	1,1616	2,5255	0,1096	-0,7875	0,8257	-2,8350
67	1,1673	2,5246	0,1092	-0,7883	0,8264	-2,8393
68	1,1728	2,5237	0,1088	-0,7891	0,8271	-2,8433
69	1,1782	2,5226	0,1084	-0,7899	0,8279	-2,8472
70	1,1834	2,5216	0,1081	-0,7907	0,8286	-2,8509
71	1,1885	2,5204	0,1077	-0,7914	0,8292	-2,8545
72	1,1934	2,5193	0,1074	-0,7922	0,8299	-2,8578
73	1,1982	2,5180	0,1070	-0,7929	0,8306	-2,8611
74	1,2029	2,5168	0,1067	-0,7936	0,8313	-2,8641
75	1,2075	2,5155	0,1064	-0,7942	0,8319	-2,8671
76	1,2120	2,5142	0,1060	-0,7949	0,8326	-2,8699
77	1,2163	2,5129	0,1057	-0,7955	0,8332	-2,8726
78	1,2206	2,5115	0,1054	-0,7961	0,8338	-2,8752
79	1,2247	2,5101	0,1051	-0,7967	0,8345	-2,8776
80	1,2288	2,5087	0,1048	-0,7973	0,8351	-2,8800
81	1,2327	2,5073	0,1045	-0,7979	0,8357	-2,8823
82	1,2366	2,5058	0,1042	-0,7985	0,8363	-2,8845
83	1,2404	2,5044	0,1039	-0,7990	0,8368	-2,8866
84	1,2441	2,5029	0,1037	-0,7995	0,8374	-2,8886
85	1,2477	2,5015	0,1034	-0,8000	0,8380	-2,8905
86	1,2512	2,5000	0,1031	-0,8006	0,8386	-2,8924
87	1,2547	2,4985	0,1029	-0,8010	0,8391	-2,8942
88	1,2581	2,4970	0,1026	-0,8015	0,8397	-2,8959
89	1,2615	2,4955	0,1023	-0,8020	0,8402	-2,8975
90	1,2647	2,4940	0,1021	-0,8025	0,8407	-2,8991
91	1,2680	2,4925	0,1018	-0,8029	0,8412	-2,9007
92	1,2711	2,4910	0,1016	-0,8033	0,8418	-2,9022
93	1,2742	2,4895	0,1014	-0,8038	0,8423	-2,9036
94	1,2772	2,4880	0,1011	-0,8042	0,8428	-2,9050
95	1,2802	2,4866	0,1009	-0,8046	0,8433	-2,9063
96	1,2831	2,4851	0,1007	-0,8050	0,8438	-2,9076
97	1,2860	2,4836	0,1004	-0,8054	0,8442	-2,9088
98	1,2888	2,4821	0,1002	-0,8058	0,8447	-2,9100

99	1,2916	2,4806	0,1000	-0,8061	0,8452	-2,9112
100	1,2943	2,4791	0,0997	-0,8065	0,8457	-2,9123

$\gamma=10$						
Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
1	0,5212	-1,4548	0,1723	-0,5391	0,3630	1,9374
2	0,4792	-1,2759	0,1699	-0,5310	0,3648	1,7930
3	0,4052	-1,0311	0,1607	-0,5126	0,3725	1,6053
4	0,3207	-0,7582	0,1487	-0,4895	0,3831	1,3952
5	0,2413	-0,4862	0,1369	-0,4657	0,3937	1,1800
6	0,1750	-0,2320	0,1267	-0,4437	0,4028	0,9712
7	0,1244	-0,0030	0,1185	-0,4246	0,4098	0,7748
8	0,0891	0,1992	0,1122	-0,4086	0,4148	0,5933
9	0,0669	0,3758	0,1075	-0,3954	0,4179	0,4273
10	0,0556	0,5294	0,1041	-0,3848	0,4195	0,2762
11	0,0530	0,6629	0,1015	-0,3762	0,4200	0,1389
12	0,0570	0,7790	0,0996	-0,3695	0,4198	0,0142
13	0,0661	0,8802	0,0981	-0,3642	0,4189	-0,0991
14	0,0790	0,9685	0,0969	-0,3601	0,4178	-0,2021
15	0,0947	1,0459	0,0959	-0,3570	0,4164	-0,2958
16	0,1122	1,1138	0,0950	-0,3547	0,4149	-0,3813
17	0,1311	1,1736	0,0942	-0,3531	0,4135	-0,4592
18	0,1507	1,2263	0,0934	-0,3520	0,4120	-0,5304
19	0,1707	1,2729	0,0927	-0,3514	0,4106	-0,5956
20	0,1908	1,3142	0,0919	-0,3511	0,4093	-0,6552
21	0,2108	1,3509	0,0911	-0,3511	0,4081	-0,7099
22	0,2305	1,3835	0,0904	-0,3514	0,4071	-0,7601
23	0,2498	1,4125	0,0896	-0,3519	0,4061	-0,8061
24	0,2686	1,4385	0,0888	-0,3526	0,4053	-0,8485
25	0,2867	1,4616	0,0880	-0,3533	0,4046	-0,8876
26	0,3043	1,4823	0,0872	-0,3542	0,4040	-0,9235
27	0,3211	1,5009	0,0864	-0,3552	0,4034	-0,9567
28	0,3373	1,5175	0,0856	-0,3562	0,4030	-0,9873
29	0,3529	1,5325	0,0849	-0,3573	0,4027	-1,0156
30	0,3677	1,5459	0,0841	-0,3584	0,4025	-1,0418
31	0,3819	1,5580	0,0834	-0,3596	0,4023	-1,0660
32	0,3954	1,5689	0,0827	-0,3607	0,4022	-1,0885
33	0,4083	1,5787	0,0820	-0,3619	0,4021	-1,1093
34	0,4206	1,5876	0,0813	-0,3630	0,4022	-1,1287
35	0,4323	1,5956	0,0807	-0,3642	0,4022	-1,1466
36	0,4434	1,6028	0,0801	-0,3653	0,4023	-1,1634
37	0,4540	1,6093	0,0795	-0,3664	0,4025	-1,1789
38	0,4641	1,6152	0,0789	-0,3675	0,4027	-1,1934
39	0,4737	1,6206	0,0784	-0,3686	0,4029	-1,2070
40	0,4829	1,6254	0,0779	-0,3697	0,4031	-1,2196

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
41	0,4916	1,6298	0,0773	-0,3707	0,4034	-1,2314
42	0,4999	1,6337	0,0769	-0,3717	0,4037	-1,2425
43	0,5078	1,6373	0,0764	-0,3727	0,4040	-1,2528
44	0,5153	1,6405	0,0760	-0,3736	0,4043	-1,2625
45	0,5225	1,6434	0,0756	-0,3746	0,4047	-1,2716
46	0,5294	1,6460	0,0752	-0,3755	0,4050	-1,2801
47	0,5359	1,6484	0,0748	-0,3764	0,4054	-1,2881
48	0,5422	1,6505	0,0744	-0,3772	0,4058	-1,2956
49	0,5482	1,6524	0,0741	-0,3781	0,4061	-1,3027
50	0,5539	1,6541	0,0737	-0,3789	0,4065	-1,3094
51	0,5594	1,6556	0,0734	-0,3796	0,4069	-1,3157
52	0,5646	1,6570	0,0731	-0,3804	0,4073	-1,3216
53	0,5697	1,6582	0,0728	-0,3811	0,4077	-1,3272
54	0,5745	1,6592	0,0726	-0,3818	0,4081	-1,3325
55	0,5792	1,6602	0,0723	-0,3825	0,4085	-1,3375
56	0,5836	1,6610	0,0721	-0,3832	0,4088	-1,3423
57	0,5879	1,6617	0,0718	-0,3839	0,4092	-1,3468
58	0,5920	1,6623	0,0716	-0,3845	0,4096	-1,3510
59	0,5960	1,6628	0,0714	-0,3851	0,4100	-1,3551
60	0,5999	1,6632	0,0711	-0,3857	0,4104	-1,3589
61	0,6036	1,6636	0,0709	-0,3863	0,4108	-1,3625
62	0,6071	1,6638	0,0707	-0,3868	0,4111	-1,3660
63	0,6106	1,6641	0,0705	-0,3874	0,4115	-1,3693
64	0,6139	1,6642	0,0703	-0,3879	0,4119	-1,3725
65	0,6171	1,6643	0,0702	-0,3884	0,4123	-1,3754
66	0,6203	1,6643	0,0700	-0,3889	0,4126	-1,3783
67	0,6233	1,6643	0,0698	-0,3894	0,4130	-1,3810
68	0,6262	1,6643	0,0697	-0,3899	0,4133	-1,3836
69	0,6291	1,6642	0,0695	-0,3903	0,4137	-1,3861
70	0,6318	1,6640	0,0693	-0,3907	0,4140	-1,3885
71	0,6345	1,6639	0,0692	-0,3912	0,4144	-1,3908
72	0,6371	1,6637	0,0691	-0,3916	0,4147	-1,3929
73	0,6396	1,6634	0,0689	-0,3920	0,4150	-1,3950
74	0,6421	1,6632	0,0688	-0,3924	0,4154	-1,3970
75	0,6445	1,6629	0,0686	-0,3928	0,4157	-1,3989
76	0,6468	1,6626	0,0685	-0,3932	0,4160	-1,4008
77	0,6491	1,6623	0,0684	-0,3935	0,4163	-1,4025
78	0,6513	1,6619	0,0683	-0,3939	0,4167	-1,4042
79	0,6534	1,6616	0,0681	-0,3942	0,4170	-1,4059
80	0,6555	1,6612	0,0680	-0,3946	0,4173	-1,4074
81	0,6576	1,6608	0,0679	-0,3949	0,4176	-1,4090
82	0,6596	1,6604	0,0678	-0,3952	0,4179	-1,4104
83	0,6615	1,6600	0,0677	-0,3955	0,4182	-1,4118
84	0,6635	1,6595	0,0675	-0,3958	0,4184	-1,4132
85	0,6653	1,6591	0,0674	-0,3961	0,4187	-1,4145

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
86	0,6672	1,6586	0,0673	-0,3964	0,4190	-1,4157
87	0,6689	1,6582	0,0672	-0,3967	0,4193	-1,4169
88	0,6707	1,6577	0,0671	-0,3970	0,4196	-1,4181
89	0,6724	1,6573	0,0670	-0,3972	0,4198	-1,4193
90	0,6741	1,6568	0,0669	-0,3975	0,4201	-1,4203
91	0,6757	1,6563	0,0668	-0,3978	0,4204	-1,4214
92	0,6773	1,6558	0,0667	-0,3980	0,4206	-1,4224
93	0,6789	1,6553	0,0666	-0,3983	0,4209	-1,4234
94	0,6804	1,6548	0,0665	-0,3985	0,4211	-1,4244
95	0,6820	1,6543	0,0664	-0,3987	0,4214	-1,4253
96	0,6834	1,6538	0,0663	-0,3990	0,4216	-1,4262
97	0,6849	1,6533	0,0662	-0,3992	0,4218	-1,4271
98	0,6863	1,6528	0,0662	-0,3994	0,4221	-1,4279
99	0,6877	1,6523	0,0661	-0,3996	0,4223	-1,4288
100	0,6891	1,6518	0,0660	-0,3998	0,4225	-1,4296

4b. Wage inflation asset allocation

γ=2						
Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
1	2,6956	-7,5953	0,7246	-2,7123	1,7800	6,1073
2	2,5537	-6,9212	0,7181	-2,6839	1,7736	5,5597
3	2,2521	-5,9341	0,6780	-2,6061	1,7989	4,8112
4	1,8883	-4,8026	0,6237	-2,5038	1,8411	3,9533
5	1,5351	-3,6592	0,5689	-2,3965	1,8870	3,0647
6	1,2322	-2,5837	0,5204	-2,2961	1,9288	2,1983
7	0,9942	-1,6126	0,4806	-2,2077	1,9629	1,3826
8	0,8204	-0,7557	0,4493	-2,1327	1,9887	0,6300
9	0,7037	-0,0086	0,4251	-2,0705	2,0068	-0,0566
10	0,6345	0,6392	0,4066	-2,0196	2,0187	-0,6794
11	0,6034	1,1998	0,3924	-1,9784	2,0257	-1,2430
12	0,6022	1,6851	0,3813	-1,9452	2,0291	-1,7525
13	0,6239	2,1058	0,3724	-1,9188	2,0299	-2,2133
14	0,6629	2,4713	0,3651	-1,8979	2,0290	-2,6304
15	0,7147	2,7895	0,3588	-1,8816	2,0269	-3,0083
16	0,7757	3,0673	0,3532	-1,8691	2,0241	-3,3513
17	0,8431	3,3103	0,3481	-1,8597	2,0211	-3,6629
18	0,9147	3,5234	0,3433	-1,8529	2,0179	-3,9464
19	0,9888	3,7106	0,3387	-1,8482	2,0148	-4,2046
20	1,0641	3,8753	0,3341	-1,8452	2,0119	-4,4403
21	1,1397	4,0206	0,3297	-1,8437	2,0093	-4,6555

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
22	1,2146	4,1488	0,3253	-1,8435	2,0070	-4,8522
23	1,2883	4,2622	0,3209	-1,8442	2,0051	-5,0324
24	1,3605	4,3626	0,3166	-1,8457	2,0035	-5,1975
25	1,4307	4,4516	0,3124	-1,8479	2,0023	-5,3490
26	1,4987	4,5305	0,3082	-1,8507	2,0015	-5,4882
27	1,5645	4,6006	0,3040	-1,8538	2,0009	-5,6161
28	1,6278	4,6628	0,3000	-1,8574	2,0007	-5,7339
29	1,6887	4,7181	0,2960	-1,8611	2,0007	-5,8424
30	1,7471	4,7672	0,2921	-1,8651	2,0010	-5,9424
31	1,8031	4,8109	0,2884	-1,8692	2,0016	-6,0347
32	1,8567	4,8497	0,2847	-1,8735	2,0024	-6,1200
33	1,9080	4,8841	0,2812	-1,8778	2,0033	-6,1988
34	1,9570	4,9147	0,2777	-1,8821	2,0045	-6,2718
35	2,0038	4,9418	0,2744	-1,8864	2,0058	-6,3394
36	2,0485	4,9659	0,2712	-1,8907	2,0072	-6,4021
37	2,0912	4,9871	0,2681	-1,8950	2,0088	-6,4602
38	2,1320	5,0059	0,2651	-1,8993	2,0104	-6,5142
39	2,1710	5,0224	0,2623	-1,9034	2,0122	-6,5644
40	2,2082	5,0369	0,2595	-1,9075	2,0140	-6,6112
41	2,2438	5,0496	0,2569	-1,9115	2,0159	-6,6546
42	2,2778	5,0606	0,2544	-1,9155	2,0179	-6,6952
43	2,3104	5,0701	0,2519	-1,9193	2,0199	-6,7330
44	2,3415	5,0783	0,2496	-1,9231	2,0219	-6,7683
45	2,3713	5,0853	0,2473	-1,9267	2,0240	-6,8012
46	2,3999	5,0912	0,2452	-1,9303	2,0261	-6,8320
47	2,4272	5,0961	0,2431	-1,9338	2,0282	-6,8609
48	2,4535	5,1001	0,2411	-1,9372	2,0304	-6,8879
49	2,4787	5,1032	0,2392	-1,9404	2,0325	-6,9132
50	2,5030	5,1056	0,2373	-1,9436	2,0346	-6,9369
51	2,5263	5,1073	0,2355	-1,9467	2,0368	-6,9592
52	2,5487	5,1084	0,2338	-1,9497	2,0389	-6,9801
53	2,5702	5,1090	0,2322	-1,9526	2,0410	-6,9998
54	2,5910	5,1090	0,2306	-1,9555	2,0431	-7,0183
55	2,6111	5,1085	0,2290	-1,9582	2,0452	-7,0357
56	2,6304	5,1076	0,2275	-1,9609	2,0473	-7,0521
57	2,6491	5,1064	0,2261	-1,9634	2,0494	-7,0675
58	2,6672	5,1048	0,2247	-1,9659	2,0514	-7,0821
59	2,6846	5,1028	0,2233	-1,9684	2,0534	-7,0958
60	2,7015	5,1006	0,2220	-1,9707	2,0555	-7,1088
61	2,7179	5,0981	0,2207	-1,9730	2,0574	-7,1211
62	2,7337	5,0953	0,2195	-1,9752	2,0594	-7,1327
63	2,7491	5,0924	0,2183	-1,9774	2,0613	-7,1437
64	2,7640	5,0892	0,2171	-1,9795	2,0633	-7,1541
65	2,7785	5,0858	0,2160	-1,9815	2,0652	-7,1640
66	2,7926	5,0823	0,2149	-1,9835	2,0670	-7,1733

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
67	2,8063	5,0787	0,2138	-1,9854	2,0689	-7,1822
68	2,8196	5,0749	0,2127	-1,9872	2,0707	-7,1906
69	2,8325	5,0710	0,2117	-1,9890	2,0725	-7,1986
70	2,8451	5,0670	0,2107	-1,9908	2,0743	-7,2062
71	2,8574	5,0629	0,2097	-1,9925	2,0760	-7,2135
72	2,8694	5,0587	0,2087	-1,9941	2,0777	-7,2203
73	2,8811	5,0544	0,2078	-1,9958	2,0794	-7,2269
74	2,8924	5,0501	0,2068	-1,9973	2,0811	-7,2331
75	2,9036	5,0457	0,2059	-1,9988	2,0828	-7,2391
76	2,9144	5,0412	0,2050	-2,0003	2,0844	-7,2447
77	2,9250	5,0367	0,2041	-2,0018	2,0860	-7,2501
78	2,9354	5,0322	0,2033	-2,0032	2,0876	-7,2553
79	2,9455	5,0276	0,2024	-2,0045	2,0892	-7,2602
80	2,9554	5,0230	0,2016	-2,0059	2,0907	-7,2649
81	2,9651	5,0184	0,2008	-2,0072	2,0922	-7,2694
82	2,9746	5,0138	0,2000	-2,0084	2,0937	-7,2737
83	2,9839	5,0092	0,1992	-2,0097	2,0952	-7,2778
84	2,9930	5,0045	0,1984	-2,0109	2,0967	-7,2817
85	3,0019	4,9999	0,1977	-2,0120	2,0981	-7,2855
86	3,0107	4,9952	0,1969	-2,0132	2,0995	-7,2891
87	3,0192	4,9906	0,1962	-2,0143	2,1009	-7,2926
88	3,0276	4,9859	0,1954	-2,0154	2,1023	-7,2959
89	3,0359	4,9813	0,1947	-2,0165	2,1036	-7,2991
90	3,0439	4,9767	0,1940	-2,0175	2,1050	-7,3021
91	3,0519	4,9721	0,1933	-2,0185	2,1063	-7,3050
92	3,0597	4,9675	0,1926	-2,0195	2,1076	-7,3078
93	3,0673	4,9629	0,1919	-2,0205	2,1089	-7,3105
94	3,0748	4,9583	0,1913	-2,0214	2,1101	-7,3131
95	3,0822	4,9537	0,1906	-2,0223	2,1114	-7,3156
96	3,0895	4,9492	0,1899	-2,0232	2,1126	-7,3180
97	3,0966	4,9447	0,1893	-2,0241	2,1138	-7,3203
98	3,1036	4,9402	0,1886	-2,0250	2,1150	-7,3225
99	3,1105	4,9357	0,1880	-2,0258	2,1162	-7,3246
100	3,1172	4,9313	0,1874	-2,0266	2,1174	-7,3266

$\gamma=5$						
Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
1	1,0474	-2,9875	0,2906	-1,0811	0,7203	3,0104
2	0,9822	-2,6863	0,2874	-1,0679	0,7201	2,7645
3	0,8535	-2,2581	0,2707	-1,0348	0,7323	2,4365
4	0,7016	-1,7731	0,2484	-0,9921	0,7506	2,0645
5	0,5561	-1,2857	0,2261	-0,9477	0,7699	1,6813
6	0,4329	-0,8284	0,2065	-0,9063	0,7870	1,3084
7	0,3375	-0,4159	0,1906	-0,8701	0,8006	0,9574

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
8	0,2692	-0,0518	0,1782	-0,8396	0,8105	0,6334
9	0,2250	0,2659	0,1687	-0,8143	0,8172	0,3375
10	0,2006	0,5418	0,1615	-0,7938	0,8213	0,0686
11	0,1920	0,7809	0,1561	-0,7772	0,8234	-0,1751
12	0,1957	0,9882	0,1519	-0,7639	0,8239	-0,3959
13	0,2089	1,1684	0,1486	-0,7534	0,8235	-0,5959
14	0,2292	1,3252	0,1458	-0,7452	0,8223	-0,7773
15	0,2545	1,4620	0,1435	-0,7389	0,8207	-0,9419
16	0,2835	1,5817	0,1415	-0,7341	0,8189	-1,0915
17	0,3151	1,6866	0,1396	-0,7305	0,8170	-1,2277
18	0,3482	1,7788	0,1378	-0,7281	0,8151	-1,3518
19	0,3821	1,8599	0,1360	-0,7264	0,8133	-1,4650
20	0,4164	1,9315	0,1343	-0,7255	0,8117	-1,5684
21	0,4506	1,9948	0,1326	-0,7252	0,8101	-1,6629
22	0,4844	2,0508	0,1309	-0,7254	0,8088	-1,7495
23	0,5175	2,1004	0,1292	-0,7259	0,8076	-1,8289
24	0,5498	2,1445	0,1275	-0,7268	0,8066	-1,9017
25	0,5812	2,1837	0,1258	-0,7279	0,8058	-1,9685
26	0,6115	2,2185	0,1242	-0,7293	0,8052	-2,0300
27	0,6407	2,2495	0,1225	-0,7308	0,8047	-2,0866
28	0,6688	2,2771	0,1209	-0,7325	0,8043	-2,1387
29	0,6958	2,3018	0,1194	-0,7342	0,8041	-2,1868
30	0,7216	2,3238	0,1178	-0,7361	0,8041	-2,2312
31	0,7463	2,3434	0,1163	-0,7379	0,8041	-2,2722
32	0,7699	2,3609	0,1149	-0,7398	0,8043	-2,3101
33	0,7924	2,3766	0,1135	-0,7418	0,8045	-2,3451
34	0,8139	2,3905	0,1121	-0,7437	0,8048	-2,3776
35	0,8344	2,4030	0,1108	-0,7456	0,8052	-2,4078
36	0,8539	2,4141	0,1095	-0,7476	0,8057	-2,4357
37	0,8726	2,4240	0,1083	-0,7495	0,8063	-2,4617
38	0,8903	2,4328	0,1071	-0,7513	0,8068	-2,4858
39	0,9073	2,4407	0,1060	-0,7532	0,8075	-2,5083
40	0,9235	2,4477	0,1049	-0,7550	0,8082	-2,5292
41	0,9389	2,4538	0,1039	-0,7567	0,8089	-2,5487
42	0,9536	2,4593	0,1029	-0,7585	0,8096	-2,5669
43	0,9677	2,4641	0,1019	-0,7602	0,8104	-2,5839
44	0,9811	2,4683	0,1010	-0,7618	0,8111	-2,5998
45	0,9939	2,4720	0,1002	-0,7634	0,8119	-2,6146
46	1,0062	2,4752	0,0993	-0,7650	0,8128	-2,6285
47	1,0180	2,4779	0,0985	-0,7665	0,8136	-2,6415
48	1,0292	2,4803	0,0977	-0,7679	0,8144	-2,6537
49	1,0400	2,4823	0,0970	-0,7694	0,8153	-2,6652
50	1,0504	2,4839	0,0963	-0,7708	0,8161	-2,6759
51	1,0603	2,4853	0,0956	-0,7721	0,8169	-2,6860
52	1,0698	2,4864	0,0950	-0,7734	0,8178	-2,6955

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
53	1,0790	2,4872	0,0943	-0,7747	0,8186	-2,7045
54	1,0878	2,4878	0,0937	-0,7759	0,8195	-2,7129
55	1,0963	2,4882	0,0931	-0,7771	0,8203	-2,7209
56	1,1045	2,4884	0,0926	-0,7783	0,8211	-2,7284
57	1,1124	2,4884	0,0920	-0,7794	0,8220	-2,7354
58	1,1200	2,4883	0,0915	-0,7805	0,8228	-2,7421
59	1,1274	2,4880	0,0910	-0,7815	0,8236	-2,7485
60	1,1345	2,4876	0,0905	-0,7825	0,8244	-2,7544
61	1,1413	2,4870	0,0900	-0,7835	0,8252	-2,7601
62	1,1480	2,4864	0,0896	-0,7845	0,8260	-2,7655
63	1,1544	2,4856	0,0891	-0,7854	0,8268	-2,7705
64	1,1607	2,4848	0,0887	-0,7863	0,8276	-2,7754
65	1,1667	2,4838	0,0883	-0,7872	0,8283	-2,7799
66	1,1726	2,4828	0,0879	-0,7880	0,8291	-2,7843
67	1,1783	2,4817	0,0875	-0,7889	0,8298	-2,7884
68	1,1838	2,4806	0,0871	-0,7897	0,8306	-2,7924
69	1,1892	2,4794	0,0867	-0,7904	0,8313	-2,7961
70	1,1944	2,4781	0,0863	-0,7912	0,8320	-2,7997
71	1,1995	2,4768	0,0860	-0,7919	0,8327	-2,8031
72	1,2045	2,4755	0,0856	-0,7927	0,8334	-2,8063
73	1,2093	2,4741	0,0853	-0,7934	0,8341	-2,8094
74	1,2140	2,4727	0,0849	-0,7940	0,8348	-2,8124
75	1,2186	2,4712	0,0846	-0,7947	0,8355	-2,8152
76	1,2231	2,4697	0,0843	-0,7953	0,8361	-2,8179
77	1,2275	2,4682	0,0839	-0,7960	0,8368	-2,8204
78	1,2317	2,4667	0,0836	-0,7966	0,8374	-2,8229
79	1,2359	2,4651	0,0833	-0,7972	0,8380	-2,8253
80	1,2400	2,4636	0,0830	-0,7977	0,8387	-2,8275
81	1,2440	2,4620	0,0827	-0,7983	0,8393	-2,8297
82	1,2479	2,4604	0,0824	-0,7988	0,8399	-2,8318
83	1,2517	2,4588	0,0822	-0,7994	0,8405	-2,8338
84	1,2554	2,4572	0,0819	-0,7999	0,8411	-2,8357
85	1,2591	2,4556	0,0816	-0,8004	0,8417	-2,8375
86	1,2626	2,4539	0,0813	-0,8009	0,8422	-2,8393
87	1,2661	2,4523	0,0811	-0,8014	0,8428	-2,8410
88	1,2696	2,4507	0,0808	-0,8018	0,8434	-2,8426
89	1,2730	2,4490	0,0805	-0,8023	0,8439	-2,8441
90	1,2763	2,4474	0,0803	-0,8028	0,8445	-2,8457
91	1,2795	2,4458	0,0800	-0,8032	0,8450	-2,8471
92	1,2827	2,4441	0,0798	-0,8036	0,8455	-2,8485
93	1,2858	2,4425	0,0795	-0,8040	0,8460	-2,8498
94	1,2888	2,4409	0,0793	-0,8045	0,8466	-2,8511
95	1,2919	2,4393	0,0790	-0,8049	0,8471	-2,8524
96	1,2948	2,4376	0,0788	-0,8052	0,8476	-2,8536
97	1,2977	2,4360	0,0786	-0,8056	0,8481	-2,8547

98	1,3006	2,4344	0,0783	-0,8060	0,8486	-2,8559
99	1,3034	2,4328	0,0781	-0,8064	0,8490	-2,8569
100	1,3061	2,4312	0,0779	-0,8067	0,8495	-2,8580

$\gamma=10$						
Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
1	0,4979	-1,4516	0,1459	-0,5373	0,3670	1,9780
2	0,4583	-1,2747	0,1438	-0,5292	0,3690	1,8328
3	0,3873	-1,0328	0,1349	-0,5110	0,3767	1,6449
4	0,3060	-0,7632	0,1233	-0,4881	0,3871	1,4350
5	0,2298	-0,4945	0,1118	-0,4647	0,3975	1,2201
6	0,1664	-0,2433	0,1019	-0,4431	0,4063	1,0117
7	0,1185	-0,0170	0,0940	-0,4243	0,4131	0,8157
8	0,0855	0,1828	0,0878	-0,4085	0,4178	0,6346
9	0,0654	0,3574	0,0833	-0,3956	0,4207	0,4688
10	0,0559	0,5093	0,0799	-0,3852	0,4222	0,3179
11	0,0548	0,6412	0,0773	-0,3768	0,4226	0,1808
12	0,0603	0,7560	0,0754	-0,3702	0,4222	0,0563
13	0,0706	0,8559	0,0740	-0,3650	0,4213	-0,0568
14	0,0846	0,9431	0,0728	-0,3610	0,4201	-0,1595
15	0,1011	1,0195	0,0718	-0,3580	0,4187	-0,2531
16	0,1195	1,0864	0,0709	-0,3557	0,4172	-0,3383
17	0,1391	1,1453	0,0700	-0,3542	0,4157	-0,4160
18	0,1593	1,1972	0,0692	-0,3531	0,4142	-0,4869
19	0,1799	1,2430	0,0685	-0,3525	0,4129	-0,5517
20	0,2005	1,2836	0,0677	-0,3523	0,4116	-0,6111
21	0,2209	1,3195	0,0669	-0,3523	0,4104	-0,6654
22	0,2410	1,3515	0,0661	-0,3527	0,4094	-0,7153
23	0,2606	1,3798	0,0653	-0,3532	0,4085	-0,7610
24	0,2796	1,4051	0,0644	-0,3538	0,4077	-0,8030
25	0,2980	1,4277	0,0636	-0,3546	0,4070	-0,8417
26	0,3158	1,4478	0,0628	-0,3555	0,4064	-0,8773
27	0,3328	1,4658	0,0620	-0,3565	0,4059	-0,9101
28	0,3492	1,4819	0,0612	-0,3575	0,4056	-0,9404
29	0,3648	1,4963	0,0605	-0,3586	0,4053	-0,9683
30	0,3797	1,5093	0,0597	-0,3597	0,4051	-0,9941
31	0,3940	1,5209	0,0590	-0,3608	0,4050	-1,0180
32	0,4076	1,5313	0,0583	-0,3620	0,4049	-1,0401
33	0,4205	1,5407	0,0576	-0,3631	0,4049	-1,0606
34	0,4328	1,5491	0,0569	-0,3643	0,4050	-1,0796
35	0,4446	1,5567	0,0562	-0,3654	0,4051	-1,0972
36	0,4557	1,5635	0,0556	-0,3665	0,4052	-1,1136
37	0,4664	1,5696	0,0550	-0,3676	0,4054	-1,1288
38	0,4764	1,5752	0,0545	-0,3687	0,4057	-1,1430
39	0,4861	1,5801	0,0539	-0,3698	0,4059	-1,1562

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
40	0,4952	1,5846	0,0534	-0,3708	0,4062	-1,1686
41	0,5039	1,5886	0,0529	-0,3718	0,4065	-1,1801
42	0,5122	1,5922	0,0524	-0,3728	0,4068	-1,1908
43	0,5201	1,5954	0,0520	-0,3738	0,4072	-1,2009
44	0,5276	1,5983	0,0515	-0,3747	0,4075	-1,2103
45	0,5348	1,6009	0,0511	-0,3756	0,4079	-1,2191
46	0,5417	1,6032	0,0507	-0,3765	0,4083	-1,2273
47	0,5482	1,6052	0,0503	-0,3774	0,4087	-1,2351
48	0,5544	1,6070	0,0500	-0,3782	0,4091	-1,2423
49	0,5604	1,6086	0,0496	-0,3790	0,4095	-1,2492
50	0,5661	1,6101	0,0493	-0,3798	0,4099	-1,2556
51	0,5716	1,6113	0,0490	-0,3806	0,4103	-1,2617
52	0,5769	1,6124	0,0487	-0,3813	0,4108	-1,2674
53	0,5819	1,6133	0,0484	-0,3820	0,4112	-1,2727
54	0,5867	1,6141	0,0481	-0,3827	0,4116	-1,2778
55	0,5914	1,6148	0,0478	-0,3834	0,4120	-1,2826
56	0,5958	1,6153	0,0476	-0,3840	0,4124	-1,2871
57	0,6001	1,6158	0,0474	-0,3847	0,4128	-1,2914
58	0,6043	1,6161	0,0471	-0,3853	0,4132	-1,2955
59	0,6083	1,6164	0,0469	-0,3859	0,4137	-1,2993
60	0,6121	1,6166	0,0467	-0,3865	0,4141	-1,3030
61	0,6158	1,6167	0,0465	-0,3870	0,4145	-1,3064
62	0,6194	1,6167	0,0463	-0,3876	0,4149	-1,3097
63	0,6228	1,6167	0,0461	-0,3881	0,4153	-1,3128
64	0,6262	1,6166	0,0459	-0,3886	0,4157	-1,3158
65	0,6294	1,6165	0,0457	-0,3891	0,4160	-1,3186
66	0,6326	1,6163	0,0455	-0,3896	0,4164	-1,3213
67	0,6356	1,6161	0,0454	-0,3900	0,4168	-1,3238
68	0,6386	1,6158	0,0452	-0,3905	0,4172	-1,3263
69	0,6414	1,6155	0,0450	-0,3909	0,4176	-1,3286
70	0,6442	1,6152	0,0449	-0,3913	0,4179	-1,3308
71	0,6469	1,6148	0,0447	-0,3918	0,4183	-1,3330
72	0,6495	1,6144	0,0446	-0,3922	0,4186	-1,3350
73	0,6521	1,6140	0,0444	-0,3926	0,4190	-1,3369
74	0,6546	1,6135	0,0443	-0,3929	0,4193	-1,3388
75	0,6570	1,6131	0,0441	-0,3933	0,4197	-1,3406
76	0,6593	1,6126	0,0440	-0,3937	0,4200	-1,3423
77	0,6616	1,6121	0,0439	-0,3940	0,4204	-1,3439
78	0,6639	1,6115	0,0438	-0,3944	0,4207	-1,3455
79	0,6660	1,6110	0,0436	-0,3947	0,4210	-1,3470
80	0,6682	1,6104	0,0435	-0,3950	0,4213	-1,3484
81	0,6703	1,6098	0,0434	-0,3953	0,4216	-1,3498
82	0,6723	1,6093	0,0433	-0,3956	0,4220	-1,3511
83	0,6743	1,6087	0,0431	-0,3959	0,4223	-1,3524
84	0,6762	1,6081	0,0430	-0,3962	0,4226	-1,3536

Horizon	Equity	Nominal Bonds	Commodities	Hedge Funds	NAREITs	T-bills
85	0,6781	1,6075	0,0429	-0,3965	0,4229	-1,3548
86	0,6800	1,6068	0,0428	-0,3968	0,4232	-1,3560
87	0,6818	1,6062	0,0427	-0,3971	0,4234	-1,3571
88	0,6836	1,6056	0,0426	-0,3973	0,4237	-1,3582
89	0,6853	1,6050	0,0425	-0,3976	0,4240	-1,3592
90	0,6870	1,6043	0,0424	-0,3978	0,4243	-1,3602
91	0,6887	1,6037	0,0423	-0,3981	0,4246	-1,3611
92	0,6903	1,6030	0,0422	-0,3983	0,4248	-1,3621
93	0,6919	1,6024	0,0421	-0,3986	0,4251	-1,3629
94	0,6935	1,6017	0,0420	-0,3988	0,4254	-1,3638
95	0,6951	1,6011	0,0419	-0,3990	0,4256	-1,3646
96	0,6966	1,6005	0,0418	-0,3992	0,4259	-1,3655
97	0,6981	1,5998	0,0417	-0,3995	0,4261	-1,3662
98	0,6995	1,5991	0,0416	-0,3997	0,4264	-1,3670
99	0,7010	1,5985	0,0415	-0,3999	0,4266	-1,3677
100	0,7024	1,5978	0,0414	-0,4001	0,4269	-1,3684